The A+ Reference Book

For the Home and Office PC Technician

Includes Network +!

Phil Croucher

Small Print (Legal Bit)

Copyrights, etc

Sources

Which are gratefully acknowledged:

- Experience.
- Many conversations with technicians.
- Hundreds of motherboard manuals, not all of which were helpful!
- Information from readers, including John Sutton.
- Lots of stray bits of paper in various workshops, especially at ProData and MicroTrader.
- AMI BIOS Tech Ref manual.
- MR BIOS Tech Ref Manual. Thanks to Mike at Microid Research!
- Readers, including Mick O'Donnell, Martyn Smith, Chris Crook, Chris Nicholson, Dart Computers, Pat Tan, John Dallman, Ulf Boehlau, Rick and Tilman at ProData, Adrian Clint of Samsung, Peter Farrow, Kerry and Toni at Award Software, Chuck French at Unicore, Ali Kiafar at ECS/TTX, John Dann at ProData, Jerome Czeikus and Mike Echlin.
- **amibios.txt**, available from Jean-Paul Rodrigue in the University of Montreal, which had useful snippets, especially the explanation of Fast Decode. His BIOS Survival Guide is at **www.lemig.umontreal.ca**.
- **amisetup**, a shareware program from Robert Muchsel.

About The Author

Phil Croucher provides technical writing and training services, and the books and courses are the result of several years' experience of freelance network management, system building and repairs. He has been involved with computing since 1986, starting off with a variation of Acorn's BBC computer, the Torch, using its own version of CP/M, called CPN. From there he has fond memories of the Sirius and the Macintosh, but has mostly been involved with IBM compatibles of all shapes and sizes, specialising in Concurrent DOS and its later versions, including REAL/32. He writes regularly for *Computer Shopper* and *PC Plus* magazines (UK) and is the resident technical expert for the AM1290 Talk Radio show *Experts On Call*.

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Introduction

This book is a combination of all my other books, notably *The BIOS Companion*, *The Hard Disk Database*, *Motherboards!*, *Hacking Systems* and *Communications and Networks*, plus a lot of other stuff I had lying around that didn't really fit before. All were quite popular in their own right, but many readers were not aware that the material was more than good enough for A+, so this is the result of many requests for something that was useful in a home or office environment where tech support was not readily available, containing all the knowledge and information that a technician would have to hand. Since that stuff is also required for the A+ exam, it was decided to make the book fit both situations, although its primary function is a source of reference. As a bonus, there is a chapter that covers Networks + as well. Like the other books, it will be updated constantly, officially once a year, in May, just before the flying season starts, and unofficially every time we reprint, so keep an eye on the web site.

About The Test

I won't waste a whole chapter telling you how to study – you know best how to do that, and the book is big enough anyway (did you know it has to be a certain size just to get on the shelves?). It's just like any other multi-choice test, except that sometimes all the potential answers are wrong! One, of course, will be less wrong than the others, so maybe that's what they're after. I haven't found out whether it's the people who set the test, or the fault of many of the other books around, but, as an example, the bit of memory between 640K and 1 Mb is constantly referred to as High Memory, when it's been Upper Memory for years, and well before the A+ exam was even thought of, and the bit up to 640K has always been known as Base Memory (just look at all those old motherboard manuals) – for some reason, Base Memory is now what remains after DOS, etc has been loaded. As a result, you have to learn things just to pass the exam, rather than because it's correct, but there you are.

Other examples come from *Networks +*, where they say a *Local Area Network* (LAN) is confined to a limited area, and a *Wide Area Network* (WAN) isn't. Actually, a university with several locations spread across the country with its own cabling is still a Local Area Network – a WAN uses a third party, such as the telephone company, to get its work done. Also, the term *Client/Server* used to relate to database operations, where calculations were done in the server rather than trailing all the way to the workstation and back – now it seems to relate to high-end network operating systems that use a dedicated server to run them, which should be defined as *server-based*, although, to be fair, this is a term used by Microsoft.

Bearing this potential confusion in mind, when I have picked up differences, I have included them in the text. Luckily, if you get an answer wrong, there's no harm done, provided you get the minimum score (currently 65% for A+, 82% for N+) – in UK aviation exams, you *lose* a half-point every time!

Still, despite the above comments, the exam is welcome, as there has long been the need for some sort of standard.

The test is not entirely theoretical, and you need some hands-on experience with DOS and Windows. Areas to concentrate particularly on include ESD and static, how to ground yourself (make sure the ground is to the building), the sequence of loading of both DOS and Windows, and the sequences of mouse clicks to get things done in the latter, such as checking for disk free space in 95, and adding hardware. A knowledge of what readings to expect when checking fuses with multimeters is handy as well.

It's also a good idea to go through the tutorial before you do the exam proper, just to get the idea of how it works. It only takes about 15 minutes and is not counted in the final results. You will also find a couple of questions relating to customer service, which are also not counted, but you have to go through them to get to the end. A good tactic is to go through the test once, answering only those questions you absolutely positively know the answer to, and marking the others for later review, because it's entirely possible to get the answer to one question as part of the text of another (I actually got two identical ones within the space of 5). There's plenty of time, certainly enough to read each question twice or even three times, which sometimes you have to do because the way they are put is so bad, especially Microsoft ones.

So, *read the questions carefully*! Some of them include a little doublethink, such as giving you a situation, then requiring you to choose the **exception** that doesn't solve the problem.

Networks +

This test is a lot stiffer, and the pass mark is now 82%, possibly to bring it in line with Novell, as they now accept it as part of their requirements for CNE. Areas to concentrate on here include IP addressing (how do you tell a Class A from a Class C address, for example) , The OSI model and what the layers do, and what equipment and protocols operate where on it. IEEE numbers are useful, as are which protocols are routeable or not. There is some emphasis on environmental stuff, and the effects of bad cabling, or what happens if you have to many devices on a ring main to which is attached your network – in other words, "unexpected or atypical conditions that could either cause problems for the network or signify that a problem condition already exists, including room conditions, the placement of building contents, personal effects, computer equipment and error messages.” So there.

Don’t forget to brush up on what TCP/IP utilities give you what information, and what the screen displays look like, so you will need to get a little hands on experience. They also like you to know about standard password and backup procedures and the need for application patches (and where to get them) and the use of anti-virus software.

Motherboards

Jumper Settings – and more

Including portables

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Introduction

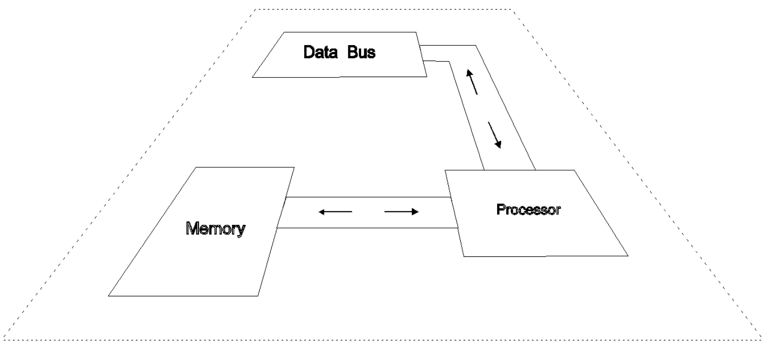
This chapter primarily contains motherboard jumper settings, but other information, such as known bugs and performance issues have been included when available. Not all comments have been verified, as they have been obtained from various places, including service departments and magazine reviews, but are believed to be reliable. To save space and costs, no diagrams have been used, as a good engineer shouldn't need them if the motherboard has been marked up properly. In other words, this is meant to be a quick reference for those familiar with computers. Parallel, serial and floppy connectors, etc. have also been excluded, except when they depart from the standard (described at the back), and where a setting indicates an on condition, the opposite has been left out, as it should be obvious. Jumpers or switches not mentioned are usually factory set and should be left alone.

The chapter is organised alphabetically, by manufacturer.

For information on identifying your motherboard through BIOS screens, refer to the *BIOS* chapter.

In General

The motherboard is the main circuit board to which all components of a PC are attached, providing a data path between them all, and distributing the different voltages needed from the power supply. Here is a picture of a typical one:



The Central Processor does all the thinking, and is told what to do by instructions contained in memory, so there will be a direct two-way bus connection between them. The bus width determines how much data can be read or written in one go.

Extra circuitry in the form of *expansion cards* is placed into *expansion slots* on the data bus, so the computer's basic setup can be changed easily (for example, you can connect more disk drives or a screen here). To save typing in the same old instructions every time, you buy software prepared earlier and copy it over the data bus into memory via the processor. There is a short cut between the data bus and memory, called DMA, covered elsewhere.

On earlier motherboards, you might have a maths co-processor fitted alongside the main processor, which is specially built to cope with floating point arithmetic (e.g. decimal points). Later CPUs (i.e. Pentium onwards) have it integrated, so it's more correctly called a *floating point unit*, or FPU. Without it, the main processor has to convert decimals and fractions to whole numbers before calculating on them, and then convert them back again, and the size of the number it can cope with depends on the register width. A coprocessor won't be used automatically, as your software must be aware of it for you to get any benefit. If you're only doing addition, multiplication, subtraction and division, you won't actually find much difference in performance. Oddly enough, a copro in a 286 is slower than one in an XT, due to the connections.

There are also support chips, which these days are combined into one or two largish ones and known collectively as the *chipset*, that control the movement of data bits and signals around the system. There's the BIOS as well, voltage regulators, and various power connectors, including for fans. Not to be forgotten, for system builders and troubleshooters, are the jumpers and switches that must be correct before the thing will even work, although motherboards are now available with Jumper Emulation through the BIOS. These will set the voltages and speeds for the CPU and memory bus, the size of the cache, etc, etc.

The motherboard must be looked at carefully when you do your shopping. Of course, nothing is perfect, and any design job is a matter of compromise, trading off benefits here and there against drawbacks. For example, soldering chips to the board instead of placing them in sockets will add stability at the expense of convenience, and packing components more tightly will allow it to run faster without generating radio emissions. To reduce cost, you might lose a few slots here and there - the trend now, for example, is to have fewer ISA slots, which is understandable as technology moves on and the functions move over to PCI, but a real pain if you have 4 ISA cards. You could even use less powerful Tag RAM that restricts cacheable memory to 64 Mb instead of 512, or have two IDE channels share a common timing register, as is done with the Triton chipset. In the early days, two-layer boards were common, and can still be found, but six or eight-layer ones are what you get from reputable manufacturers now, because the layers keep the circuit traces separate; you would have one with them going one way and another going elsewhere, reducing crosstalk and making the board sturdier. A good example is the FIC SD-11 for the Athlon, which has six layers. Another consideration is the speed of Level 2 cache – the faster you want it, the shorter the track lengths must be, and the longer must be the latency settings in your BIOS. However, you shouldn't be put off by negative aspects, as they will often be balanced by something positive.

So, bearing in mind that you've got to coordinate the activities of the above-mentioned items, which are often "computers" in their own right, how would you start if you were designing a motherboard? Where would you start drawing on a blank piece of paper, assuming that money is no object, because a sad fact of life is that the Sales or Commercial department of any company will have a tendency to negate the good work that designers and engineers do. You may, for example, be given a target cost for the particular market your motherboard is destined for, because it's another fact that customers in general don't see beyond the bottom line. The proportion of people who appreciate value is, unfortunately, quite small. At least one cheap motherboard doesn't allow 32-bit disk access in Windows '95 because it uses the VXPro or HXPro chipset (nothing to do with Intel, just made to sound that way), and you can also expect about 20% less performance as a result.

Many decisions are, in fact, made for you, in that you have to conform to a standard size, and the expansion slots have to be at the back, as must the keyboard and power connectors. The most popular size is the Baby AT, which is in possibly around 95% of motherboards today ("baby" refers to size, not performance – the original AT motherboard was very large). The ATX has a few extra facilities, including better power management, but needs a different case and power supply, and a connection to a switch jumper on the motherboard. The NLX, LPX, and other sizes are there if you are interested in smaller boards and cases.

There are other obscure things to think about as well, such as the power drain of memory chips. The smaller the current they use, the less the power consumption, and therefore heat, but if it's set too low you need an extra wait state, for stability—too high and you get ringing and reflections, and errors. Power is always a consideration; for example, if a hard drive gets only a small amount less than the voltage it requires, it will cease to work properly, and you will see a C: drive error message. CPUs are no different - the Pentium II, for example, needs voltages between 2.1-3.5 V, and currents from 300 mA to 8, 10 or 12 A, and back again in a single clock cycle. Many CPUs made to run at 3.3v can be more stable at 3.5, although they will run a little hotter, because of the increased spread between core and I/O voltages which will produce a cleaner signal.

Even lowly capacitors have an impact (they smooth out voltage transients). According to Intel specifications, the Pentium Pro needs between 40-50 decoupling capacitors. In one test, a Soyo board was found to have only 11 in contrast to a Tyan which had 54 (11 may well be all that's needed, for all I know, but more capacitors connected in parallel ensure a longer life for your board). Also, high-quality tantalum capacitors cost 11-29 cents, but some manufacturers use electrolytics instead, that are even cheaper. Low cost capacitors age more quickly, and those related to the CPU get hot and dry out sooner, with the result that voltages may get out of range and your PC locks up from the extra heat. You also need to ensure the board has switching voltage regulators rather than passive ones, as they are less sensitive to low quality power supplies, particularly if your CPU is demanding in terms of current (passive regulators are just resistors that convert the excess voltage into heat, of which there is enough already).

You then have to arrange the rest of the components in the remaining space to keep the connections between them (that is, the *trace lengths*) as short as possible, both to keep down the journey time and reduce possible radio emissions as higher speeds are approached. Every movement of electricity has an associated magnetic field, which can induce current in nearby wires as it fluctuates, which could look to the computer like extra data, with the obvious consequences. Designing this out is expensive, and is naturally reflected in the cost price. Also, the length of IDE cables must be a *maximum* of 18", which *includes* any traces on the motherboard, and you can expect to half this if two cables share one set of timing registers and/or buffers, as they do on some Triton boards. Check this if you're getting inexplicable GPFs.

You have to consider the range of CPUs your motherboard will accommodate, then the chipset that will support them, and whether you can harness their maximum potential. It bears repeating - the chipset is more important than the CPU, which, incidentally, could be placed somewhere near a fan for better cooling.

Next, you must catch your BIOS. When you (as a manufacturer) buy one from Award, AMI, MR or Phoenix, you also get software that allows you to specify the facilities you want, which then creates the code to put in the ROM, or Flash ROM. Very often, there are settings available that the motherboard designer has left out, or rather has not allowed you to access. **amisetup** is a program that gives you a peek into AMI BIOSes, and one called **ctchip** covers many others (though not all). You can get a link to the latter at **www.xs4all.nl**. Also, try the **TweakBIOS** utility from **www.miro.pair.com**.

What to look for when buying

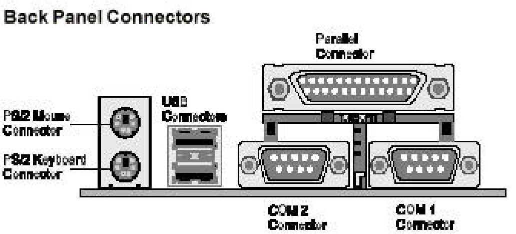
As far as performance goes, there is actually little difference between boards within a similar price range and with similar specifications, although a different chipset could make a significant impact. In fact, they may even look very much alike, due to the design constraints mentioned above, so quality is one thing to look out for, as well as facilities, compatibility, price and support, not forgetting a decent manual. At the high end, under Windows '95, the range of difference between boards is within .5 Winstone points, and .9 with NT, so there are other things to look at for the best purchase, notably stability and reliability at high speeds (no good having a fast car if the suspension can't handle tight corners). If you want to see graphs about this and many other comparisons, take a look at the motherboard section of Dr Thomas Pabst's Hardware Page at **www.sysdoc.pair.com**.

Let's have a look in more detail:

Size

There are two basic types, XT and AT, with the latter being subdivided even further. You can recognise XT boards because they only have 8-bit ISA slots, and you can only configure them with switches. The original design from IBM for both types was rather large, but clone manufacturers began to make smaller versions, which became known as Baby-XT or Baby-AT, etc. AT boards also have CMOS memory and larger (16-bit) ISA slots.

Later came LPX, for low profile cases. They used riser boards, with a mini-din connector for the keyboard and mouse, commonly called the PS/2 connector. Often, VGA and serial/parallel connectors would be built-in as well. These days, we have ATX (and Micro-ATX) which require special power supplies to produce 3.3v directly, so you don't need voltage regulators, and which have I/O directly on board, including floppy and EIDE, as well as the usual serial/parallel/USB, etc (video is not generally supplied, and neither are network connectors). These are all grouped in one place, at the rear left:



Also, cooling is improved, as air is blown into the case rather than out, and the CPU is placed nearer the fan in the power supply, which also has a single, keyed connector to avoid mistakes.

NLX is a variation on LPX, but with more modern features.

Power Supply

This converts AC from your wall socket into the different voltages needed around the motherboard and the machine. This is not an item you should try to repair unless you know what you're doing, as it contains capacitors that could retain a lethal charge for some time, so it's regarded as something you swap out when you have a problem. Capacitors are described in the *Electricity* chapter.

CPU

Do you want to use more than one? You can only do this with Intel chips at the moment, except the Celeron and some older Pentiums, but Abit have made a dual Socket 370 (Celeron PPGA) board that bypasses the SMP limitations inside the chip. However, the AMD Athlon will support this in the future, though, oddly, some of the PIII range may not. The Pentium Pro natively supports four CPUs, whilst the Pentium and Pentium II support only two.

You may also only do *Symmetrical Multiprocessing* (SMP) with certain operating systems, notably Windows NT, OS/2, Sun, SCO, HP, FreeBSD and Linux. Even then, any increase in performance depends on your software, which must have modules that work independently of each other (that is, be multi-threaded). You are more likely to find an improvement in the ability to multitask, so you could possibly burn a CD, watch TV, download a file and sort a table of contents at the same time (regularly done here).

Overclocking

This is the practice of making parts of your machine run faster than their rated speed, like CPUs and video cards, but it really started with the first AT, when people used faster clock crystals. It's based on the premise that the items concerned come from the same production run and only get segregated on testing – in other words, some CPUs will fail and be reclassified at a lower speed (although I don't leave out the hand of the marketing department somewhere), and advantage is taken of manufacturer's tolerance ranges. The main problems are overheating (don't forget the voltage regulators) and bus timing signals, but Pentium IIs or Celerons are better at it than others—some people report an increase of up to 25% in speed for over 8 months without any troubles. Even though Intel CPUs have a projected life of 10 years, they will realistically be out of date well before that, so any life-shortening overclocking tricks will probably not matter. Mind you, rather like sports cars, it's something to watch out for when buying secondhand, as you don't know how they've been treated.

Socket

As CPUs have improved, they have used sockets with different specifications, up to Socket 8 for the Pentium Pro. Socket 7 has been kept alive by Intel's competitors and improved to *Super*

Socket 7, which actually refers to the facilities on the motherboard, and not the capabilities of the CPU it houses. These include AGP, large L2 cache (up to 1 Mb) and customisation for just about everything from speeds to voltages. The Pentium II does not use Socket 7 technology, but Slot 1, with Slot 2 around somewhere (Intel refers to them as 242- and 330-contact slot connectors, respectively). The reason for the change, according to them, is the increased bandwidth, but just to confuse things further, the Celeron now uses a Socket (370), having previously been able to use Slot 1.

Slot A, for the Athlon, looks like Slot 1 (don't confuse them), but the pinouts are different, partly for copyright reasons and partly because AMD felt it was time to blaze new trails (but maybe Intel not licensing the design was an influence, too). The result is a bus design that is technically superior, but which can use current cooling technology. It has a set speed for memory at present, 100 MHz, but will be selectable in the future – it will have to be, because a CPU that fast needs very quick support.

Chipset

Intel's main rival is VIA, but SiS and ALi are worthy runners up, not forgetting ETEQ. The Via **VPX/97** has many features of the VP2/97, plus allowing an asynchronous PCI bus, good for Cyrix processors, at least, especially as VIA now own them. The **VP3** was the first non-Intel chipset to support AGP. The AMD 640 chipset is the same as the VIA VP2/97; it's made at the same factory, but has different labels.

There are currently six choices for Slot 1; the Intel 440FX (old), the 440LX (better), the 440EX (weak), the 440BX and 820, for the PIII. However, the VIA Apollo Pro Plus has better speed and features than them all, except possibly the latter, which increases FSB speed to 133 MHz using RAMBUS and UDMA/66 (the Pro Plus does, too, but without RAMBUS support). For the Athlon, the AMD-750 chipset uses the 751 system controller and 756 peripheral bus controller, and the VIA KX133 is used on some Asus boards. Socket 370 uses the 440ZX, a cut-down version of the BX, as well as the 810, which, presumably, is a cut-down version of the 820 with integrated sound and graphics. It is limited, as it has a bug that stops it supporting the Pentium III, and a better route may be to use a converter for a Slot 1 board if you want upgradability – at least you can use a BX chipset. The 810E supports a 133 MHz bus, UDMA/66 and 4x AGP. Talking of bugs, there is one in the 820 that stops it accepting more than two RIMMs.

The older 430TX, FX and VX can only cache the first 64Mb of RAM. In contrast, the 440BX supports up to 1Gb of RAM and the GX up to 2Gb.

Cache

L1 cache is usually inside the CPU, and L2 cache outside, that is, between the CPU and system memory. Later chips, such as the Celeron (A version), Pentium II, Athlon, etc. have them both included, except that the Celeron's L2 cache runs at the same speed as the processor and gives it a performance edge, even though it is half the size of the PII's.

How much L2 cache you need really depends on the amount of system memory; according to Dell, on earlier motherboards, jumping from 128K to 256K only increases the hit rate by around

5%. These days, however, 1 Mb caches are common, but larger caches cause their own complications, such as difficulty in returning information within one clock cycle, so two clock cycles are now the vogue, and three are used inside the Athlon. You therefore need buffers to store the information until it's needed. Luckily, pipelining, where accesses are done independently, reduces the pain somewhat.

Cacheing is not always efficient, especially where data changes often (as in games) or is too big for a cache (large graphics) and software has to go to main memory anyway. Having said that, most applications, though not necessarily multitasking operating systems, benefit from them.

Expansion Slots

The number of ISA slots is steadily reducing – in fact, the TMC T15VGF has none at all, like many new Soyo boards. As PCI slots cannot readily handle multifunction cards (which is why all the floppy, IDE, serial and parallel ports have suddenly appeared on the motherboard), this may cause you a few problems as you try and shoehorn all your old equipment in. It's worth noting that the PCI version of an ISA card is not always faster (certainly with network cards), but you may be forced into using one because you run out of slots.

Memory

SIMM/DIMM banks, and types of RAM therein (some boards don't recognise modules above 32 Mb). How much memory can the cache handle? Sometimes not above 64 Mb, and if you go over that on a VX/TX board you can expect a performance drop of around 5%.

When it comes to the higher bus speeds, SDRAM is the best choice, so look out for at least a TX chipset (HX boards can only support slower EDO), but the TX appears to have a timing problem that restricts full SDRAM performance, and has less buffers than the HX, although they have around the same performance. In turn, the HX chipset can handle faster EDO timings than the FX. SDRAM is also a good choice when you don't particularly want speed, but bandwidth.

Memory is covered more thoroughly in the *Memory* chapter.

AGP

Standing for *Accelerated Graphics Port*, this is a system based on PCI and the old VESA local bus, and used in Pentium II machines with the Intel 440 LX chipset and above (other chipsets support AGP with Socket 7). The idea was allow graphic instructions to be controlled by the CPU and bypass the PCI bus, at 66 MHz, and reduce the cost of PCs; 3-D data would move to system memory, making room in the graphics controller for other functions, so, in effect, the graphics system acquires its own bus and the AGP card becomes an interface for the monitor. However, memory on video cards is now faster, and very plentiful, up to 64 Mb in cases, and manufacturers tend to ignore Intel's original intentions - many proposed features have not actually been implemented, leaving AGP somewhat on the shelf, although version 4 threatens to pass the 1 Gb/second barrier (what happened to version 3 and AGP Pro?).

The original voltage was 3.3v, reduced to 1.5v with AGP2.

When it uses both sides of the timing signal (that is, double-clocks, known as X2), you can move twice as much data and achieve an effective 133 MHz clock speed, allowing up to 533 Mb/sec, which is four times what PCI is allegedly capable of. There is also no arbitration to slow things down. Peak AGP 2x bandwidth is the same as that of 66 MHz SDRAM. Since the CPU will need some of this, you need higher memory bandwidth and higher speeds to give AGP the headroom it needs. Aside from the 440 LX chipset, you also need at least DirectX 5.0, Windows '95 OSR 2.1 and **vgartd.vxd**, an Intel driver, not forgetting SDRAM for the bandwidth. NT 4 also supports AGP, after Service Pack 4.

It is also supported by VIA on Socket 7 boards with their VP3 chipset (look at TMC, for example), and found on Slot A Athlon boards.

Connectors

Most boards support Infra Red, the *Universal Serial Bus* (USB), or even FireWire (now known as HPSB, or *High Performance Serial Bus*), but you don't often get the cabling and connectors with the cheaper ones. This is especially true with a PS/2 mouse connector, and be aware that not all connectors are wired the same way if you have to buy them separately – this especially applies to 9-pin serial connectors.

Flash ROM

For easy upgrades of the BIOS. There are several types of Flash ROM; one comes from Intel which needs 12v, and another from SST, which takes .5 (your BIOS ID string will have a *i* or an *s* suffix to identify them). Flash ROMs are explained more fully in the BIOS chapter.

Quality of Manufacture

Check whether any resistors or capacitors are surface mounted (they should be), expect nothing less than a Lithium battery, and be careful if you see stickers everywhere - they can be used to hide things (especially beware of stickers that carry dire prognostications about voiding the warranty if removed). Cheap printing on chips is often a dead giveaway, as was used during the "fake cache" episode some years back.

Decent Manual

This should not only contain the jumper settings, but have memory map details, POST Codes and decent explanations of the BIOS settings.

Decent Web Site

This sort of follows on from the above, and forms part of the overall support package. The Asus and Tyan sites are definitely worth a look.

Finally

There's a lot more to look at than just the bottom line, although some of us occasionally have to stick to a budget. Unless money is no object, any buying decision is a result of compromise, so, assuming you're upgrading, you need to look at what ISA cards you already have, whether your present memory chips will do (probably not), if you're going to keep your current case (in which case, don't buy ATX), what CPU you want and eventually what chipset.

Identifying your motherboard

Look for something in white print on the surface, particularly in between the expansion bus slots, or maybe underneath. If you have a manual, there may be a clue inside, but many are anonymous. Also look under any stickers, bearing in mind that this may invalidate the warranty. If you don't see a manufacturer's name, you may see a model number (with a lot of forward slashes in, and maybe a Revision Number) with which you can do a simple search on the Internet There are many sites that contain much information about motherboards and manuals which you can get to from ours at **www.electrocution.com.**

Also, try the FCC web site at **www.fcc.gov/oet/fccid**.

At the beginning of each manufacturers' section that follows, there is a small table with the manufacturer's code as found in the BIOS string.

BIOS ID string

Refer to the *BIOS* chapter.

The CPU

The 8088

This was the brains of the original IBM PC (and history has a great bearing on what we get up to today, as we will discover), manufactured by Intel. No more need be said about it, except that although it was classified as being 16-bit, it spoke to the data bus and memory with 8 bits, which was both to keep the costs down and keep in line with the capabilities of the support chips. The 8086 was 16-bit internally and externally, so was about 20% faster, but was more expensive. The 80186 and 80188 also had about 15 or 20 system components included in the same chip, and became useful for dedicated expansion cards, as well as paving the way for the 80286 (see below). NEC made a clone, called the V22.

Anyway, when the 8088 wanted to send two characters to the screen over the data bus, they had to be sent one at a time, rather than both together, so there was an idle state where nothing was done every time data was sent (even at 4.77 MHz!).

In addition, it could only talk to 1 Mb of memory; the width of the address bus determines the amount of memory locations that can be addressed at any time (the *address range*) and there were 20 physical connections between memory and the Central Processor. Since computers work on the binary system, and therefore count with only two fingers, it's a simple calculation as to how much memory the CPU can talk to at once:

$$2^{20}=1048,576K$$

In fact, 8-bits, as supplied in the original PC can only represent 2^8, or 256 possible values, and the 16-bit word in the CPU could address 65,536 (or 64K), which still wasn't enough for serious work, so a **segment:offset** scheme of memory addressing was devised, where two numbers are used for an address to get a bigger total (see *Base Memory*, below, for more about this). The problem was to maintain compatibility with the 16-bit registers in the CPU while using 20 address lines. For the moment, just bear in mind that, although the CPU can see 1 Mb in total, it can only see it 64K at a time, because the offset is limited to 16 bits, and the largest number you can create with them is 65, 535.

The 80286

The 80286 was introduced in response to those who were cloning the IBM PC. The connections between the various parts of the motherboard became 16-bit throughout, thus increasing efficiency—at the same clock speed, the throughput is 4 times more. It also had 24 memory address lines, so it could talk to 16 Mb of *physical* memory (1 Gb virtual). Having said that, DOS couldn't use it, since the extra had to be addressed in *protected mode*, using something like Xenix (or OS/2, which was created a little afterwards). DOS can only run in *real mode*, which is restricted to the 1 Mb that can be seen by the 8088.

Just to emphasise the point—when a 286 (or above) emulates an 8086 to run DOS, it's running in real mode—a Pentium running DOS is just a fast PC!

Protected mode is there to protect processes from interfering with each other, hence the name. The idea is that programs don't write to the wrong place in memory because a protected mode memory address is not the same as one used in real mode; that is, there is no guarantee to a program that an address used is the same as its real equivalent. A memory segment in real mode, or the first part of a **segment:offset** address becomes a *selector*, which refers to a *descriptor table*, which is like a table of contents of the memory, so you get a **selector:offset** system. The descriptor table's job is to relate sectors to real addresses in memory, so there is one more step to the process of memory addressing in protected mode as there is in real mode. A 286 descriptor can store addresses as large as 16,777,216 bytes (16 Mb). Because the selector pointer is a smaller number than the full segment address, more selectors can fit into the same number of registers,which may go part of the way to explaining how you can see an extra bit of memory above 1 Mb in real mode, to get the High Memory area (see *Memory*).

As an aside, the first three bytes of a selector are used by Windows to check that the selector concerned relates to memory actually owned by the program you are using, and that memory can be written to, otherwise the program is shut down.

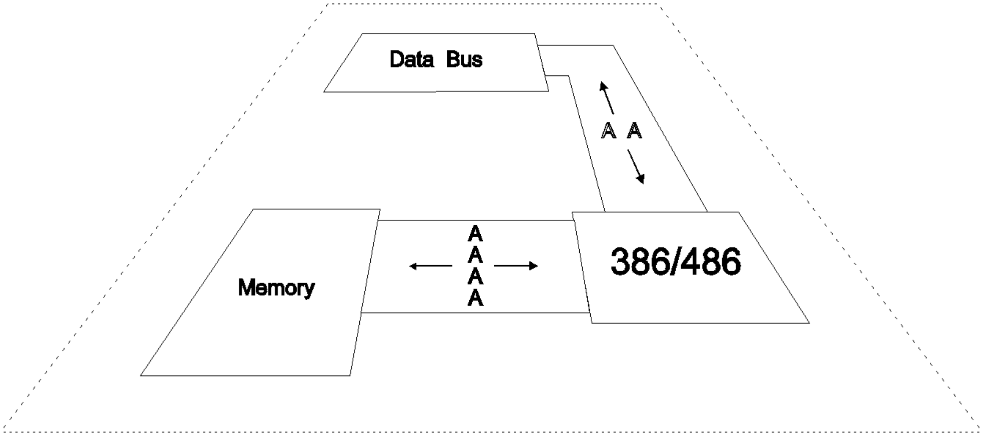
One problem was that the 286 went into protected mode easily, but found it difficult to get out again, and needed the chip level equivalent of **ctrl-alt-del** to do so. This used to be done with special codes that were interpreted by the keyboard controller (through an unused pin), but chips were later inserted to watch for these codes and reset the CPU immediately, rather than wait. This "fast decode" of the reset command allowed faster switching between real and protected mode (for 16-bit software), with resultant better performance, although the 286 is still ungainly at running Windows.

The 286 also began to be cloned, but legally, as Intel had to farm out manufacturing to keep up with the demand.

The 80386

Compaq was first to use the 80386 (the DX, as opposed to the SX—see below), which uses 32 bits between itself and memory, but 16 towards the data bus, which hasn't, until recently, been developed in tandem with the rest of the machine. This is partly to ensure backwards compatibility and partly due to the plumbing arrangements—because of its design (based on the technological knowledge of the time), if the data bus is run too fast, you get *electrical noise*, or extra voltages (extra 1s), which will look to the computer like extra data.

You also now have a speed problem..... The Central Processor may run at 33 Megahertz or so (think of it as miles per hour), but the (ISA) data bus still runs at 8, because of the original design constraints. It is at once the busiest and slowest part of the computer, which is where your *Cache Scheme* helps.



Not only do you therefore have the equivalent of four-lane highways narrowing down to two-lane ones, these days you have to slow right down from anything up to 600 mph (MHz) in the CPU area, through 100 around memory, right down to 8 mph by the time you reach the ISA bus. Even with a PCI bus running at 33 MHz, a 450 MHz CPU is running 14 times faster, so your drive has to be really fast to catch up.

In view of the above, you can begin to see that processor speed alone is no guide to performance, and in some cases may even be irrelevant. A slow hard disk (on the data bus), for instance, will always make any processor wait for its data and waste cycles that could be used for serious work. In fact, as far as NetWare is concerned, a 486/33 is only noticeably better than a 386 when network loading is heavy.

The 386 can run multiple copies of real mode, that is, it can create several 8088s inside itself, called *Virtual Machines*, so that real mode programs, provided they are well behaved, can have some of the benefits of protected mode. It uses *paging* to remap memory so these machines are brought to the attention of the CPU when the programs in them need to be run; this is done on a *timeslice* basis, around 60 times a second, which is how we get multitasking in Windows, or in Multiuser DOS (in '95, the slice is every 20 ns). It doesn't sound like much, but you can do a lot inside 60 ns.

Because of paging, these DOS sessions can be anywhere in memory, but, when used, they are made to look as if they are below 1 Mb, in real mode. Virtual DOS machines can be created in extended memory because real mode programs under DOS (and/or Windows) don't write to real addresses, but *selectors*, and therefore have their calls redirected to the descriptor table. By changing the relationships in the descriptor table, programs can be moved around without them knowing anything about it; all they need to know is how to work with selectors.

The 386 can also switch in and out of protected mode on the fly, or at least in a more elegant way than the 286. To get to the hard disk and other parts of the computer, protected-mode software, such as Windows, has to get DOS to perform *real mode services*, so the CPU has to switch in and out of protected mode continually (actually, on a 386 or above, the switching is to virtual 8086 mode rather than real mode). The goal is, therefore, to use real mode as little as possible and to run in protected mode. Windows does this by using *32-bit instructions*.

The 386 uses pipelining to help streamline memory accesses—they are done independently of each other (at the same time) while other units get on with their jobs, reducing intermediate steps and latency. Prefetching exists where data is stored in CPU registers while spare cycles are used to fetch the next. The 386 has a *pre-fetch unit* for instructions, that tries to guess which ones you want next (a cache, sort of).

The 386 uses an externally generated clock frequency, and only the rising (positive) edge of it to calculate the output signal and the processor frequency, so the clock must run at twice the speed of the CPU. The bus interface operates with a two clock pulse cycle.

Although the 386 is 32-bit and has certain benefits, like the ability to manipulate memory and switch in and out of protected mode more readily, replacing a 286 with a 386 doesn't automatically give you performance benefits if you're running 16-bit 80286 code (i.e. most programs in DOS and sometimes Windows, which sits on top of it). At the same clock speed, the 286 requires fewer clock cycles to execute many instructions, as well as executing some in the same number as the 386 (74 are faster, 66 the same speed, leaving 50 that actually run better in a 386). This is because the 386 has to emulate a 286 and needs more cycles to do it.

The 80386SX

The 80386SX is 32-bit internally, but 16-bit externally to both memory and the data bus, so you get bottlenecking, although it wasn't designed with that in mind. It is a cut-down version of the 80386DX, created both to cut costs and give the impression that the 286 is out of date, because at the time other manufacturers could make the 286 under licence. Although it can run 386-specific software, it looks like a 286 to the machine it is in, so existing motherboards could be used, with a little redesigning, as the chips are not pin-compatible. At the same clock speed, a 386SX machine is around 25% slower than the 386DX.

The 80386SL

A low power chip, designed for laptops, with a cache controller designed for 16-64K, SMI (System Management Interrupt) with power management and expanded memory support. It also came with the 82360SL I/O subsystem, the first combination of many functions into one chipset.

The 80486

To non-technical people, the 80486 is a fast 80386 (DX) with an on-board maths co-processor and 8K of cache memory. It's not really newer technology as such (although it is second-generation), but better use is made of its facilities. For example, it takes fewer instruction cycles to do the same job (2 rather than 4.5 on the 386), and is optimised to keep as many operations inside the chip as possible. The 386 prefetch unit was replaced by 8K of SRAM cache, and pipelining was replaced by *burst mode*, which works on the theory that most of the time spent getting data concerns getting its address; you don't need it again once you're there.

Burst allows devices to send lots of data in a short time without interruption. Pipelining on the 386 requires 2 clocks per transfer; only one is needed with 486 Burst Mode. Memory parity checks also take their own path at the same time as the data they relate to. The 486 has an on-board clock, and uses both edges of the square wave signal to calculate the clock signal, so the board runs at the same speed as the CPU. In addition, the bus system uses a single pulse cycle.

The cache in the CPU (known as Level 1, or L1) is the fastest in the machine, as it runs at the same speed, and has no delays. It updates main memory only when the CPU hands over control to another device (e.g. a bus master), and so needs to know what changes there are. Generally speaking, at the same clock speed, a 486 will deliver between 2-3 times the performance of a 386. If a 486 is SL-enhanced, it will have a & symbol in the third row on the lower label, which might look like this:

```
&E5VIX SX808
```

The P24D is similar, but with a **W** in the same row (indicates *Write-Back*):

```
&EW5VIX SX808
```

The **W** on a DX4 means the same thing.

The 80486SX

The 486SX is as above, but with the maths co-processor facility disabled, therefore (generally speaking) you should find no significant difference between it and a 386; a 386/40 is broadly equivalent to a 486/25.

The 80486SL Enhanced

Again, for notebooks, like the 386SL, but with a Suspend/Resume feature.

Clock Doubling

The DX/2 chip runs at double the speed of the original, but only inside itself; for example, the bus will still be running at "normal" speed. Unfortunately, high speed motherboards are more expensive for technical reasons. Actual performance depends on how many accesses are satisfied from the chip's cache, which is how (in case you were wondering) the CPU is kept busy, rather than waiting for the rest of the machine.

If the CPU has to go outside the cache, *effective speed* is the same as the motherboard or, more properly, the relevant bus (memory or data), so best performance is obtained when all the CPU's needs are satisfied from inside itself. The DX4 has a larger cache (16K) to cope with the higher speed.

Sadly, a cached DX2 system wastes exactly twice as many useable cycles as a normal one does! An Overdrive Chip and a DX2 are more or less the same thing, but the former can be fitted by the end-user (i.e. you), and the latter is intended for manufacturers. The DX/4 is actually clock *tripled* (the 4 is to do with the 486 number; not the speed), but can be clock doubled with appropriate switching on the motherboard, so you could use a 50 MHz board and get better performance from the various buses.

Overclocking

This is the practice of making certain parts of your machine run faster than their rated speed, particularly CPUs, but it really started way back with the first AT, when people used faster clock crystals. It is based on the premise that the items concerned come from the same production run and only get segregated on testing – in other words, some CPUs will be made to run at 200 MHz, but others will fail and be reclassified for 166 MHz (although I don’t leave out the hand of the marketing department somewhere), and advantage is taken of manufacturer’s tolerance ranges. The main problems are overheating (don’t forget the voltage regulators) and bus timing signals, especially AGP and PCI, and, to be sure, the failures may be in subtle areas which your software will never touch, but, to my way of thinking, Intel and the other companies have far more money and facilities for testing than I have, and my Aviation background makes me uncomfortable test flying strange equipment, so the recommendation is to be very careful. Certainly, Flight Sim 98 is sensitive to overclocking, even from 200-233 MHz, where the background starts disappearing, and scrolling in Word ’97 suffers too. In any case, non-Intel processors tend to be overclocked already, and SCSI buses are self clocking anyway.

Having said all that, if data safety is not a problem (i.e. you're playing games), it is true to say that Pentium II/Celeron processors are better at it than other CPUs—some people report an increase of up to 25% in speed for over 8 months without any troubles. Even though Intel CPUs have a projected life of 10 years, they will realistically be out of date well before that, so any life-shortening overclocking tricks will not matter.

Try **www.aceshardware.com/articles/how-to/overclockcrazy.shtml** for a really good article on overclocking.

The Pentium

Essentially two 486s in parallel (or rather an SX and a DX), so more instructions are processed at the same time; typically two at once, assuming software can take advantage of it, and get the timing of the binary code just right. It has separate 8K caches, for instructions and data, split into banks which can be accessed alternately. It has a 64-bit external bus, but is 32-bit internally. Also, the data bus is not necessarily as large as the address bus.

The core speed (in the chip; not *core voltage*, for MMX) will be more than the external, or front side bus, speed, so a 90 MHz CPU's bus runs at 60 MHz (the memory bus coincidentally runs at the same speed). Where the front side (or *system*) bus allows the CPU to communicate with peripherals and main memory, the back side bus connects it with the L2 cache.

The multiplication is set by two external pins, BF0 and BF1, so you can run a 100 MHz Pentium at 1.5 rather than 2, and with a motherboard speed at 66 MHz, as opposed to 50. The PCI bus can be switched to match the rest of the machine (see the a chart in a couple of pages). *60 and 66 MHz versions are 5 volt—the remainder approx 3.3v*. 3.52 Volts is known as the VRE spec, also used by Cyrix. Three codes indicate the voltage an earlier Pentium CPU has been tested at:

Code	Voltage	Allowed Range
V	Standard	3.135-3.465v (3.3v)
VR	Voltage Regulated	3.3-3.465v
VRE	Voltage Regulated Extension	3.45-3.6v (3.52v)

VR processors won't run below 3.3v, and VRE processors need a higher voltage to run at all, so these codes stem from quality control. VRE became a standard because the higher voltage allows a chip to be run faster. On a newer Pentium, voltage information will be on the bottom, after the *s-spec* marking. The s-spec is a 3-digit number following SX, SK, SU, SY, or SZ, which includes such things as stepping, or version numbers, together with other characteristics. For voltages, there will be a slash mark followed by three letters, such as SK110 /ABC, for example:

```
SX994/VMU
 iPP
```

It all decodes as follows (VMU=3.52v, Min valid timing and single processor):

Pentium Markings

Spec	SX???, SY???
	SK???, Q0???
Vcc (A)	S=STD
	V=VRE (3.52, or 3.135-3.6v)
Timings(B)	S=STD
Timings(C)	S=STD
	M=Min valid MD timing
DP Support	S=STD
	U=Uniprocessor and multiprocessing; i.e. not dual processing.
I75	For 75MHz
iPP	For 75/90/100/120/133MHz

In other words, the first letter after the slash indicates voltage class, the second the timing specification and the last the dual processor capability. The best processor (for overclocking anyway) is one with SSS after the slash. The worst? VMU. **iPP** just means you have a P54C.

A P133 with either SY022 or SU073 marked on it may have BF1 disabled internally, thus restricting 2.5x and 3x clock multipliers.

Pentium Pro

This is a Socket 8 RISC chip with a 486 hardware emulator on it. Several techniques are used by it to produce more performance than its predecessors; speed is achieved by dividing processing into more stages, and more work is done within each clock cycle; three instructions can be decoded in each one, as opposed to two for the Pentium. In addition, instruction decoding and execution are *decoupled*, which means that instructions can still be executed if one pipeline stops (such as when one is waiting for data from memory; the Pentium would stop all processing at this point). Instructions are sometimes therefore executed *out of order*, that is, not necessarily as written down in the program, but rather when information is available, although they won't be that much out of sequence; just enough to make things run smoother.

It has an 8K cache for programs and data, but has the processor and a 256K L2 cache in the same package, able to cache up to 64 Gb. The cache runs at full processor speed. The chip is optimised for 32-bit code, so will run 16-bit code no faster than a Pentium. Good for multiprocessor work.

Pentium II

An MMX-enhanced Pentium Pro using Slot 1 technology with no L2 cache on board, but included on a daughtercard inside the cartridge, running at half the processor speed on its own bus. The II can be slower than the Pro for certain applications, as the Pro’s FPU is better and the L2 cache is on board. It can also only cache up to 512 Mb of RAM, but it also has twice as much L1 and L2 cache. Up to 333 MHz, the P II only runs on a 66 MHz bus (even if you switch a BX chipset motherboard to 100 MHz, the chip can be autodetected and the bus speed reduced automatically. To get around this, see the instructions on Dr Thomas Pabst’s Hardware Page at **www.sysdoc.pair.com**). Later versions, running above 350 MHz, can use a 100 MHz bus. The

L2 cache on the 333s and above only use 2 chips instead of 4, which your BIOS needs to be aware of to get the maximum benefit.

Pentium III

Aside from higher clock speeds, the only essential difference between this chip and the PII is SSE, or *Streaming SIMD Extensions*. SIMD stands for *Single Instruction, Multiple Data*. *Streaming* concerns the transfer of long streams of data to and from memory, very useful for databases. Also included are a few extensions to MMX to speed up video processing, particularly 3D and lighting calculations, assuming your software can use the instructions. PIIIs made with the Katmai (.25 micron) manufacturing process have a larger (512K) 2-way set associative L2 cache running at half the processor speed. Coppermine is the the .18 micron process (look for the E suffix, for Enhanced, up to 600 MHz – the 650 MHz ones all use it – it means Advanced Transfer Cache and Advanced Buffering Support) with 256K of 8-way set associative L2 cache running at full processor speed, because it is now on the die.

A *B* suffix indicates the ability to run with the 133 MHz FSB (533, 600 MHz). 677 & 733 MHz processors don't have suffixes because they are the only chips to run at that speed, so there is no confusion. All will use Slot 1 initially, but will migrate to Socket 370 (the flip-chip module), as used by the Celeron. This makes it a similar size chip to the Pentium Pro. This sort of design is possible because cache chips are not needed locally or on a daughtercard, as the process is down to .18 microns, leaving more room on-chip. This also means a cooler chip, less heating and more overclocking!

Celeron

A cut-down version of the PII aimed at the low-cost market, initially supplied without an L2 cache, which prompted the unofficial name of DeCeleron. It was subsequently reissued with 128K of L2 cache running at processor speed, resulting in a chip that has gained some respect, especially as it rivals the PII in many areas. It started off using Slot 1, but now uses Socket 370.

Converters are available to allow Socket 370 chips to use Slot 1. Although the chip is as fast, if not faster, than PIIs or even PIIIs, its front side bus only runs at 66 MHz. Also, you will not be able to upgrade a socket 370 Celeron to a Pentium III (if for no other reason, they don't use the same vcoltages). Also, be aware that the 400 and 433 MHz versions use fixed clock multipliers of 6 and 6.5, which means 600 and 650 if you try to use an FSB of 100 MHz.

Cyrix Instead

The 6x86 is a Pentium-type chip with Pentium Pro characteristics, as it can execute faster instructions out of sequence, amongst other things. It is also made by IBM under licence (see below). They use a *P-Rating* to determine performance relative to the Pentium, so a 6x86-166 is equivalent to a Pentium 166, even running at 133 MHz. The 233MHz version of the 6x86MX uses a 75 MHz bus, for which you should use a Cyrix-specific chipset, since no Intel chipset runs at that speed. Well, officially, anyway. These would include SiS, ALI and VIA, which all work with Intels, of course. The MediaGX is based on the 5x86 and includes a graphics controller, DRAM controller and PCI bus interface. There are lots of functions on Cyrix chips that need

BIOS support. If you don't have it, there are lots of separate utilities that will turn them on (such as the L1 cache under NT).

486

A DX4 with iDX4 pinout has "DX4 P/O" on the second row of the lower CPU label. One with M7 pinout does not have this indication and the lower CPU label has only two rows. The line might look like this:

```
Cx 486DX2 V 66 G P
```

Cx	Manufacturer
486DX2	Chip type
V	Voltage V=3.3-4v. Blank=5v
66	Speed range
G	Package. G=168 Ceramic
P	Commercial. 0-85.C at 5v. 0-70.C at 3.3-4v

586

Should be labelled. If not, (028) = STD, (16) = VRE . If the chip is labelled 6x86L and 2.8V, use P55C settings.

6x86

Should be labelled with core voltage. VCC spec (028) = 3.4-3.7v, (16) = 3.15-3.45v.

IBM

IBM has a licence to make chips produced by Intel, so they can use the official masks (photographic blueprints) that others cannot, as well as adding more features. The Blue Lightning was a 32-bit chip similar to the 486DX.

AMD

For the K5, use the equivalent Pentium settings. After the P-rating on the face of the chip are three letters. The first is the package type (A=SPGA 296 pins), the second refers to the voltage and the third to case temperature. Voltages are listed in the first table below and temperatures in degrees C in the second:

K5 Letter	Voltage (Core/I/O)
B	3.45-3.6 (3.5)
C	3.3-3.465 (3.3)
F	3.135-3.465 (3.3)
G	x/y
H	2.86-3/3.3-3.465 (2.9/3.3)
J	2.57-2.84/3.3-3.465 (2.7/3.3)
K	2.38-2.63/3.3-3.465 (2.5/3.3)

Ltr	oC	Ltr	oC
Q	60	X	65
R	70	Y	75
W	55	Z	85

The K6 has a 64K cache, as opposed to 32K on Intel chips, and uses a RISC core with two decoder units to translate x86 commands that are parallel-processed 6 at a time. The K6-2 and 3 (Socket 7) are better versions of the same and easily give the Pentium II a run for its money. A feature called *Write Allocation* lessens the impact of a L1 cache miss and increases performance by about 5%, assuming your chipset behaves properly with it. You need software called **setk6** to enable it, downloadable from *c't magazine* in Germany, at **www.fnl.nl/ct-nl/ftp/index.htm**.

The Athlon, or K7, uses Slot A technology and has three super-scalar fully pipelined execution units for floating point, with allowance for MMX and 3DNow! instructions, together with 128K of L1 cache and 512K of half-speed L2 cache on board (at the moment) with its own special bus. The L1 cache is four times larger than that on the PIII, and the Athlon can decode any three x86 instructions at a time, whereas the PIII can only do this if two of the three are simple and relate to a single internal operation. It can also send up to nine internal instructions per clock cycle compared to the PIII's five. The system bus (between CPU and system logic) also runs at 200 MHz, being developed from the EV6 bus used with the DEC Alpha, so a new chipset is required, supplied by AMD initially. A side benefit of using this bus is that multiprocessor chipsets for the Alpha 21264 will also support the Athlon. Slot A looks like Slot 1, but the pinouts are different, partly for copyright reasons and partly because AMD felt it was time to blaze new trails. The result is a bus design that is technically superior.

486

There are three types of DX4; V8T, DX4-S (SV8T) and DX4-S (SV8B). The V8T is non SL-enhanced CPU with a write-through internal cache. The DX4-S (SV8T) is SL-enhanced, also with write-through internal cache. The DX4-S (SV8B) is SL-enhanced but with a write-back cache. An SL-enhanced AMD DX4 has a letter "S" following the "AMD DX4-100" label. The last letter ("B" or "T") indicates the cache mode supported. The full line might look like:

```
A 80486DX 4-100 N V 8 T
```

A	168-pin PGA
80486DX	Chip type
4	Clock Tripled (2=Clock doubled)
100	Speed
N	No ICE Microcode (S=SL Enhanced compatible)
V	3v core with 5v tolerant I/O. Blank=5v
8	8K cache
T	Write Through Cache (B=Write Back)

K5

These will have a line looking like this:

```
AMD-K5-PRxxxAXY
```

where *xxx* is Performance Rating, A=296-pin SPGA. X could be:

B	3.45-3.6v
C	3.3-3/465v
F	3.135-3.465v
H	2.76-3/3.135-3.465v (core/IO)
J	2.57-2.84/3.135-3.465v (core/IO)
K	2.38-2.63/3.135-3.465v (core/IO)

Y refers to case temperature:

W	55C
Q	60C
X	65C
R	70C
Y	75C
Z	85C

K6-2

There is a gold number on the upper side of the ceramic which identifies the core inside. 26050 means the older XT core, while 26051-26057 means the newer CXT. All K6-2 366, 380 and 400 MHz CPUs have the CXT core, as are possibly all those made after the date code 9844.

IDT

This company makes, or made, the *WinChip* (aka the C6), which was designed to run Windows business applications. The 200-speed version performs about 18% faster than the Intel 200 MMX and is approximately 25% cheaper. It is single-voltage, so you can get MMX on older boards, has a larger internal cache and disables the L2 cache when fitted, on the basis that a multitasking operating system tends not to benefit from it anyway.

MMX

This is an extension to x86 code that allows better handling of the repetitive instructions typically found with multimedia applications, allowing parallel processing of many data items with only one instruction, or as many 8-bit instructions as will fit into a 64-bit register, so video, at least, will be smoother and faster. For example, normal Pentiums only process 1 pixel per clock cycle, where the 64-bit MMX registers will be able to handle 8, although a 32 K cache also has something to do with it. MMX also performs many of the functions of sound, video or modem cards. The MMX processor's core runs between 2.0-3.5 volts, but the output uses 3.1-3.6v (3.3), so motherboards need 2 voltage regulators. Talking of which, see the chart at the end of the chapter for chip voltages and other settings. MMX uses Socket 7 and above. Intel chips have 2 MMX pipelines, whereas the AMD K6 and Cyrix 6x86 have only one, but their MMX registers are in a dedicated unit, so they only need one cycle to switch to MMX. On Intel chips, they are integrated into the FPU so you can't do maths and MMX instructions at the same time, and over 50 instructions are required to change from one function to the other. So, if you're using 3D video, for example, the MMX instructions produce the speed, but much of the advantage is lost after the coordinates are calculated by the FPU and the registers have to be changed over.

Summing up

In principle, the faster the CPU the better, but only if your applications do chip-centred work rather than writing to disk. For example, on a typical wordprocessing task in an older machine, replacing a 16 MHz 386 with a 33 MHz one (that's double the speed) will only get you something like a 5-10% increase in practical performance, regardless of what the benchmarks might say. For a database, which accesses the hard disk a lot, spend the money on a faster hard disk.

Also, with only 8 Mb RAM, you won't see much performance increase from a DX2/66 until you get to a Pentium 90 (hardly any between a DX4/100 and a Pentium 75). With Windows, this is because the hard disk is used a lot for virtual memory (swap files), which means more activity over the data bus. Since the PCI bus runs at 33MHz (actually half the front side bus speed which, coincidentally, is often the same as the memory bus speed), the bottleneck is the disk I/O, running at much the same speed on them all. This is especially true if you use *Programmed I/O* (PIO), where the CPU scrutinises every bit to and from the hard drive (although Multi-sector I/O or EIDE will improve things).

As the Pentium 90's motherboard runs faster (60 MHz), the I/O can proceed at a much faster pace (although a more sophisticated chipset helps). With 16 Mb of RAM, on the other hand, performance will be almost double anyway, because the need to go to the hard disk is so much reduced, and the processor can make a better contribution to performance. The biggest jump is from a DX2/66 to a DX/4, with the curve flattening out progressively up to the Pentium 90. There is also not a lot of difference between a 166-200 Mhz Pentium, the 200-233 MHz MMX and 266-300 MHz Pentium II, unless you speed up the I/O systems. Intel’s competitors do relatively poorly with the MMX and FPU side of things, so maybe combine them with a good quality graphics accelerator to narrow the gap for 3D, though this won’t help with image editing.

Chip Reference Chart

For dual voltage CPUs, note that I/O processes only take up about 10% of the power used by the CPU, so voltages for this will likely work within a range of settings.

Intel SLE 486DX/DX2/DX4/OPD CPUs marked with & E XXXX support green functions. P24Ds marked with & E W XXXX support writeback mode as well. The P24T-63/83 are Overdrive CPUs, and the board should be set to 5v. AMD normal CPUs are marked NV8T – the enhanced ones (with w/b cache) are marked SV8B.

Maker	Processor	Socket	Voltage	Mem Bus	Clock X	PCI Bus
Intel	486DX (P24)	LIF/3	5	As CPU	1	As CPU
Intel	486DX2/50 (P24)	LIF/3	5	25	2	25
Intel	486DX2/66 (P24)	LIF/3	5/3.3	33	2	33
Intel	486SX (P23) (P24)	LIF	5	As CPU	1	As CPU
Intel	486 SL-Enhanced		5	As CPU	1	As CPU
Intel	486DX4/75	3	3.3	25	3	25
Intel	486DX4/100 (P24C)	3	3.45	33	3	33
Intel	P24D		5			
AMD	486DX2/80	3	3.45	40	2	
AMD	486DX4/100	3	3.45	33	3	

Maker	Processor	Socket	Voltage	Mem Bus	Clock X	PCI Bus
AMD	486DX4/120	3	3.45	40	3	
AMD	486DX4/133	3	3.45	33	4	33
AMD	486SX	3	5	As CPU	1	As CPU
AMD	486DX	3	5	As CPU	1	As CPU
Cyrix/IBM	486DX	3	5	As CPU	1	As CPU
Cyrix/IBM	486DX2-V50	3	3.3	25	2	
Cyrix/IBM	486DX2-V66	3	3.6	33	2	
Cyrix/IBM	486DX2-V80	3	4	40	2	
Cyrix/IBM	486DX4-100	3	3.45	33	3	33
Cyrix/IBM	5x86-100	3	3.45	33	3	
Cyrix/IBM	5x86-120	3	3.45	40	3	
Cyrix/IBM	5x86-133	3	3.45	33	4	
Evergreen	486 upgrade	1,2,3,6	5	33	4	33
Kingston	Turbo 133	1,2,3,6	5	33	4	33
Intel	P 60	4	5	60	1	30
Intel	P 66	4	5	66	1	33
Intel	Pent OD P5T	4	5	60/66	2	
Intel	Pent OD P54CTB	5/7	3.52	50/60/66	2.5	
Intel	P 54C-75	5/7	3.52	50	1.5	25
Intel	P 54C-90	5/7	3.52	60	1.5	30
Intel	P 54C-100	5/7	3.52	66	1.5	33
Intel	P 54C-100	5/7	3.52	50	2	25
Intel	P 54C-120	5/7	3.52	60	2	30
Intel	P 54C-133	5/7	3.52	66	2	33
Intel	P 54C-150	5/7	3.52	60	2.5	30
Intel	P 54C-166	7	3.52	66	2.5	33
Intel	P 54C-200	7	3.52	66	3	33
Intel	P54C-233	5/7	3.52	66	3.5	33
AMD	K5-PR75	5/7	3.52	50	1.5	25
AMD	K5-PR90	5/7	3.52	60	1.5	30
AMD	K5-PR100	5/7	3.52	66	1.5	33
AMD	K5-PR120	5/7	3.52	60	2	30
AMD	K5-PR133	5/7	3.52	66	2	33
AMD	K5-PR150	5/7	3.52	60	2.5	30
AMD	K5 PR166	5/7	3.52	66	2.5	33
Cyrix/IBM	6x86 P120+ (100)	5/7	3.52	50	2	25
Cyrix/IBM	6x86 P133+ (110)	5/7	3.52	55	2	
Cyrix/IBM	6x86 P150+ (120)	5/7	3.52	60	2	30
Cyrix/IBM	6x86 P166+ (133)	5/7	3.52	66	2	33
Cyrix/IBM	6x86 P200+ (150)	7	3.52	75	2	37.5
Intel	P55C-166 MMX	7	2.8/3.3	66	2.5	33
Intel	P55C-200 MMX	7	2.8/3.3	66	3	33
Intel	P55C-233 MMX	7	2.8/3.3	66	3.5	33
AMD	K6 166	7	2.9/3.3	66	2.5	33
AMD	K6 200	7	2.9/3.3	66	3	33
AMD	K6 233	7	2.1/3.3	66	3.5	33
AMD	K6 266	7	2.2/3.3	66	4	33
AMD	K6 300	7	2.1/3.3	66	4.5	33
AMD	K6 PR233 (.35m)	7	3.2/3.3	66	3.5	33
AMD	K6 3D	7	2.2/3.3			

Maker	Processor	Socket	Voltage	Mem Bus	Clock X	PCI Bus
Cyrix/IBM	6x86MX PR150	7	2.9/3.3	60	2	30
Cyrix/IBM	6x86MX PR166	7	2.9/3.3	60	2.5	30
Cyrix/IBM	6x86MX PR200	7	2.9/3.3	66	2.5	33
Cyrix/IBM	6x86MX PR233	7	2.9/3.2	66	3	33
Cyrix/IBM	6x86MX PR266	7	2.9/3.2	66	3.5	37.5
IDT	C6	7	3.3			
Intel	Pro 150	8	3.1	60	2.5	30
Intel	Pro 180	8	3.3	60	3	30
Intel	Pro 200	8	3.3	66	3	33
Intel	Pentium II 233	Slot 1		66	3.5	33
Intel	Pentium II 266	Slot 1		66	4	33
Intel	Pentium II 300	Slot 1		66	4.5	33
Intel	Pentium II 333	Slot 1		66	5	33
Intel	Pentium II 350	Slot 1		100	3.5	33
Intel	Pentium II 400	Slot 1		100	4	33

A board with the same jumper settings for 1.5x and 3.5x clock multipliers is due to the 233 MHz chip being wired internally to change the 1.5 setting. And in case you ever wondered, here are the specs for the sockets:

Socket	Description
LIF	486 boards, no lever
ZIF 1	486 boards, with 168 or 169 pins
ZIF 2	486 boards, 238 pins
ZIF 3	486 boards, 237 pins, most common
ZIF 4	Pentium P5 (60/66)
ZIF 5	Pentium Classic (P54C), single voltage, up to 166 MHz
ZIF 6	486 boards, 235 pins
ZIF 7	As for ZIF 5, plus 1 pin for Overdrive P55CT, over 166 MHz
ZIF 8	Pentium Pro
Slot 1	Pentium II

Notes

A

AAEON Technology Inc

www.aaeon.com.tw

Ability Electron Co Ltd

Aka Elpina
www.ability-tw.com

Abit

www.abit.com.tw
www.abit-usa.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0	P14T	BC-6A	PB4 (Ali 1487/89 chipset)
1C-40	PK5	CC	PS6/PN5
2	PW4/PW4T	CC-D6	PH5
2-02	AH4-T (DX4)	DC	PT5/IT5H
2-15	PE5	EC-1G	IT5V v 1G
2C-C5	PB4	EC-1S	IT5V v 1S

Code	Motherboard	Code	Motherboard
2C-5E	PB4	EC-1Y	SM5-A
2C-7A	PB4	EC-2L	SM5
2C-B8	PB4	EC-2R	SM5-A
2C-D2	PB4	EC-3K	IT5H v1.51
9C(-9D)	PH5	EC-9B	PH5
AC	BX6 (BX)/AX5	FC	IT5H v2
AC(-7T)	LX-6 (LX)	FC-3Q	SM5-A
AC	PR5 (VX)	FC-3Y	
BC-3P	AX5 or PX5		

AX5

Item	Description	Notes
Form Factor		
CPU		Jumperless setup
Speeds (MHz)		
Chipset		
BIOS		
Bus	4 ISA/4PCI	
Memory (Mb)		4 x 72pin
Cache (K)		
Performance		Bus Speeds (MHz) up to 83MHz
Problems		
Comments		Cannot disable USB interrupt

AP5C

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	Up to 133 MHz	
Chipset	Triton	
BIOS	AMI Flash	
Bus	4 ISA/4PCI	1 each shared
Memory (Mb)	128 Mb	EDO/FPM
Cache (K)	512K	PB or asynchronous
I/O	2S, 1P, Floppy, IDE	IDE via chipset
Problems		ATI Mach64 may produce ghosted images at high resolutions and/or colour depths.
Comments		

BE6

Jumperless

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III/Celeron	Slot 1
Speeds (MHz)	233-550	100 FSB

Item	Description	Notes
Chipset	440 BX	
BIOS	Award	
Bus	5 PCI/2 ISA	1 shared
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)		
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	2 EIDE, UDMA/66
Video		AGP
Audio		
Performance		Quite good

BE6-II

Jumperless

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III/Celeron	Slot 1
Speeds (MHz)	233-550	100 FSB
Chipset	440 BX	
BIOS	Award	
Bus	5 PCI/1 ISA	
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)		
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	2 EIDE, UDMA/66
Video		AGP
Audio		
Performance		Quite good

BP6

Jumperless

Item	Description	Notes
Form Factor	ATX	
CPU	Celeron	2 x Socket 370
Speeds (MHz)		
Chipset	440 BX	
BIOS	Award	
Bus	5 PCI/2 ISA	1 shared – up to 133 MHz
Memory (Mb)		3 DIMM sockets
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	
Video		AGP

BX6

Jumperless

Item	Description	Notes
Form Factor	ATX	

Item	Description	Notes
CPU	Pentium II/Celeron	Slot 1
Speeds (MHz)	233-550	
Chipset	440 BX	
BIOS	Award	
Bus	4 PCI/3 ISA	1 shared – up to 133MHz
Memory (Mb)	1 Gb	4 DIMM sockets
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	
Video		AGP
Performance		Quite good

LX6

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	500	
Chipset		
BIOS		
Bus	4 PCI/3 ISA	
Memory (Mb)	512 Mb SDRAM 1 Gb EDO	4 DIMM sockets
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	
Video		AGP
Performance		100 MHz bus speed, but only fair performance.

PB4

Item	Description	Notes
Form Factor	AT	
CPU	486DX/2/SX/SL/4	P24D/T, also Cyrix/AMD
Speeds (MHz)	266	
Chipset		
BIOS	Award	
Bus	3 PCI/4 ISA	
Memory (Mb)		2 72-pin SIMM. EDO and asymmetrical DRAM
Cache (K)	256K	
I/O	2S, 1P, Floppy, 2IDE	

Jumper	*Position*		*Function*
JP1-2	**JP1**	**JP2**	**CPU Voltage**
	1-2	2-3	3.45
	2-3	2-3	3.6
	4-5	2-3	4
	1-2	1-2	5
JP3	1-2		128K cache (32Kx8 at U3,6,7,10)
	2-3		256K cache (64Kx8 at U3,6,7,10)

Jumper	*Position*	*Function*							
		Use 16Kx8 or 32Kx8 tag RAM at U4							
JP5-9	**CPU**	**RJ1**	**RJ2**	**RJ3**	**JP5**	**JP6**	**JP7**	**JP8**	**JP9**
RJ1-3	486DX/2/4	1-8	1-8	Off	Off	1-2	Off	Off	Off
	P24T	7-14	1-8	Off	Off	1-2	Off	Off	Off
	P24D	3-10	1-8	Off	2-3	1-2	Off	Off	1-2
	AMD 486DX2	1-8	1-8	Off	Off	2-3	Off	On	Off
	AMD 486DX4 (NV8T)*	1-8	1-8	Off	Off	2-3	Off	Off	Off
	AMD 5x86-133/160	3-10	1-8	Off	2-3	1-2	On	Off	1-2
	Enh AM486, 5x86-150	3-10	1-8	Off	2-3	1-2	Off	Off	1-2
	Cyrix DX4/DX2 (M7)**	1-8	Off	1-8	1-2	1-2	Off	Off	2-3
	Cyrix Cx5x86	1-8	1-8	Off	2-3	1-2	Off	Off	1-2
		**If your Cyrix DX4-100 has DX4-P/O on it, use Cyrix Cx5x86							
JP8	Off*	Reserved							
JP4,111	**System Speed**	**JP4**	**JP11**	**JP12**	**JP19**				
2,19	25 MHz	Off	Off	1-2	Off				
	33 MHz	On	On	1-2	Off				
	40 MHz	On	Off	1-2	Off				
	50 MHz	Off	On	2-3	On				
JP12	1-2*	Reserved							
JP14	Off*	Reserved							
JP15	1-2,5-6	12v Flash ROM							
	2-3,4-5	5v EPROM							
JP17	1-2*	Normal operation							
	2-3	Discharge CMOS							

PN5

Item	Description	Notes
Form Factor	AT	
CPU	Pentium, AMD 5x86, Cyrix 6x86	
Speeds (MHz)	75-200	
Chipset	Intel 82430 HX	
BIOS	Award PnP	
Bus	3 PCI/4 ISA	
Memory (Mb)		EDO
Cache (K)	256K	PB. COAST upgrade
I/O	2S, 1P, floppy, 2 EIDE, IR	

Jumper	*Position*		*Function*
JP4	Off*		Enable Onboard I/O
JP5,6,20	Off*		256K cache
	On		512K cache
JP26	On		Discharge CMOS
DS1,2	**DS1**	**DS2**	**Clock multiplier**
	Off	On	1 (DS1 on for Cyrix)
	Off	Off	1.5
	Off	On	2
	On	On	2.5
	On	Off	3 (DS1 off for Cyrix)
	On	Off	4 (Cyrix)

Jumper	*Position*			*Function*
DS3,4,7	**DS3**	**DS4**	**DS7**	**CPU external clock**
	On	On	Off	50 MHz
	Off	Off	Off	55 MHz
	Off	On	Off	60 MHz
	On	Off	Off	66 MHz*
DS5	On*			AT bus=CPU ext/8
	Off			AT bus=CPU ext/6
DS6	On			60 MHz DRAM refresh rate
	Off*			66 MHz DRAM refresh rate

CPU Voltage	DSV1	DSV2	DSV3	DSV4	DSV5	DSV6	DSV7	DSV8
2.5	Off	Off	Off	Off	Off	On	On	Off
2.7	Off	Off	Off	Off	On	Off	On	Off
2.8	Off	Off	Off	On	Off	Off	On	Off
2.9	Off	Off	On	Off	Off	Off	On	Off
3.38*	Off	On	Off	Off	Off	Off	On	Off
3.52	On	Off	Off	Off	Off	Off	Off	On

PW4(T)

Item	Description	Notes
Form Factor	AT	
CPU	80486, Cyrix M7, AMD	DX4
Speeds (MHz)		
Chipset		
BIOS	Award/AMI	
Bus	3 ISA/3 VL	1 ISA is 8-bit. 2 VL are Masters
Memory (Mb)	256	4 30-pin sockets, 2 72-pin
Cache (K)	1024	256 standard
I/O		

Jumper	*Position*	*Function*					
JP5	On*	Colour					
	Off	Mono					
JP6	Off*	Reserved					
JP9	On	VL Bus 0 wait write					
	Off*	VL bus 1 wait write					
JP10	On*	>33 MHz System speed (VL bus)					
	Off	<=33 MHz System speed (VL bus)					
JP27-29	**System Speed**	**JP27**	**JP28**	**JP29**	**JP27**	**JP28**	**JP29**
	20 MHz	Off	Off	Off	Off	Off	On
	25 MHz	Off	Off	On	On	Off	On
	33 MHz	On	On	On	Off	On	On
	40 MHz	Off	On	On	On	Off	Off
	50 MHz	On	Off	Off			
		LH figures for U30 clock generator. RH for U31.					
JP60-62	**Cache size**	**JP60**	**JP61**	**JP62**	**JPX3**		
JPX3	128K (U2,4,6,8)	2-3	1-2	2-3	9-16		
	256K (64K in U2,4,6,8)	2-3	2-3	2-3	3-10		

Jumper	*Position*	*Function*			
	256K (16Kx8 tag, 64K in U2,4,6,8)	2-3	4-5	2-3	3-10
	256K (32K in all sockets)	2-3	1-2	2-3	13-20
	256K (16Kx8 tag, 32K all sockets))	2-3	4-5	2-3	13-20
	512K (64K in all sockets)	2-3	1-2	2-3	1-8
	512K (128K in U2,4,6,8)	2-3	1-2	2-3	3-10
	1 Mb (128K all sockets)	1-2	1-2	1-2	1-8
JP47-52	1-2	SM (System Management Output) – for green power supply			
JP67	1-2	Normal			
	2-3	Discharge CMOS			

Intel Inside

	SX	SX(SL)	DX/DX2	DX/2 (SL)	DX4-75(SL)	DX4-100(SL)	P24T	P24D
RN8	1-8	1-8	1-8	1-8	Off	Off	1-8	1-8
JP37	Off	Off	Off	Off	On	Off	Off	Off
JP38	Off	Off	Off	Off	Off	On	Off	Off
JP39	Off	Off	Off	Off	Off	Off	Off	Off
JP40	Off	Off	Off	Off	Off	Off	Off	Off
JP20	1-2	1-2	Off	Off	Off	Off	Off	Off
JP26	1-2	Off	1-2	Off	Off	Off	Off	Off
JP42	Off	1-2	Off	1-2	1-2	1-2	1-2	1-2
JP65	Off	Off	1-2	1-2	1-2	1-2	1-2	1-2
RN5	Off	Off	Off	Off	Off	Off	Off	Off
RN6	1-8	1-8	1-8	1-8	1-8	1-8	1-8	1-8
RN7	Off	Off	1-8	1-8	1-8	1-8	1-8	1-8
JPX1	5-12	5-12	5-12	5-12	5-12	5-12	5-12	5-12
JPX2	Off	Off	Off	Off	Off	Off	Off	Off
JP15	Off	Off	Off	Off	Off	Off	1-2	1-2
JP18	Off	Off	Off	Off	Off	Off	Off	1-2
JP21	Off	Off	Off	Off	Off	Off	1-2	1-2
JP33	Off	Off	Off	Off	Off	Off	Off	1-2
JP34	Off	Off	Off	Off	Off	Off	Off	1-2
JP35	Off	Off	Off	Off	Off	Off	1-2	1-2
JP16	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3
JP17	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3

Cyrix Instead

	DX(2)	DX2-V50	DX2-V66	DX2-V80	DX4-100	Cx5x86
RN8	1-8	Off	Off	Off	Off	Off
JP37	Off	On	Off	Off	Off	Off
JP38	Off	Off	Off	Off	On	On
JP39	Off	Off	On	Off	Off	On
JP40	Off	Off	Off	On	Off	Off
JP20	Off	Off	Off	Off	Off	Off
JP26	Off	Off	Off	Off	Off	1-2
JP42	1-2	1-2	1-2	1-2	1-2	Off
JP65	1-2	1-2	1-2	1-2	1-2	1-2
RN5	1-8	1-8	1-8	1-8	1-8	Off
RN6	Off	Off	Off	Off	Off	1-8

	DX(2)	DX2-V50	DX2-V66	DX2-V80	DX4-100	Cx5x86
RN7	1-8	1-8	1-8	1-8	1-8	1-8
JPX1	1-8	1-8	1-8	1-8	1-8	5-12
JPX2	1-8	1-8	1-8	1-8	1-8	Off
JP15	Off	Off	Off	Off	Off	1-2
JP18	Off	Off	Off	Off	Off	1-2
JP21	Off	Off	Off	Off	Off	Off
JP33	Off	Off	Off	Off	Off	1-2
JP34	Off	Off	Off	Off	Off	1-2
JP35	Off	Off	Off	Off	Off	1-2
JP16	2-3	2-3	2-3	2-3	2-3	2-3
JP17	2-3	2-3	2-3	2-3	2-3	2-3

AMD/UMC

	DX(2) 5v	DX4 3.45v	DX2 3.45v	Enhanced	UMC U5-S
RN8	1-8	Off	Off	Off	1-8
JP37	Off	On	Off	Off	Off
JP38	Off	On	On	On	Off
JP39	Off	Off	Off	Off	Off
JP40	Off	Off	Off	Off	Off
JP20	Off	Off	Off	Off	1-2
JP26	1-2	1-2	1-2	Off	1-2
JP42	Off	Off	Off	1-2	Off
JP65	1-2	1-2	1-2	1-2	Off
RN5	Off	Off	Off	Off	Off
RN6	1-8	1-8	1-8	1-8	1-8
RN7	1-8	1-8	1-8	1-8	Off
JPX1	5-12	5-12	5-12	5-12	5-12
JPX2	Off	Off	Off	Off	Off
JP15	Off	Off	2-3	1-2	Off
JP18	Off	Off	Off	1-2	Off
JP21	Off	Off	Off	Off	Off
JP33	Off	Off	Off	1-2	Off
JP34	Off	Off	Off	1-2	Off
JP35	Off	Off	Off	1-2	Off
JP16	1-2	1-2	1-2	2-3	2-3
JP17	1-2	1-2	1-2	2-3	2-3

WB6

Jumperless

Item	Description	Notes
Form Factor	Micro ATX	
CPU	Pentium III/Celeron	Slot 1
Speeds (MHz)	233-550	100 FSB
Chipset	Intel 810E	
BIOS	Award	
Bus	3 PCI 1 AMR	
Memory (Mb)		2 DIMM sockets

Item	Description	Notes
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	2 EIDE controllers, UDMA/66

Acer

See also AOpen
www.acer.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0C-00	MTX A512		

Acermate 386SX/20n

Item	Description	Notes
Form Factor	Proprietary	
CPU	386SX	
Speeds (MHz)	20	
Chipset	Ali	
BIOS		
Bus	2 ISA	Uses sideways board
Memory (Mb)	5	
Cache (K)		
I/O	2S, 1P, Floppy, IDE	
Video		On board

Jumper	*Position*	*Function*
J4	On*	VGA enable
	Off	VGA Disable
J7	Check*	Check Password
	Pass	Clear Password
J8	On	IRQ9 to VGA
	Off*	IRQ9 to expansion card
J10-13,15,16,19,20	Reserved	Do not use

A1GX-1

	P24C NV8T/B	P24D	AMD DX2 SV8T	AMD DX4 SV8T	AMD DX2 SV8B	AMD DX4 SV8B	Cyrix/IB M/TI DX2	Cyrix/IB M DX4	Cyrix/IB M 5x86	O/D P24T
JPX2	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3
JP13	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3
JP14	2-3	2-3	2-3	2-3	2-3	2-3	Open	Open	2-3	2-3
JP15	2-3	2-3	2-3	2-3	2-3	2-3	1-2	1-2	Open	2-3
JP17	2-3	2-3	2-3	2-3	2-3	2-3	1-2	1-2	1st 1-2	2-3

	P24C NV8T/B	P24D	AMD DX2 SV8T	AMD DX4 SV8T	AMD DX2 SV8B	AMD DX4 SV8B	Cyrix/IB M/TI DX2	Cyrix/IB M DX4	Cyrix/IB M 5x86	O/D P24T
JP18	2-3	2-3	2-3	2-3	1-2	1-2	2-3	2-3	Open	2-3
JP19	2-3	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2
JP20	2-3	2-3	2-3	2-3	2-3	2-3	1-2	1-2	2-3	2-3
JP21	2-3	2-3	2-3	2-3	2-3	2-3	1-2	1-2	2-3	2-3
JP22	2-3	1-2	2-3	2-3	1-2	1-2	2-3	2-3	2-3*	1-2
JP23	2-3	2-3	2-3	2-3	2-3	2-3	1-2	1-2	2-3	2-3
JP25	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	Open	2-3
JP26	2-3	1-2	2-3	2-3	1-2	1-2	2-3	2-3	2-3*	1-2
JP27	3-4	3-4	2-3	3-4	2-3	3-4	3-4	3-4	3-4	1-2
JP32	1-2	1-2	1-2	1-2	1-2	1-2	1-2/2-3	2-3	1-2	1-2

*4th 1-2

Jumper	*Position*		*Function*
JP1	1-2		OEM BIOS
	2-3*		Acer BIOS
JP2	1-2		Enable Password Check
	2-3*		Bypass Password
JP3	1-2		COM1 boot
	2-3*		Normal boot
JP4,5	**JP4**	**JP5**	**Onboard Memory**
	1-2	2-3	4 Mb
	2-3	1-2	8 Mb
	1-2	1-2	Disable
JP6	1-2		Disable onboard super I/O
	2-3*		Enable
JP7	2-3*		Printer DRQ3
	1-2		Printer DRQ1
JP8	1-2		Printer DACK1
	2-3*		Printer DACK3
JP9	2-3*		Enable onboard VGA
JP10	1-2		IDE port 0F4h, 0F8h, 0FCh
	2-3*		IDE port 074h, 078h, 07Ch
JP11	1-5		25 MHz
	2-6		33 MHz
	3-7		40 MHz (not recommended)
JP28	1-2		Enable Suspend/Resume button
	2-3*		Enable Reset button
JP29	1-2		Disable onboard IDE
	2-3*		Enable
JPX1	1-2		Flash ROM
	2-3*		EPROM
JP30,31	**JP30**	**JP31**	**Cache size**
	1-2	1-2	128K, 4 x 32K x 8
	2-3	2-3	256K, 8 x 32K x 8

Front Panel Header

Position	Function
1-2	Keylock

Position	Function
3-5	Power LED
7-10	Speaker
12-13	Green LED
15-17	Suspend switch
19-20	Reset

A1GX-2

	i486 P24C	i486 3.3v WB	Cyrix/IBM /TI DX2	Cyrix DX4/100	TI DX4 /100	C5x86	AMD DX2 NV8T
JP17	2-3	2-3	1-2	1-2	1-2	1st 1-2 6th 2-3 7th 2-3	2-3
JP18	1-2	1-2	2-3	2-3	2-3	Open	1-2
JP19	2-3	1-2	1-2	1-2	2-3	1-2	2-3
JP26	2-3	1-2	2-3	2-3	2-3	4th 1-2 5th 1-2 6th 2-3 7th 2-3	2-3
JP27	3-4	3-4	3-4	3-4	3-4	3-4	2-3
JP32	1-2	1-2	1-2/2-3	1-2	1-2	1-2	1-2
JP36	1-2	1-2	1-2	1-2	1-2	1-2	1-2

	DX4 NV8T	DX2 NV8B	DX4 NV8B	Enh AMD DX2 SV8T	Enh AMD DX4 SV8T	Enh AMD DX2 SV8B	Enh AMD DX4 SV8B
JP17	2-3	2-3	2-3	2-3	2-3	2-3	2-3
JP18	2-3	1-2	2-3	2-3	2-3	1-2	1-2
JP19	2-3	1-2	1-2	1-2	1-2	1-2	1-2
JP26	2-3	1-2	1-2	2-3	2-3	1-2	1-2
JP27	3-4	2-3	3-4	2-3	3-4	2-3	3-4
JP32	1-2	1-2	1-2	1-2	1-2	1-2	1-2
JP36	1-2	1-2	1-2	1-2	1-2	1-2	1-2

Jumper	*Position*	*Function*
JP1	1-2 2-3*	OEM BIOS Acer BIOS
JP2	1-2 2-3*	Enable Password Check Bypass Password
JP3	1-2 2-3*	Mono/COM1 boot Normal boot (VGA)
JP5	2-3 1-2	Enable onboard memory Disable
JP6	1-2 2-3*	Disable onboard super I/O Enable
JP7	2-3* 1-2	Printer DRQ3 Printer DRQ1
JP8	1-2 2-3*	Printer DACK1 Printer DACK3
JP9	1-2 2-3*	Disable onboard VGA Enable

Jumper	Position	Function
JP10	1-2	IDE port 0F4h, 0F8h, 0FCh
	2-3*	IDE port 074h, 078h, 07Ch
JP11	1-4	25 MHz
	2-5	33 MHz
	3-7	40 MHz (not recommended)
JP28	1-2	Enable Suspend/Resume button
	2-3*	Enable Reset button
JP29	1-2	Disable onboard IDE
	2-3*	Enable
JP 33	1-2	Feature Connector
	2-3	I2C interface
JP35	Open	IDE LED
	Closed	IDE, FDD, CD ROM LED
JPX1	1-2	Flash ROM
	2-3*	EPROM

Front Panel Header

Position	Function
1-2	Keylock
3-5	Power LED
7-10	Speaker
12-13	Green LED
15-17	Suspend switch
19-20	Reset

A1G4

	486	ODP 486	P24C	P24D	AMD 3.3v	Cyrix	UMC	TI/Acer
JP11	1-2	1-2	1-2	1-2	1-2	2-3	1-2	2-3
JP12	1-2	1-2	1-3	2-3	1-2	1-2	1-2	2-3
JP13	2-3	1-2	1-2	1-2	1-2	1-2	1-2	2-3
JP18	2-3	2-3	2-3	1-2	2-3	2-3	2-3	2-3
JP20	2-3	2-3	2-3	2-3	2-3	1-2	2-3	1-2
JP30-32	Open	Open	Open	Open	Open	Closed	Open	Open
JP33	1-2	1-2	1-2	1-2	1-2	2-3	1-2	1-2
JP34-36	Closed	Closed	Closed	Closed	Open	Open	Closed	Open
JP39	1-2,4-5	1-2,4-5	1-2,4-5	1-2,4-5	1-2,4-5	1-2,4-5	1-2,4-5	2-3,5-6
JP40	2-3	2-3	2-3	2-3	1-2	2-3	1-2	2-3
JP41	2-3	2-3	2-3	2-3	1-2	2-3	1-2	2-3
JP42	2-3	2-3	2-3	2-3	2-3	2-3	2-3	1-2
JP43	Open	Open	Open	Open	Open	Open	Open	Open
JP44	Open	Open	Power	Open	Power	Open	Open	Open
JP45	Closed	Closed	Board	Closed	Board	Closed	Closed	Closed
JP46	1-2	1-2	1-2	2-3	1-2	1-2	1-2	1-2
JP47	1-2	1-2	1-2	1-2	1-2	2-3	1-2	1-2
JP48	Open	Open	Open	Open	Open	Open	Open	Open

Jumper	*Position*				*Function*
JP2	2-3				Enable password check
	1-2				Disable
JP10,17,19	**JP10**	**JP17**	**JP19**	**CN14**	**CPU Clock**
CN14	1-2	-2	2-3	2-6	40 MHz
	2-3	2-3	2-3	3-7	33 MHz
	2-3	2-3	2-3	4-8	25 MHz
JP14	Closed				Enable onboard VGA
	Open				Disable
JP16	Open				Enable onboard local bus IDE
	Closed				Disable
JP20	1-2				Intel SL enh or Cyrix CPU
	2-3				Normal CPU
JP21	Closed				Enable onboard super I/O
	Open				Disable
JP28	1-2				Enable onboard memory
	2-3				Disable
JP30,31	1-2				128K cache (4 x 32K x 8)
	2-3				256K cache (8 x 32K x 8)
JP37-38	1-2				Enable Reset button
	2-3				Disable

Front Panel Header

Position	Function
1-2	Keylock
3-5	Power LED
7-10	Speaker
12-13	Green LED
15-17	Suspend switch
19-20	Reset

AP53

Item	Description	Notes
Form Factor	AT	
CPU	Pentium	
Speeds (MHz)		
Chipset	Intel 430HX	
BIOS	AMI	
Bus	4 PCI/3 ISA	
Memory (Mb)		4 x 72-pin sockets
Cache (K)		
I/O	2S, 1P, floppy, IDE, USB	

Jumper	*Position*	*Function*
JP1,3	**JP1**	**Bus Speed**
	1-2,3-4	25 MKz
	1-2	30 MHz
	3-4	33 MHz

Jumper	*Position*		*Function*
JP3	1-2,3-4		Out for P55C
JP4	In		Enable PS/2 Mouse
	Out		Disable
JP5	1-2		Normal
	2-3		Clear CMOS
JP8	1-2		Enable onboard I/O
	2-3		Disable
JP10	1-2,3-4		3x CPU
	3-4,5-6		4x CPU
	5-6,7-8		5x CPU
	1-2,7-8		6x CPU
JP11	1-2		3.43v Core
	3-4		3.52v
	5-6		2.5v
	7-8		2.7v
	9-10		2.8v
	11-12		2.9v
JP12	1-2		Chipset/PBSRAM Voltage 3.43v
	3-4		3.52v
JP13	1-2,3-4		In for P55C
JP 1301	**JP1301**	**JP1302**	**Flash ROM Boot Block**
JP1302	1-2	1-2	Reserved
	2-3	2-3	Enabled

AX6F

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Thermal protection
Speeds (MHz)		
Chipset	Intel 82440FX PCIset	
BIOS	Award Flash	
Bus		
Memory (Mb)	512	FPM/EDO. 4 x 72-pin sockets
Cache (K)	None	
I/O	2S, 1P, floppy, IDE, USB, PS/2	

Jumper	*Position*			*Function*
JP1-3	**JP1**	**JP2**	**JP3**	**CPU Frequency Ratio**
	2-3	1-2	2-3	1.5x
	1-2	1-2	1-2	2x
	1-2	1-2	2-3	2.5x
	1-2	2-3	1-2	3x
	1-2	2-3	2-3	3.5x
	2-3	1-2	1-2	4x
	2-3	1-2	2-3	4.5x
	2-3	2-3	1-2	5x
	2-3	2-3	2-3	5.5x
	1-2	1-2	1-2	6x
	1-2	1-2	2-3	6.5x
	1-2	2-3	1-2	7x
	1-2	2-3	2-3	7.5x

Jumper	Position			Function
	2-3	1-2	1-2	8x
JP5,6	**JP5**	**JP6**		**CPU external clock**
	1-2	1-2		66 MHz*
	2-3	2-3		60 MHz
JP14	1-2			Normal operation
	2-3			Clear CMOS

Front Panel Header

Position	Function
1-2	Keylock
3-5	Power LED
7-10	Speaker
12-13	Green LED
15-17	Suspend switch
19-20	Reset

F433T

Jumper	Position	Function
JP2	1-2*	33 MHz
JP3	1-2*	
J4	1-2*	486DX
	2-3	486SX
JP4	In	Discharge battery (erase CMOS)
	Out*	Charge battery
JP6	N/C	UPS Connector
JY2	In*	Enable system security setup
	Out	Disable system security setup
JN4	In*	Enable reset switch
	Out	Disable reset switch
J8	On	IRQ9 to VGA
	Off*	IRQ9 to expansion card
SW1	Reserved	Do not use

ViL5G

Jumper	Position		Function
JP1,2	**JP1**	**JP2**	**Cache Size**
	1-2,4-5,8-9	1-2,4-5,8-9	128K (32Kx4)
	1-2,5-6,8-9	1-2,4-5,8-9	256K (64Kx4)
	1-2,5-6,7-8	1-2,4-5,7-8	512K (128Kx4)
	2-3,5-6,8-9	2-3,5-6,8-9	256K (32Kx8)
JP6			Clear CMOS
JP18	1-2		VESA write 0 wait state
	2-3		VESA write 1 wait state
JP19	1-2		VESA bus speed <=33 MHz
	2-3		VESA bus speed >33 MHz

5v CPU

	i486SX/DX DX2/SL enh	Cyrix DX/DX2	Intel/AMD SX	Intel/AMD DX/DX2	Intel P24D
JP9	1-2	2-3	1-2	1-2	1-2
JP10	1-2	2-3	1-2	1-2	2-3
JP13	1-2	1-2	Open	Open	1-2
JP23	3-4,5-6,7-8	2-3,5-6,7-8	6-7	5-6,7-8	1-2,3-4,5-6,7-8
JP24	7-8	2-3,7-8	Open	7-8	7-8
JP25	Open	2-3* or Open**	Open	Open	1-2,5-6
JP26	1-2,5-6	4-5	Open	Open	2-3,5-6,7-8
JP27	4-5,7-8	2-3,7-8	7-8	7-8	4-5,6-7

*Without voltage regulator – Cyrix CPU in w/t mode only. **With voltage regulator.

3.45v CPU

	i486DX4	AMD DX2	AMD DX4	Cyrix DX2
JP9	1-2	1-2	1-2	2-3
JP10	1-2	1-2	1-2	2-3
JP13	1-2	Open	Open	1-2
JP23	3-4,5-6,7-8	5-6,7-8	5-6,7-8	2-3,5-6,7-8
JP24	7-8	7-8	7-8	2-3,7-8
JP25	Open	3-4*	3-4	3-4
JP26	1-2,5-6	*	Open	4-5
JP27	4-5,7-8	7-8	7-8	2-3,7-8
JP16	1-2	Open	Open	Open

*Connect pin 8 of JP25 to pin 7 of JP26.

32/20

Jumper	*Position*	*Function*				
S1-4	**ROM Size**	**S1**	**S2**	**S3**	**S4**	**JP5**
JP5	27128	On*	On*	Off*	Off*	2-3
	27256	Off	Off	On	On	2-3
	27512	Off	Off	On	On	1-2
S5	On	CGA				
	Off*	Mono				
S6	Off*	20 MHz				
	On	SMART Mode (not under Xenix)				
S8	On	ROM Shadow Disabled				
	Off	ROM Shadow Enabled				
JP6-8	**Math CoPro**	**JP6**	**JP7**	**JP8**		
	Installed	1-2	1-2	2-3		
	Not Installed*	2-3*	2-3*	1-2*		
JP9	Open*	2Mb on board				
	1-2(A)	4Mb on board				

500+

Jumper	*Position*	*Function*
S1	On	Disable Floppy

Jumper	*Position*			*Function*
	Off*			Enable Floppy
S2	On			Enable 8087
	Off			Disable 8087
S3-4	S3	S4		Base Mem
	Off	On		640K
	On	Off		512K
	Off	Off		256K
S5-8	**S5**	**S6**		**Display**
	Off	Off		Mono 80x25
	On	Off		Colour 80x25
	Off	On		Colour 40x25
	On	On		EGA etc
S1, 7-8	**S1**	**S7**	**S8**	**Floppy**
	Off	On	On	1 drive
	Off	Off	On	2 drives

710

SW1

Jumper	*Position*	*Function*
S1	On	Enable IRQ 2
S2	On	Enable RTC 0 (300-303)
	Off	Enable RTC 1 (2C0-2C3)
S3	On	Enable COM 2 (2F8-2FF)
	Off	Disable COM 2
S4	On	Enable COM 1 (3F8-3FF)

SW2

Switch	*Position*			*Function*
S1	On			Disable Floppy
	Off			Enable Floppy
S2	On			Disable 8087-1
	Off			Enable 8087-1
S3-4	**S3**	**S4**		**Memory**
	Off	Off		Bank 1
	On	Off		Bank 1 & 2
	Off	On		Bank 1, 2 & 3
	On	On		Reserved
S5	Reserved			Do not use
S6	On			Disable display
	Off			Enable display
S1, 7-8	**S1**	**S7**	**S8**	**Floppy**
	Off	On	On	1 drive
	Off	Off	On	2 drives

SW3

Switch	*Position*	*Function*

Switch	Position				Function
S1-4	**S1**	**S2**	**S3**	**S4**	**Bank Address**
	Off	Off	Off	Off	C0000-C3FFF
	On	Off	Off	Off	C4000-C7FFF
	Off	On	Off	Off	C8000-CBFFF
	On	On	Off	Off	CC000-CFFFF
	Off	Off	On	Off	D0000-D3FFF
	On	Off	On	Off	D4000-D7FFF
	Off	On	On	Off	D8000-DBFFF
	On	On	On	Off	DC000-DFFFF
	Off	Off	Off	On	E0000-E3FFF
	On	Off	Off	On	E4000-E7FFF
	Off	On	Off	On	E8000-EBFFF
	On	On	Off	On	EC000-EFFFF
	Off	Off	On	On	F0000-F3FFF
S5	On				3 Mb RAM
	Off				768K RAM
S6	On				RAM Bank enable
	Off				RAM Bank disable
S7	On				64K ROM
	Off				40K ROM
S8	On				10 MHz
	Off				4.77 MHz

SW4

Switch	Position	Function
S1	Colour	Colour display
	Mono	Mono display
JP1	In A	Disable display
	In B	Enable display

910

SW1

Switch	Position			Function
S1-3	**S1**	**S2**	**S3**	**Memory Size**
	Off	On	Off	256K
	Off	On	On	512K
	On	Off	On	640K
	Off	Off	On	1024K
S4	On			0 Wait State
	Off			1 Wait State

SW2

Switch	Position	Function					
S1-2	**EPROM**	**S1**	**S2**	**S5**	**S6**	**S7**	**S8**
5-8	27128	On	Off	On	Off	Off	On
	27256	On	Off	Off	On	Off	On
	27512	Off	On	Off	On	Off	On

Switch	Position	Function
S4	On	Colour Display
	Off	Mono Display
JP11	H	High System Speed
	N	Low System Speed

913

SW1

Switch	Function	Position			
S1-4	**EPROM**	**S1**	**S2**	**S3**	**S4**
	27128	On	Off	Off	On
	27256	On	Off	On	Off
	27512	Off	On	On	Off

SW2

Jumper	Position	Function
S1	Off	12 MHz
	On	8 MHz
S2	Off	Disable Floppy
	On	Enable Floppy
S3	Off	HD controller installed
	On	No HD controller
S4	Off	Disable COM 1 (3F8-3FF)
	On	Enable COM 1

SW3

Switch	Function	Position							
S1-8	**Display**	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**
	EGA	Off	On	On	Off	On	On	On	On
	CGA	Off	Off	Off	On	Off	On	On	On
	MGA	Off	Off	On	Off	Off	On	On	On

SW4

Switch	Function	Position		
S1-3	**Memory Size**	**S1**	**S2**	**S3**
	512K	On	On	On
	640K	Off	On	On
	512+512K	On	Off	On
	640+384K	Off	Off	On

915

As for System 913

915V

Jumper	Position	Function		
JA	A	Enable VGA		
	B	Disable VGA		
JB,C,D		**B**	**C**	**D**
	Disable COM 1	-	A	B
	Disable COM 2	-	B	B
	Disable HD	B	B	A
	Enable HD	A	A	A

1100LX

Jumper	*Position*	*Function*
JP1	In	512K ROM
	Out	256K ROM
JP2	In	Maths copro installed
	Out*	No maths copro
JP3	In	Reset system password
	Out*	System password disabled

1100/16

Switch	*Position*			*Function*				
S1-4	**EPROM**			**S1**	**S2**	**S3**	**S4**	**JP5**
JP5	27128			On	On	Off	Off	B
	27256			Off	Off	On	On	B
	27512			Off	Off	On	On	A
S5	On			CGA Display				
	Off			EGA, MGA, MDA Display				
S6	Off			20 MHz				
	On			SMART speed				
S7, JP9	**S7**	**JP9**		**Memory**				
	Off			640+1Mb+256				
	Off	A		640+3Mb+256				
S8	Off			RAM BIOS				
	On			ROM BIOS				
JP6,7,8	**JP6**	**JP7**	**JP8**	**Maths Copro**				
	A	A	B	There				
	B	B	A	Not there				

1120SX

Jumper	*Position*	*Function*
J1	In*	Detect add-On display and
	Out	Disable On-board VGA automatically
JP3	A*	Enable password check
	B	Bypass and clear existing password

1100/25

SW1

Switch	*Function*	*Position*			
S1-4	**EPROM**	**S1**	**S2**	**S3**	**S4**
	27128	On	Off	On	Off
	27256	On*	Off*	Off*	On
	27512	Off	On	Off	On
S5-8	**I/O recovery delay**	**S5**	**S6**	**S7**	**S8**
	0	Off	Off	Off	Off
	1	Off	Off	Off	On
	2	Off	Off	On	Off
	3	Off	Off	On	On
	4	Off	On	On	On
	5	Off	On	Off	On
	6	Off	On	On	Off
	8	On	Off	Off	Off
	9	On	Off	Off	On
	10	On	Off	On	Off
	11	On	Off	On	On
	12	On	On	Off	Off
	13	On	On	Off	On
	14	On	On	On	Off
	15	On	On	On	On

SW2

Switch	*Position*			*Function*				
S1	On*			25-pin=COM1, 9-pin=COM2				
	Off			9-pin=COM1, 25-pin=COM2				
S2	Off*			Enable COM1				
	On			Disable COM1				
S3	Off*			Enable COM2				
	On			Disable COM2				
S4	Off*			Enable Printer Port				
	On			Disable Printer Port				
S5-7	**Printer Port**			**S5**	**S6**	**S7**		
	LPT1			Off*	Off*	On*		
	LPT2			On	On	Off		
S8	Off*			Shadow RAM enabled				
	On			Shadow RAM disabled				
S9	Off*			Primary display Mono or extended				
	On			Primary display CGA				
S10	Off*			DRAM Bank B enabled				
	On			DRAM Bank B disabled				
JP6-8	**JP6**	**JP7**	**JP8**	**Maths Copro**				
	1-2	1-2	1-2	There				
	2-3*	2-3*	2-3*	Not there				
JP12	1-2*			Remap 256K to FA0000-FDFFFF				
	2-3			Do not remap or permit RAM cacheing of F00000-FFFFFF				
JP13-16	**RAM**	**Bank**		**Modules**	**JP13**	**JP14**	**JP15**	**JP16**

Switch	*Position*		*Function*				
	2 Mb	A	512 x 9	2-3*	2-3*	1-2*	1-2*
	4 Mb	A&B	512 x 9	2-3	2-3	1-2	1-2
	6 Mb	A	512 x 9	1-2	1-2	1-2	1-2
		B	1M x 9				
	4 Mb	A	1M x 9	1-2	1-2	2-3	2-3
	8 Mb	A&B	1M x 9	1-2	1-2	2-3	2-3

1100/33

As for 1100/25

1120C

As for 1100/25

1133T

Jumper	*Position*	*Function*	
J4	In*	Setup accessible	
	Out	Setup inaccessible	
J6	1-2*	Normal CMOS state	
	2-3	Discharge CMOS	
JA1	32K cache	5-6	
	64K cache	1-2*	5-6*
	128K cache	1-2	4-5

1170

Jumper	*Position*			*Function*
JP1-3	**JP1**	**JP2**	**JP3**	**Tuning write timing**
	Out*	Out	Out*	Open
	In	In*	In	Close
JP4	1-2			27512 EPROM
	2-3*			27256 EPROM
JP5	1-2*			Enable I/O recovery
	2-3			Disable I/O recovery
JP6	Out			Disable Parity Check
	In*			Normal parity operation
JP7				UPS interface
JP8	1-2			INIT directly connected to onboard controller
	2-3*			INIT pass through buffer
JP9	1-2*			Enable power-on password in setup
	2-3			Disable power-on password in setup
JP10	1-2			DMA timing low speed
	2-3*			DMA timing 25 MHz

Daughterboard

Jumper	*Position*	*Function*
JP1	1-2*	TCR always high

Jumper	*Position*	*Function*
	2-3	TCR connects 486 to system board
JP2	1-2	WRDYIN signal
	2-3*	Cascade JP3-2
JP3	1-2*	80486 RDY signal
	2-3	80486 B13 not connected

1172

Jumper	Position	Function
JP3	On*	Keyboard and reset button active
	Off	Keyboard and reset button locked
JP5	1-2*	80486/7 in socket B
	2-3	80486SX in socket B
JP15	1-2	27512 EPROM
	2-3*	27256 EPROM
JP18	On	Discharge CMOS
	Off*	Normal
JP22	1-2	Other Acer display card (Normal VGA)
	2-3*	ATI Onboard display (faster VGA performance)
JP71	1-2*	16-bit ROM
	2-3	8-bit ROM
S1	On*	Enable Floppy
	Off	Disable Floppy
S2	On*	Enable HD controller
	Off	Disable HD controller
S3	On*	Enable COM1
	Off	Disable COM1
S4	On*	Enable COM2
	Off	Disable COM2
S5	On*	Enable LPT1
	Off	Disable LPT1
S6	On*	Reserve 15-16 Mb for system
	Off	Enable add-On card
S7	On*	Enable reset function
	Off	Disable reset function
S8	On*	Enable password security
	Off	Disable password security

1200

Jumper	*Position*	*Function*
JP1,4	1-2	Indicate hardware errors in Intel chipset (EBC and ISP)
JP2	1-2*	512/256K EPROM
	2-3	128K EPROM
JP3	2-3*	128/256K EPROM
	1-2	512K EPROM
JPX2	1-2	Page miss; for debugging only
	2-3*	Detect page hit or miss
JPX3	1-2	Forces CHHIT high for cache miss; debugging only
	2-3*	Detect cache hit or miss (CHHIT low if hit)
JPX4	2-3*	Fast CPU reset

Jumper	*Position*	*Function*
	1-2	Normal CPU reset
JPX5	1-2*	9 ns RAS delay
	2-3	20 ns RAS delay
JPX6	1-2*	Enable password security
	2-3	Disable password security
JPX7	1-2	CLK1
	2-3	DCLK; debugging only

1733

Jumper	*Position*		*Function*	
JP1			UPS sense signal input	
JP2	1-2		No reset	
	2-3*		Fast RC reset	
JP3,4	**JP3**	**JP4**	**MB Clock**	
	Out	Out	Disconnect	
	In*	In*	Connect	
JP5	In*		3 BCLK I/O recovery time	
	Out		1 BCLK I/O recovery time	
JP6			External speaker	
JP7	1-2		External speaker	
	2-3		Onboard buzzer	
JP8	In*		Dual Bus arbitration	
	Out		Single Bus arbitration	
TP1	1-2*		Normal LCS	
	2-3		Delayed LCS	
J4	1-2		Latched IRQ INTR	
	2-3*		Unlatch INTR	
J5,6	**CPU type**		**J5**	**J6**
	80486 33		Out*	In*
	80386 33		In	Out
J7,8			Reserved	
J9	1-2		Show OEM BIOS message	
	2-3*		Show Acer BIOS message	
S1	On*		System security bypassed	
	Off		Not bypassed	
S2	On*		Enable reset function	
	Off		Disable reset function	
S3	On		CPU 64 bit bus (486/33, 50)	
	Off		CPU 32 bit bus (486SX, 386)	

1933T

Jumper	*Position*	*Function*
J1		Keyboard/mouse connector
J2	1-2	33 MHz CPU speed
J3	1-2	
J4	1-2*	486DX
	2-3	486SX
JP4	In	Discharge battery, erase CMOS
	Out	Charge battery

Jumper	*Position*	*Function*
JP6		UPS connector
JY2	In*	Enable system security setup
	Out	Disable system security setup
JY5	2-3*	For chipup CPU
JN4	In*	Enable reset switch
	Out	Disable reset switch
SW1		Reserved

3000SP33

Jumper	*Position*	*Function*
JP1	1-2	UPS present
	2-3	UPS not present
JP2	1-2*	Enable password security
	2-3	Disable password security
JP3	1-2*	512/256K EPROM
	2-3	128K EPROM
JP4	1-2	512K EPROM
	2-3*	256/128K EPROM
JP5	1-2*	I/O recovery time added
	2-3	No /O recovery time added
JP6	1-2*	Latched interrupt
	2-3	Unlatched interrupt
JP9	1-2	25 MHz CPU (Acer 1200/25)
	2-3	33 MHz CPU (Acerframe 3000SP33)
JP10	1-2	Disable page hit cycle (for diags)
	2-3	Enable page hit cycle (normal ops)
JP11	1-2	Cache hit cycle disabled (diags)
	2-3	Cache hit cycle enabled (normal ops)
JP13	1-2	Speaker on JP14
	2-3	On board buzzer

Daughterboard

Jumper	*Position*	*Function*
JP1	1-2	CPU read 4167 with 0 wait state
	2-3*	CPU read 4167 with 1 wait state
JP2	1-2	WRDY: system board ready
	2-3*	WRDY1#: cascade to JP3
JP3	1-2*	RDY: i486 ready
	2-3	Reserved – do not use

M3

Jumper	*Position*	*Function*
JP1	1-2	Check password
	2-3	Bypass
JP2	Open	Disable reset button
	Closed	Enable
JP3	1-2	Acer BIOS

Jumper	*Position*	*Function*
	2-3	OEM
JP4	1-2	128 or 256 byte RTC NVRAM
	2-3	4K, reserved
JP6	1-2	Buzzer
	2-3	Speaker

Ali CPU Board (3.3v)

PCB 94414-1. Max 133 MHz. As for M5

Pentium CPU Board

PCB 94323-1

Jumper	Position	Function
JP1	1-2	Pentium 90
	2-3	Reserved

M3A

Jumper	*Position*			*Function*
JP1	1-2			Acer BIOS logo
	2-3			No logo
JP2	1-2			Check password
	2-3			Bypass
JP3	1-2			Buzzer
	2-3			Speaker
JP4-6	**JP4**	**JP5**	**JP6**	**CPU frequency**
	2-3	1-2,4-5	2-3	75 MHz
	2-3	1-2,3-4	2-3	90 MHz
	2-3	2-3,4-5	2-3	100 MHz
	2-3	1-2,3-4	1-2	120 MHz
	2-3	2-3,4-5	1-2	133 MHz
	1-2	1-2,3-4	1-2	150 MHz
	1-2	2-3,4-5	1-2	166 MHz
	1-2	2-3,4-5	2-3	200 MHz
JP7-9	1-2			P54C
	2-3			P55C
JP3 (?)	1-2			256K cache
	2-3			512K cache
JP10	1-2			Enable SMM switch
	2-3			Enable reset switch (e.g. normal power supply)
	3-4			Additional reset switch
JP11	1-2			CPU VR voltage (3.3-3.46v)
	2-3			CPU VRE voltage (3.45-3.6v)

M5

Dual Pentium

Jumper	*Position*	*Function*
JP1	1-2	Acer BIOS logo

Jumper	*Position*	*Function*
	2-3	OEM logo
JP2	1-2	Check password
	2-3	Bypass
JP3	1-2	DREQ1
	2-3	DREQ3
JP4	1-2	DACK1
	2-3	DACK3
JP5	Open	Disable reset button
	Short	Enable
JP6	1-2	Buzzer
	2-3	Speaker

CPU/Memory Board

PCB 93404-1. Max 133 MHz

Jumper	*Position*			*Function*
JP1,13	**JP1**	**JP13**		**Cache size**
	1-2	2-3		256K
	2-3	1-2		512K
JP2	1-2			3/2 bus core ratio
	2-3			2/1
JP12,14,15	**JP12**	**JP14**	**JP15**	**SRAM**
	1-2	Short	Short	Standard
	2-3	Open	Open	Synchronous
JP17,18	**JP17**	**JP18**		**SRAM**
	Short	Short		Standard
	1-1	2-2		Synchronous (1 of 17,18, 2 of 17,18)

CPU/Memory Board

PCB 93404-2. Max 166 MHz

Jumper	*Position*			*Function*
JP1,13	**JP1**	**JP13**		**Cache size**
	1-2	2-3		256K
	2-3	1-2		512K
JP2,3	**JP2**	**JP3**		**Bus core ratio**
	1-2	1-2		3/2
	2-3	1-2		2/1
	2-3	2-3		5/2
JP12,14,15	**JP12**	**JP14**	**JP15**	**SRAM**
	1-2	Short	Short	Standard
	2-3	Open	Open	Synchronous
JP17,18	**JP17**	**JP18**		**SRAM**
	Short	Short		Standard
	1-1	2-2		Synchronous (1 of 17,18, 2 of 17,18)

Ali CPU Board (3.3v)

PCB 94414-1. Max 133 MHz

Jumper	*Position*	*Function*
JP1	Open	50 MHz host clock

Jumper	*Position*		*Function*
	1-2		60 MHz
	2-3		66 MHz
JP2	Open		Reserved
JP4	1-2		CPU VR voltage (3.3-3.46v)
	2-3		CPU VRE voltage (3.45-3.6v)
JP5,7	**JP5**	**JP7**	**L2 Cache size**
	1-2	1-2	256K
	2-3	2-3	1Mb
JP6	2-3		Reserved
JP8	Closed		2/1 bus core ratio
	Open		3/2

Ali CPU Board (3.3v)

PCB 94414-2. Max 166 MHz

Jumper	*Position*		*Function*
JP1	Open		50 MHz host clock
	1-2		60 MHz
	2-3		66 MHz
JP2	Open		Reserved
JP4	1-2		CPU VR voltage (3.3-3.46v)
	2-3		CPU VRE voltage (3.45-3.6v)
JP5,7	**JP5**	**JP7**	**L2 Cache size**
	1-2	1-2	256K
	2-3	2-3	1Mb
JP6	2-3		Reserved
JP8	Closed		2/1 bus core ratio
	Open		3/2
	(?)		5/2

M7

Jumper	*Position*			*Function*
JP1	1-2			CPU VR voltage (3.3-3.46v)
	2-3			CPU VRE voltage (3.45-3.6v)
JP2	1-2			SCSI terminator on
	2-3			Software settings
JP3	1-2			256K cache
	2-3			512K cache
JP4-5,7	**JP4**	**JP5**	**JP7**	**CPU frequency**
	2-3	2-3	1-2	75 MHz
	2-3	2-3	2-3	90 MHz
	2-3	2-3	3-4	100 MHz
	2-3	1-2	2-3	120 MHz
	2-3	1-2	3-4	133 MHz
	1-2	1-2	2-3	150 MHz
	1-2	1-2	3-4	166 MHz
	1-2	2-3	3-4	200 MHz
JP6	1-2			16-bit (Wide) SCSI
	2-3			8-bit
JP8	1-2			Acer BIOS logo

Jumper	*Position*	*Function*
	2-3	No logo
JP9	1-2	Check password
	2-3	Bypass
JP10	1-2	Buzzer
	2-3	Speaker
JP11	1-2	Front panel reset enabled
JP12	2-3	256K BIOS enabled (fixed setting)
CN16	1-2	Keylock
	3-5	Power LED
	7-10	Speaker
	12-13	Green (Turbo)LED
	15-17	Turbo switch
	19-20	Reset

M9B

Jumper	*Position*	*Function*
JP1	1-2	Check password
	2-3	Bypass
JP2	1-2	Acer BIOS logo
	2-3	OEM
JP3	1-2	SCSI terminator on
	2-3	BIOS settings
JP4	1-2	Wide SCSI
	2-3	Narrow SCSI
JP5	1-2	Enable hardware reset
JP6	1-2	Buzzer
	2-3	Speaker

CPU/Memory Board

Jumper	*Position*				*Function*
CN1	1-5,2-6,3-7,4-8				2x CPU
	1-5,2-6,4-8				3x
	1-5,2-6,3-7				4x
	1-5,2-6				2.5x
	2-6,4-8				3.5x
CN2 (CPU 1)	**1-5**	**2-6**	**3-7**	**4-8**	**CPU 1 & 2 Voltage**
CN3 (CPU 2)	Short	Short	Short	Short	3.5v
	Short	Short	Short	Open	3.4v
	Short	Short	Open	Short	3.3v
	Short	Short	Open	Open	3.2v
	Short	Open	Short	Short	3.1v
	Short	Open	Short	Open	3v
	Short	Open	Open	Short	2.9v
	Short	Open	Open	Open	2.8v
	Open	Short	Short	Short	2.7v
	Open	Short	Short	Open	2.6v
	Open	Short	Open	Short	2.5v
	Open	Short	Open	Open	2.4v
	Open	Open	Short	Short	2.3v
	Open	Open	Short	Open	2.2v

Jumper	Position				Function
	Open	Open	Open	Short	2.1v
	Open	Open	Open	Open	No CPU
J16	1-2				66 MHz host clock
	2-3				60 MHz

M9N

Jumper	Position	Function
JP1	1-2	Enable software control for CN4 (power supply)
	2-3	Disable
JP2	1-2	Branded BIOS type
	2-3	Generic
JP3	1-2	Check password
	2-3	Bypass
JP4	1-2	SCSI Channel 1 High-byte termination always on
	2-3	Software control
	Open	Off
JP5	1-2	Normal (Auto VGA)
	2-3	Disable onboard VGA

CPU/Memory Board

Jumper	Position	Function
JP1	1-2,3-4,5-6,7-8	2x CPU
	1-2,3-4,7-8	3x
	1-2,3-4,5-6	4x
	1-2,3-4	2.5x
	1-2,7-8	3.5x
JP2	1-2	ITP CPU 1
	2-3	ITP CPU 2
JP5	1-2	66 MHz Host bus
	2-3	60 MHz

M11A

Pentium Pro

Jumper	Position	Function
J4	1-2	128K Flash ROM
	2-3	256K Flash ROM
J5	1-2	Check password
	2-3	Bypass
J6	Open	Narrow SCSI
	1-2	Wide SCSI
J9	1-2	60 MHz host clock
	2-3	66 MHz
J10	Open	SCSI terminator off
	1-2	On
	2-3	BIOS settings
J13	1-2	Buzzer
	2-3	Speaker
CN13	1-5,2-6,3-7,4-8	2x CPU

Jumper	Position				Function
	1-5,2-6,4-8				3x
	1-5,2-6,3-7				4x
	1-5,2-6				5x
	2-6,3-7,4-8				2.5x
	2-6,4-8				3.5x
CN14	**1-5**	**2-6**	**3-7**	**4-8**	**CPU Voltage**
	Short	Short	Short	Short	3.5v
	Short	Short	Short	Open	3.4v
	Short	Short	Open	Short	3.3v
	Short	Short	Open	Open	3.2v
	Short	Open	Short	Short	3.1v
	Short	Open	Short	Open	3v
	Short	Open	Open	Short	2.9v
	Short	Open	Open	Open	2.8v
	Open	Short	Short	Short	2.7v
	Open	Short	Short	Open	2.6v
	Open	Short	Open	Short	2.5v
	Open	Short	Open	Open	2.4v
	Open	Open	Short	Short	2.3v
	Open	Open	Short	Open	2.2v
	Open	Open	Open	Short	2.1v
JMP1	1-2				Reset
	2-3				Enable SMM

V12LC

Switch	Position	Function
JP1	1-2	Acer BIOS
	2-3	OEM
JP2	1-2	Check password
	2-3	Bypass
JP3	1-2	Flash ROM
	2-3	EPROM
JP4,5	1-2	ECP DMA1 using DRQ1 and DACK1
	2-3	ECP DMA3 using DRQ3 and DACK3
JP6	1-2	Disable onboard I/O
JP7	1-2	Disable onbaord VGA
JP8	1-4	50 MHz host clock
	2-5	60 MHz host clock
	3-6	66 MHz host clock
JP9	1-2	Disable EIDE
	2-3	Enable
JP11	1-2	No delay for M1451
	2-3	Delay ADS# by 1 CPU clock cycle
JP12	1-2	P54C or K5
	2-3	Cyrix M1
JP13	1-2	3.38v CPU
	2-3	3.52v CPU
JP14	1-2	3/2 clock frequency
	2-3	2/1
JP15	1-2	Reset switch in suspend mode
	2-3	As reset switch

Switch	Position	Function
CN6	1-2	Keylock
	3-5	Power LED
	7-10	Speaker
	12-13	Green mode
	15-18	Turbo
	19-20	Reset

V12LC-2X

Switch	Position		Function		
JP1	1-2		Acer BIOS		
	2-3		OEM		
JP2	1-2		Check password		
	2-3		Bypass		
JP3	Open		SST 29EE010 BIOS ROM		
	1-2		EPROM		
	2-3		Flash ROM (Intel 28F010, 28F001, 28F101)		
JP6	1-2		Disable onboard I/O		
JP8	1-4		50 MHz host clock		
	2-5		60 MHz host clock		
	3-6		66 MHz host clock		
JP12	1-2		P54C or K5		
	2-3		Cyrix M1		
JP13	1-2		3.38v CPU		
	2-3		3.52v CPU		
JP14,18	**JP14**	**JP18**	**Intel**	**M1/K5**	**Clock Ratio**
	1-2	1-2	3/2	3/2,2/2,3/1	
	2-3	1-2	2/1	1/1	
	1-2	2-3	3/1	3/2,2/2,3/1	
	2-3	2-3	5/2	1/1	
JP15	1-2		Reset switch in suspend mode		
	2-3		As reset switch		
JP16,17	1-2		CN1 as feature connector		
	2-3		CN1 as 12C interface		
JP19	Open		Reserved (HD LED)		
JP20	1-2		Programming boot block		
	2-3		Normal		
CN6	1-2		Keylock		
	3-5		Power LED		
	7-10		Speaker		
	12-13		Green mode		
	15-18		Turbo		
	19-20		Reset		

V20

Switch	Position	Function
JP1	1-2	Check password
	2-3	Bypass
JP2	1-2	Acer BIOS
	2-3	OEM

Switch	*Position*		*Function*
JP3	3-4		Reserved
JP4	1-2,3-4,5-6		Reserved
JP6	2-3		Reserved
JP7	2-3		Reserved
JP8	1-2		Enable M5115
	2-3		Disable
JP10	1-2		Reserved
JP9,20	**JP9**	**JP20**	**CPU Type**
	1-2	2-3	P24D/P24T (Overdrive)
	2-3	1-2	486-S
JP11	1-2		Local IDE I/O address 0FXH
	2-3		Local IDE I/O address 07XH
JP12	1-2		Disable local IDE
	2-3		Enable
JP22	1-2		DX4 3x
	2-3		2.5x
	3-4		2x
JP23	1-2		Enable reset button
	2-3		Disable
JP24	1-2		Reset becomes Suspend
	2-3		Normal

CPU	JP17	JP21	JP26	JP27
25 MHz	1-5	2-3	1-2	1-2
33 MHz	2-6	2-3	1-2	1-2
50 MHz	1-5	2-3	1-2	1-2
66 MHz	2-6	2-3	1-2	1-2
100 MHz	2-6	2-3	1-2	1-2
Am 66 MHz	2-6	2-3	2-3	2-3
Am 100 MHz	2-6	2-3	2-3	2-3

V30-1

Switch	*Position*			*Function*
JP1	Open			Reserved
JP2	Open			LPT Normal
	Closed			LPT ECP
JP3	1-2			DRQ3 for LPT ECP
	2-3			DRQ1
JP4	1-2			DACK3 for LPT ECP
	2-3			DACK1
JP5	Open			Disable PS/2 mouse (IRQ 12)
	Closed			Enable
JP6	1-2			Enable SMC 665
JP7	1-2			Check password
	2-3			Bypass
JP9	Closed			Reserved
JP10	Closed			Reserved
JP11,13	**JP11**	**JP13**	**CN13**	**CPU Frequency**
CN13	1-2	1-2	1-4,2-5	75 MHz

Switch	*Position*			*Function*
	2-3	1-2	1-4,3-6	90 MHz
	2-3	1-2	2-5	100 MHz
	2-3	2-3	1-4,3-6	120 MHz
	2-3	2-3	2-5	133 MHz
JP12	2-3			Reserved
JP15	1-2			Clear RTC
	2-3			Normal
JP16	1-2NetWare 3x has 5 areas			Reserved
JP17	Open			Reserved
JP19	Closed			Reserved
JX21	1-2			VR or standard CPU (3.3v)
	2-3			VRE CPU (3.6v)
CN16	1-2			Keylock
	3-5			Power LED
	7-10			Speaker
	12-13			Green mode
	15-18			Turbo
	19-20			Reset

V30-2

Switch	*Position*	*Function*
JP1	Open	Reserved
JP2	Open	LPT Normal
	Closed	LPT ECP
JP3	1-2	DRQ3 for LPT ECP
	2-3	DRQ1
JP4	1-2	DACK3 for LPT ECP
	2-3	DACK1
JP5	Open	Disable PS/2 mouse (IRQ 12)
	Closed	Enable
JP6	1-2	Enable SMC 665
	2-3	Disable
JP7	1-2	Check password
	2-3	Bypass
JP8	1-2	Acer BIOS
	2-3	OEM
JP9	Open	Reserved
JP10	1-2	Reserved
JP11	Open	Reserved
JP12	1-2	Reserved
JP15	1-2	Clear RTC
JP18	1-2	Reserved
JP19	Open	Reserved
JP22	Closed	Reserved
JP20	1-2	VR or standard CPU (3.3v)
	2-3	VRE CPU (3.6v)
CN16	1-2	Keylock
	3-5	Power LED
	7-10	Speaker
	12-13	Green mode

Switch	*Position*	*Function*
	15-18	Turbo
	19-20	Reset

CPU	JP13	JP14	JP15	CN12
75 MHz	1-2	1-2	1-2	1-3,2-4
90 MHz	2-3	1-2	1-2	1-3
100 MHz	2-3	1-2	1-2	2-4
120 MHz	2-3	1-2	2-3	1-3
133 MHz	2-3	1-2	2-3	2-4
150 MHz	2-3	2-3	2-3	1-3
166 MHz	2-3	2-3	2-3	2-4

V35

Switch	*Position*	*Function*
JP1	1-2	Check password
	2-3	Bypass
JP3	1-2	64 Mb cacheable memory
	2-3	512 Mb
JP5	1-2	3.3v CPU
	2-3	3.6v CPU
JP7	1-2	Disable L2 cache
	2-3	256K
JP10	1-2	Enable SMI switch
	2-3	Enable reset switch
CN16	1-2	Keylock
	3-5	Power LED
	7-10	Speaker
	12-13	Green mode
	15-18	Turbo
	19-20	Reset

CPU	JP4	JP8	JP9	CN12
75 MHz	1-2	1-2	1-2	1-3,2-4
90 MHz	2-3	1-2	1-2	2-4
100 MHz	2-3	1-2	1-2	1-3
120 MHz	2-3	2-3	1-2	2-4
133 MHz	2-3	2-3	1-2	1-3
150 MHz	2-3	2-3	2-3	2-4
166 MHz	2-3	2-3	2-3	1-3
200 MHz	2-3	1-2	2-3	1-3

V35N

Switch	*Position*			*Function*
CN10,	**CN10**	**CN11**	**CNX1**	**CPU Type**
11,X1	1-3,2-4	1-3,2-4	Open	P54C
	Open	Open	1-5,2-6,3-7,4-8	P55C
JP1	1-2			Check password

Switch	*Position*	*Function*
	2-3	Bypass
JP2	1-2	Acer BIOS logo
	2-3	OEM
JP3	1-2	64 Mb cacheable memory
	2-3	512 Mb
JP5	1-2	3.3v CPU
	2-3	3.6v CPU
JP6	1-2	60 MHz DRAM refresh rate
	2-3	66 MHz
JP7	1-2	Disable L2 cache
	2-3	256K
JP10	1-2	Enable SMI switch
	2-3	Enable reset switch
CN16	1-2	Keylock
	3-5	Power LED
	7-10	Speaker
	12-13	Green mode
	15-18	Turbo
	19-20	Reset

CPU	JP4	JP5	JP8	JP9	CN12
75 MHz	1-2	1-2	1-2	1-2	1-3,2-4
90 MHz	2-3	1-2	1-2	1-2	2-4
100 MHz	2-3	2-3	1-2	1-2	1-3
120 MHz	2-3	1-2	2-3	1-2	2-4
133 MHz	2-3	2-3	2-3	1-2	1-3
150 MHz	2-3	1-2	2-3	2-3	2-4
166 MHz	2-3	2-3	2-3	2-3	1-3
200 MHz	2-3	2-3	1-2	2-3	1-3
233 MHz	2-3	2-3	1-2	1-2	1-3

V50LA-N

Switch	*Position*		*Function*
JP2	1-2		Acer BIOS logo
	2-3		OEM
JP3	1-2		Check password
	2-3		Bypass
JP4	1-2		Enable Flash ROM boot block
	2-3		Disable
JP5	1-2		Reserved
	2-3		Flash ROM (Intel 28F001)
	3-4		Flash ROM (SST, Winbond 29EE010)
JP6	1-4		50 MHz host clock
	2-5		60 MHz
	3-6		66 MHz
JP7,8	JP7	JP8	L2 cache
	1-2	1-2	256K
	1-2	2-3	512K
	2-3	2-3	1 Mb
JP9	1-2		P54C or K5

Switch	*Position*		*Function*		
	2-3		Cyrix M1		
JP10,11	**JP10**	**JP11**	**Intel**	**M1/K5**	**Clock Ratio**
	1-2	1-2	3/2	3/1	
	1-2	2-3	2/1	2/1	
	2-3	1-2	3/1		
	2-3	2-3	5/2		
JP12	1-2		3.38v CPU		
	2-3		3.52v CPU		
CN16	1-2		Keylock		
	3-5		Power LED		
	7-10		Speaker		
	12-13		Green mode		
	15-18		Turbo		
	19-20		Reset		

V55-2

Switch	*Position*		*Function*
SW1-2	**SW1**	**SW2**	**CPU Clock Ratio**
	On	Off	3x
	On	On	2.5x
	Off	On	2x
	Off	Off	1.5x
SW3-4	**SW3**	**SW4**	**Host bus clock**
	On	Off	66 MHz
	Off	On	60 MHz
	On	On	50 MHz
JP4	1-2		EPROM
	2-3		Flash ROM
JP5	1-2		NC ROM
	2-3		29EE010
	3-4		28F001
JP6	1-2		3.2v CPU core
	2-3		2.8v (P55C)
JP7	1-2		3.5v CPU I/O voltage
	2-3		3.3v
JP8,9	1-2		512K cache
	2-3		256K cache
JP10	2-3		Reserved
JP11	Open		Normal
	Closed		Clear CMOS (No jumper, just short pads)
CN16	1-2		Keylock
	3-5		Power LED
	7-10		Speaker
	12-13		Green mode
	15-18		Turbo
	19-20		Reset

V55LA

Jumper	*Position*	*Function*

Jumper	*Position*		*Function*		
SW2/1-2	**1**	**2**	**Host clock frequency**		
	On	On	50 MHz		
	On	Off	60 MHz		
	Off	On	66 MHz		
SW2/3-4	**3**	**4**	**Intel**	**M1**	**K5 Clock Ratio**
	On	On	5/2	1/1	2/1
	Off	Off	3/2	3/1	3/2
	On	Off	2/1	2/1	-
	Off	On	3/1	4/1	-
SW2/5	On		Disable onboard sound		
	Off		Enable		
SW2/6	On		Bypass password		
	Off		Check password		
JP1	1-2		Acer BIOS		
	2-3		OEM		
JP2	1-2		LED for IDE and FDD		
	2-3		IDE only		
JP3,4	**JP3**	**JP4**	**Cache size**		
	1-2	1-2	256K		
	1-2	2-3	512K		
	2-3	2-3	1 Mb		
JP5	1-2		Allow boot block programming		
	2-3		Normal		
JP6	1-2		Flash ROM (28F010)		
	2-3		EPROM		
	Open		Block Flash EPROM (SST 29EE010)		
JP7	Closed		Single voltage CPU		
	Open		Dual voltage		
JP11	1-2		SMM switch		
	2-3		Reset switch		
	3-4		Additional reset switch		
JP16	1-2		UPS enabled for software shutdown		
	2-3		Disabled		
JP42	1-2		L2 cache Intel/M1 1+4 mode		
	2-3		L2 cache M1 Linear Burst mode		
JP43	1-2		3.5v CPU I/O voltage		
	2-3		3.3v		
JP44	1-2		2.5v CPU core voltage		
	2-3		2.8v		
CN19	1-2		Keylock		
	3-5		Power LED		
	7-10		Speaker		
	12-13		Green mode		
	15-18		Turbo		
	19-20		Reset		

V55LA-2

Jumper	*Position*				*Function*
SW2/1-4	**1**	**2**	**3**	**4**	**CPU Frequency**
Intel	On	On	Off	Off	75 MHz
	On	Off	Off	Off	90 MHz

Jumper	*Position*				*Function*
	Off	On	Off	Off	100 MHz
	On	Off	On	Off	120 MHz
	Off	On	On	Off	133 MHz
	On	Off	On	On	150 MHz
	Off	On	On	On	166 MHz
	Off	On	Off	On	200 MHz
Cyrix/IBM	On	On	On	Off	P120+
M1	On	Off	On	Off	P150+
	Off	On	On	Off	P166+
Cyrix	Off	On	On	On	PR166
M2	On	Off	Off	On	PR180
	Off	On	Off	On	PR200
AMD K5	On	On	Off	Off	PR75
	On	Off	Off	Off	PR90
	Off	On	Off	Off	PR100
	On	Off	On	Off	PR120
	Off	On	On	Off	PR133
	Off	On	On	On	PR166
AMD K6	Off	On	On	On	PR166
	Off	On	Off	On	PR200
	Off	On	Off	Off	PR233
SW2/5	On				Disable onbaord sound
SW2/6	On				Bypass password
	Off				Check password
JP1	1-2				Acer BIOS
	2-3				OEM
JP2	1-2				LED for IDE and FDD
	2-3				IDE only
JP3,4	**JP3**	**JP4**			**Cache size**
	1-2	1-2			256K
	1-2	2-3			512K
	2-3	2-3			1 Mb
JP7	Closed				Single voltage CPU
	Open				Dual voltage
JP11	1-2				SMM switch
	2-3				Reset switch
	3-4				Additional reset switch
JP16	1-2				UPS enabled for software shutdown
	2-3				Disabled
JP43	1-2				3.5v CPU I/O voltage
	2-3				3.3v
JP44	1-2				2.5v CPU core voltage
	2-3				2.8v
CN19	1-2				Keylock
	3-5				Power LED
	7-10				Speaker
	12-13				Green mode
	15-18				Turbo
	19-20				Reset

V56LA

Jumper	Position						Function
JP8-9	**JP8**	**JP9**	**JP13**	**JP14**	**JP15**	**JP17**	**CPU Frequency**
JP13-15	3-6	On	1-2	1-2	1-2	1-2	100 MHz
JP17	2-5	On	1-2	1-2	1-2	2-3	120 MHz
Intel	3-6	On	1-2	1-2	1-2	1-2	133 MHz
	2-5	On	1-2	1-2	2-3	2-3	150 MHz
	3-6	On	1-2	1-2	2-3	2-3	166 MHz
	3-6	On	1-2	1-2	2-3	1-2	200 MHz
Intel	3-6	Off	1-2	1-2	2-3	2-3	166 MHz
MMX	3-6	Off	1-2	1-2	2-3	1-2	200 MHz
Cyrix 6x86	1-4	On	1-2	1-2	2-3	2-3	P120+
	2-5	On	1-2	1-2	2-3	2-3	P150+
	3-6	On	1-2	1-2	2-3	2-3	P166+
Cyrix 6x86L	1-4	Off	1-2	1-2	2-3	2-3	P120+
	2-5	Off	1-2	1-2	2-3	2-3	P150+
	3-6	Off	1-2	1-2	2-3	2-3	P166+
AMD K5	2-5	On	1-2	1-2	1-2	1-2	PR120
	3-6	On	1-2	1-2	1-2	1-2	PR133
AMD K6	2-5	On	1-2	1-2	1-2	2-3	PR150
	3-6	On	2-3	2-3	2-3	2-3	PR166
JP1	1-2						Disable VGA
	2-3						Enable
JP3	1-2						Acer BIOS
	2-3						OEM
JP4	1-2						Check password
	2-3						Bypass
JP6	1-2						256K cache
	2-3						512K cache
JP7	1-2						1 Mb BIOS ROM
	2-3						2 Mb BIOS ROM
JP16	1-2						L2 cache Interleave mode
	2-3						L2 cache Linear Burst mode
JP18	1-2						CN20 LED for IDE and FDD
	2-3						IDE only
JP19	1-2						19-20 of CN17 suspend/resume
	2-3						As reset button
JP20	1-2						UPS enabled (CN21)
	2-3						Disabled
JP3001	2-3						Reserved
CN19	1-2						Keylock
	3-5						Power LED
	7-10						Speaker
	12-13						Green mode
	15-18						Turbo
	19-20						Reset

V58-1X

Jumper	Position					Function
S1-3	**JP14**	**JP15**	**S1**	**S2**	**S3**	**CPU Frequency**
JP14,15	1-3,2-4	3-5,4-6	Off	Off	Off	90 MHz

Jumper	*Position*					*Function*
Intel	3-5,4-6	3-5,4-6	Off	Off	Off	100 MHz
	1-3,2-4	3-5,4-6	On	Off	Off	120 MHz
	3-5,4-6	3-5,4-6	On	Off	Off	133 MHz
	1-3,2-4	3-5,4-6	On	On	Off	150 MHz
	3-5,4-6	3-5,4-6	On	On	Off	166 MHz
	3-5,4-6	3-5,4-6	Off	On	Off	200 MHz
	3-5,4-6	3-5,4-6	Off	Off	Off	233 MHz
Cyrix 6x86	1-3,2-4	3-5,4-6	On	Off	Off	P150+
	3-5,4-6	3-5,4-6	On	Off	Off	P166+
Cyrix M2	3-5,4-6	3-5,4-6	On	On	Off	PR166
	1-3,2-4	3-5,4-6	Off	On	Off	PR180
	3-5,4-6	3-5,4-6	Off	On	Off	PR200
AMD K6	3-5,4-6	3-5,4-6	3-5,4-6	On	On	PR166
	3-5,4-6	3-5,4-6	3-5,4-6	On	Off	PR200
	3-5,4-6	3-5,4-6	3-5,4-6	Off	Off	PR233
S4	On					Check password
	Off					Bypass
JP1,15	JP1	JP15				Power supply type
	1-3,2-4	1-2				Traditional power supply
	3-5,4-6	2-3				Resume power supply
JP2	1-2					LED for IDE & FDD
	2-3					IDE only
JP4	1-2					L2 cache Interleave/1+4 mode
	2-3					L2 cache Linear Burst mode
JP5	1-2					12v for MXIC BIOS program
	2-3					5v for SST, ATMEL
	3-4					Reserved
JP6	2-3					Reserved
JP7	1-2					Monitor 3.2v CPU core voltage
	3-4					Monitor 2.9v CPU core voltage
	5-6					Monitor 2.8v CPU core voltage
JP8	1-3,2-4					Dual voltage CPU (P55C, K6, 6x86L)
	3-5,4-6					Single voltage CPU
JP9	1-2					Monitor 3.5v CPU I/O voltage
	3-4					Monitor 3.3v CPU I/O voltage
JP10	2-3					Reserved
JP11	1-2					3.3v CPU core voltage
	3-4					2.8v
	5-6					2.9v
	7-8					3.2v
	9-10					3.5v
	11-12					2.1v
	13-14					Reserved

V58LA

Jumper	*Position*					*Function*
S1/4,5	**JP14**	**JP15**	**CN23**	**S1/4**	**S1/5**	**CPU Frequency**
JP14,15	1-3,2-4	1-3,2-4	1-3,2-4	Off	Off	90 MHz
Intel	1-3,2-4	3-5,4-6	1-3,2-4	Off	Off	100 MHz
	1-3,2-4	1-3,2-4	1-3,2-4	Off	On	120 MHz
	1-3,2-4	3-5,4-6	1-3,2-4	Off	On	133 MHz

Jumper	*Position*					*Function*
	1-3,2-4	1-3,2-4	1-3,2-4	On	On	150 MHz
	1-3,2-4	3-5,4-6	1-3,2-4	On	On	166 MHz
	1-3,2-4	3-5,4-6	1-3,2-4	On	Off	200 MHz
	1-3,2-4	3-5,4-6	3-5,4-6	On	On	166 MHz MMX
	1-3,2-4	3-5,4-6	3-5,4-6	On	Off	200 MHz MMX
	1-3,2-4	3-5,4-6	3-5,4-6	Off	Off	233 MHz MMX
Cyrix 6x86	1-3,2-4	1-3,2-4	1-3,2-4	Off	On	P150+
	1-3,2-4	3-5,4-6	1-3,2-4	Off	On	P166+
Cyrix 6x86L	1-3,2-4	1-3,2-4	3-5,4-6	Off	On	P150+
	1-3,2-4	3-5,4-6	3-5,4-6	Off	On	P166+
AMD K5	1-3,2-4	1-3,2-4	1-3,2-4	Off	Off	PR90
	1-3,2-4	3-5,4-6	1-3,2-4	Off	Off	PR100
	1-3,2-4	1-3,2-4	1-3,2-4	Off	On	PR120
	1-3,2-4	3-5,4-6	1-3,2-4	Off	On	PR133
	1-3,2-4	3-5,4-6	1-3,2-4	Off	On	PR166
AMD K6	1-3,2-4	3-5,4-6	3-5,4-6	On	On	PR166
	1-3,2-4	3-5,4-6	3-5,4-6	On	Off	PR200
	1-3,2-4	3-5,4-6	3-5,4-6	Off	Off	PR233
S1	On					Bypass password
	Off					Check password
S2	On					Disable onboard sound
S3	On					Disable onboard LAN
S4	On					Cypress CY2273
	Off					CLK 9148
JP1	1-2					Acer BIOS
	2-3					OEM
JP2	1-2					LED for IDE & FDD
	2-3					IDE only
JP3	1-2					Suspend
	2-3					Reset
JP5	1-2					L2 cache Interleave/1+4 mode (Intel/Cyrix M1/M2)
	2-3					L2 cache Linear Burst mode (Cyrix M1/M2)
JP10	1-2					Standby power supply -> 1A
	2-3					Standby power supply < 1A
CN23	1-3,2-4					Single voltage CPU
	3-5,4-6					Dual voltage CPU
CN36	1-2					2.8v CPU core voltage
	3-4					2.9v
	5-6					3.2v
	7-8					3.31v
	9-10					3.52v

V60N

Switch	*Position*				*Function*
JP1	1-2				Check password
	2-3				Bypass
JP3	1-2				Acer BIOS
	2-3				OEM
JP4	1-2				128K Flash ROM
	2-3				256K Flash ROM
JP9-10	**JP9**	**JP10**	**JP12**	**JP13**	**CPU voltage**

Switch	*Position*				*Function*
12-13	2-3	2-3	2-3	2-3	3.5v
	2-3	2-3	2-3	1-2	3.4v
	2-3	2-3	1-2	2-3	3.3v
	1-2	1-2	2-3	2-3	3.2v
	2-3	2-3	1-2	1-2	3.1v
	1-2	2-3	2-3	2-3	3v
	1-2	2-3	2-3	1-2	2.9v
	1-2	2-3	1-2	2-3	2.8v
	2-3	1-2	2-3	2-3	2.7v
	1-2	2-3	1-2	1-2	2.6v
	2-3	1-2	1-2	1-2	2.5v
JP11	1-4				Software shutdown
	2-5				External SMI
	3-6				Reset
JP15	1-2				12v BIOS
	2-3				5v BIOS

CPU	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
150 MHz	On	Off	Off	Off	On	Off	On	On
166 MHz	Off	On	Off	Off	On	Off	On	On
180 MHz	On	Off	Off	Off	On	On	Off	On
200 MHz	Off	On	Off	Off	On	On	Off	On

V65LA

As for V65X, except:

Switch	*Position*	*Function*
CN16	3-5	Power LED
	12-13	Turbo LED
	19-20	Reset

V65X

Switch	*Position*				*Function*
SW1	On				60 MHz host
	Off				66 MHz
SW2	On				Bypass password
	Off				Check password
SW3	On				OEM BIOS
	Off				Acer BIOS
SW5-8	**SW5**	**SW6**	**SW7**	**SW8**	**CPU speed**
	On	Off	Off	On	233 MHz
	Off	On	On	On	266 MHz
	Off	On	Off	On	300 MHz
CN12	3-5				Power LED
	12-13				Turbo LED
	19-20				Reset

X1B

Dual Pentium Pro

Jumper	*Position*				*Function*
JP2-5	**J5/10**	**J4/9**	**J3/8**	**J2/7**	**CPU 1 & 2 Voltage**
7-10	Short	Short	Short	Short	3.5v
	Short	Short	Short	Open	3.4v
	Short	Short	Open	Short	3.3v
	Short	Short	Open	Open	3.2v
	Short	Open	Short	Short	3.1v
	Short	Open	Short	Open	3v
	Short	Open	Open	Short	2.9v
	Short	Open	Open	Open	2.8v
	Open	Short	Short	Short	2.7v
	Open	Short	Short	Open	2.6v
	Open	Short	Open	Short	2.5v
	Open	Short	Open	Open	2.4v
	Open	Open	Short	Short	2.3v
	Open	Open	Short	Open	2.2v
	Open	Open	Open	Short	2.1v
	Open	Open	Open	Open	No CPU
J12	1-2				60 MHz host bus
	2-3				66 MHz host bus
J13	Open				Narrow SCSI
	Closed				Wide SCSI
J14	Open				Reserved
J15	2-3				Reserved
J16	1-2				Termination on
	2-3				Use BIOS settings
J18	1-2				Check password
	2-3				Bypass
J19	1-2				Acer BIOS logo
	2-3				OEM BIOS logo
CN15	1-5,2-6,3-7,4-8				2x CPU
	1-5,2-6,4-8				3x
	1-5,2-6,3-7				4x
	1-5,2-6				5x
	2-6,3-7,4-8				2.5x
	2-6,4-8				3.5x
J1501	1-2				Buzzer
	2-3				Speaker

X3

Quad Pentium Pro

Jumper	*Position*	*Function*
JPX1-3		Reserved
JP1		Reserved
JP2		Reserved
JP3	1-2,3-4,5-6,7-8	2x CPU
	1-2,3-4,7-8	3x
	1-2,3-4,5-6	4x
	1-2,3-4	5x

Jumper	Position		Function
	3-4,5-6,7-8		2.5x
	3-4,7-8		3.5x
JP4,5	**JP4**	**JP5**	**Group 2 CPUs (2 & 4)**
	2-3	Open	2 only
	1-2	1-2	4 only
	1-2	2-3	2 & 4
JP6,7	**JP6**	**JP7**	**Group 1 CPUs (1 & 3)**
	2-3	Open	1 only
	1-2	1-2	3 only
	1-2	2-3	1 & 3
JP8,9	**JP8**	**JP9**	**Groups 1 & 2**
	2-3	1-2	1 only
	1-2	2-3	2 only
	2-3	2-3	1 & 2
JP11	1-2		Check password
	2-3		Bypass password
JP12			Reserved
JP13	1-2		Enable onboard VGA
	2-3		Disable
JP14			Reserved
JP15	1-2		60 MHz host clock
	2-3		66 MHz host clock
	Open		50 MHz host clock

Achitec Corp

www.achitec.com.tw

Achme Computer

www.achme.com

486 AL4

PCI/VLB

Jumper	Position						Function
JC1,4,6	**JC1**	**JC4**	**JC6**	**JC7**	**JC8**	**JC13**	**CPU Type**
7,8,13	2-3	2-3	2-3	2-3	2-3	1-2	Intel/AMD SX
	2-3	3-4	2-3	2-3	2-3	1-2	Intel SX SL
	1-2,3-4	2-3	2-3	2-3	2-3	1-2	Intel/AMD DX/DX2
	1-2,3-4	3-4	2-3	2-3	2-3	1-2	Intel DX/DX2 SL
	1-2,3-4	1-2,3-4	2-4	2-4	1-2	2-3	Curix M7 (+JC11 3)
JK1,2	**JK1**	**JK2**					**CPU Speed**
	1,2	1,2,3					25 MHz
	1,3	1,2,3					33 MHz
	2	4.5.6					40 MHz
JS1,2	**JS1**	**JS2**					**Cache Size**
	1-2	2-3					128K (32Kx8)
	2-3	1-2					256K ((32Kx8)

Jumper	*Position*			*Function*
	2-3	2-3		256K (64Kx8)
JV1-3	**JV1**	**JV2**	**JV3**	**VL Bus**
	2-3	1-2	1-2	<=33 MHz
	2-3	2-3	1-2	> 33 MHz
JP4,12	**JP4**	**JP12**		**PCI IDE**
	In	1-2		Rising Edge trigger
	In	2-3		Falling edge trigger
	In	Out		Low Active lever trigger
	In	2-3		Low Active level trigger
	In	Out		No PCI add-in card
				Use above with BIOS settings
JP6	1-2			Non-NCR 53C810 PCI SCSI
	2-3			NCR 53C810
JP20	1-2			12v Flash Memory
	2-3			5v Flash Memory
	None			Normal

Acme

Maybe same as Achme

ACORP International

www.acorp.com.tw

Award BIOS ID (00)

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0C	PT-51VL	AC	SD-P5TD
9C	586VX/5VIA5S	BC	5VX32 vB/5TX52 vE
9C	5TX32		

586VX

San-Li SL-586V?

5VX32 ver B

San-Li SL-586V+?

Acouire, Inc

Acro Computer Corp

Acrosser Technology Co

www.acrosser.com

Activei Systems Inc

Pride Corp
www.pridecorp.com
www.activei.com

Acusharp

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
HC-00	Excalibur TX 1569		

Excalibur TX 1569

Same as Shuttle HOT 569

Adcom

ADI

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
8C-00	4DXP-UC5		

Adlink Technology Ltd

www.adlink.com.tw

Advanced Integration Research (AIR)

See AIR. Out of business, anyway

Advanced Jenn Bao Enterprises

www.ajb.com.tw

Advanced Logic Research

See ALR

Advanced Micro Products (AMP)

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	SD-380H		

SD-380H

Freetech?

Advantech

www.advantech.com.tw

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
AC-00	PCM 5862		

AEG Olympia

Olystar 20F

SW1

Jumper	*Position*	*Function*
1	On*	Enable COM1
2		Reserved
3	Off	Enable RTC 1
	On	Enable RTC 0
4	Off	Disable IRQ2
	On	Enable IRQ2

SW2

Jumper	*Position*	*Function*		
S1	Off*	Enable floppies		
	On	Disable floppies		
S2	Off	8087 installed		
	On	8087 not installed		
S3-4	**Memory**	**S3**	**S4**	
	256K	Off	Off	Bank 1
	512K	On	Off	Banks 1,2
	640K	Off	On	Banks 1,2,3
	Do not use	On	On	
		768K model has 3&4 set off and On. Also set SW3-5 off and SW3-6 On.		
S5		Reserved		
S6	Off	Enable Onboard display		
	On	Disable Onboard display		
S7-8	Floppy	S7	S8	
	Single	On	On	
	Dual	Off	On	

SW3

Switch	*Position*	*Function*			
S1-4	**Bank Address**	**S1**	**S2**	**S3**	**S4**
	C0000-C3FFF	On	On	On	On
	C4000-C7FFF	On	On	On	On
	C8000-CBFFF	On	Off	On	On
	CC000-CFFFF	Off	Off	On	On
	D0000-D3FFF	On	On	Off	On
	D4000-D7FFF	Off	On	Off	On
	D8000-DBFFF	On	Off	Off	On
	DC000-DFFFF	Off	Off	Off	On
	E0000-E3FFF	On	On	On	Off
	E4000-E7FFF	Off	On	On	Off
	E8000-EBFFF	On	Off	On	Off

Switch	*Position*	*Function*			
	EC000-EFFFF	Off	Off	On	Off
S5	On	Reserved			
	Off	768K RAM			
S6	On	RAM Bank enable			
	Off*	RAM Bank disable			
S7	On	64K ROM			
	Off	40K ROM			
S8	On	10 MHz			
	Off	4.77 MHz			

SW4

Jumper	*Position*	*Function*
S1		Mono display
S2		Colour display
JP1	A In	Disable Onboard display
	B In	Enable Onboard display

Olystar 40F

Jumper	*Position*		*Function*
JP4,5	**JP4**	**JP5**	**Maths copro**
	2-3		8087 not there
	1-2	1-2	8087 present
JP6,7	**JP6**	**JP7**	**MGA mode**
	1-2		MGA
	2-3	1-2	CGA
	1-2	2-3	CGA emulate
JP8,9	**JP8**	**JP9**	
	2-3		COM1/2&HD
	2-3		Disable COM1
	1-2		Disable COM2
	2-3	1-2	Disable HD
JP10,11	**JP10**	**JP11**	**EPROM**
	2-3		27128
	2-3		27256
	1-2	1-2	27512
JP12,16	**JP12**	**JP16**	**HD**
	1-2		Enable
	1-2	1-2	Disable

Olystar 60F/H

Jumper	*Position*			*Function*
JA	A			VGA Enabled
	B			VGA Disabled
JC,D	**JC**	**JD**		
	A	B		COM1 disable
	B	B		COM2 disable
JB,C,D	**JB**	**JC**	**JD**	
	B	B	A	Disk controller disable

Jumper	Position			Function
	A	A	A	Disk controller enable

Olystar 60 H16

Jumper	Position			Function
JP1	Off			System locked
	On			System unlocked
JP2	1-2			Coprocessor asynchronous mode
	2-3			Coprocessor synchronous mode
JP7,8,10	**JP7**	**JP8**	**JP10**	**BIOS Type**
	1-2	1-2	1-2	16-bit
	2-3	2-3	2-3	8-bit
JA1	5-6			32K cache
	1-2*	5-6*		64K cache
	1-2	4-5		128K cache

Olystar 70 H20

VGA Board

Jumper	Position	Function
J1	In	VGA auto setting by BIOS
	Out	VGA disabled
J2	In	VGA connect IRQ9
	Out	VGA disconnect IRQ9
J3	In	VGA BIOS enabled

Main Board

Jumper	Position	Function
J3	A	Password check enabled
	B	Password check disabled
J4	20	20 MHz
	16	16 MHz
J5	20	DRAM CAS precharge 1/2T
	16	DRAM CAS precharge T

Olystar 70S

Jumper	Position	Function
J2	In	VGA enabled
J4	In	VGA BIOS enabled
J7	In	Password enabled
J8	In	IRQ9 to Onboard VGA
	Out	IRQ9 to expansion card
J9	In	Oscillator
	Out	External
J14	In	System BIOS only
	Out	VGA and System BIOS combined

Jumper	*Position*	*Function*
J15		CPU speed
J20		MEMCS16

Olystar 80T33

SW1

Switch	*Function*	*Position*			
S1-4	**EPROM**	**S1**	**S2**	**S3**	**S4**
	27128	On	Off	On	Off
	27256	On*	Off*	Off*	On
	27512	Off	On	Off	On
S5-8	**I/O recovery delay**	**S5**	**S6**	**S7**	**S8**
	0	Off	Off	Off	Off
	1	Off	Off	Off	On
	2	Off	Off	On	Off
	3	Off	Off	On	On
	4	Off	On	On	On
	5	Off	On	Off	On
	6	Off	On	On	Off
	8*	On	Off	Off	Off
	9	On	Off	Off	On
	10	On	Off	On	Off
	11	On	Off	On	On
	12	On	On	Off	Off
	13	On	On	Off	On
	14	On	On	On	Off
	15	On	On	On	On

SW2

Switch	*Position*			*Function*
S1	On*			25-pin=COM1, 9-pin=COM2
	Off			9-pin=COM1, 25-pin=COM2
S2	Off*			Enable COM1
	On			Disable COM1
S3	Off*			Enable COM2
	On			Disable COM2
S4	Off*			Enable Printer Port
	On			Disable Printer Port
S5-7	**S5**	**S6**	**S7**	**Printer Port**
	Off*	Off*	On*	LPT1
	On	On	Off	LPT2
S8	Off*			RAM BIOS selected
	On			ROM BIOS selected
S9	Off*			Primary display Mono or extended
	On			Primary display CGA
S10	Off*			DRAM Bank B enabled
	On			DRAM Bank B disabled
JP6-8	**JP6**	**JP7**	**JP8**	**Maths Copro**
	1-2	1-2	1-2	There

Switch	*Position*			*Function*				
	2-3*	2-3*	2-3*	Not there				
JP12	1-2*			Remap 256K to FA0000-FDFFFF				
	2-3			Do not remap or permit RAM cacheing of F00000-FFFFFF				
JP13-16	**RAM**	**Bank**		**Modules**	**JP13**	**JP14**	**JP15**	**JP16**
	2 Mb	A		512 x 9	2-3*	2-3*	1-2*	1-2*
	4 Mb	A&B		512 x 9	2-3	2-3	1-2	1-2
	6 Mb	A		512 x 9	1-2	1-2	1-2	1-2
		B		1M x 9				
	4 Mb	A		1M x 9	1-2	1-2	2-3	2-3
	8 Mb	A&B		1M x 9	1-2	1-2	2-3	2-3

AIR

Advanced Integration Research
Out of business

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
FC	54CPI		

486ED

EISA

Jumper	*Position*			*Function*
J1-3	**J1**	**J2**	**J3**	**CPU Type**
	Off	Off	2-3	486SX (P23)
	On	1-2	1-2	486DX and 486DX2 (P24)
	On	2-3	1-2	487SX , P23T, OverDrive

Cache Size

Jumper	64K	128K	256K	512K
JC1	1-2	2-3	2-3	2-3
JC2	1-2	2-3	2-3	2-3
JC3	1-2	1-2	2-3	2-3
JC4	1-2	1-2	1-2	2-3
JC5	1-2	1-2	1-2	2-3
JC6	1-2	1-2	2-3	2-3
JC7	1-2	2-3	2-3	2-3
JP9	2-3	1-2	4-5	1-2

CPU Clock Frequency

Jumper	20MHz	25MHz	33MHz	50MHz
JO1	Off	On	On	Off

Jumper	20MHz	25MHz	33MHz	50MHz
JO2	On	Off	On	Off
JO3	On	On	Off	Off
JO4	On	On	On	Off
JL2	Off	Off	Off	On

486EI v1.0

EISA/VESA

Jumper	*Position*			*Function*
J1-3	**J1**	**J2**	**J3**	**CPU Type**
	Open	Open	2-3	486SX
	Short	1-2	1-2*	DX, DX2, DX4
	Short	2-3	1-2	487SX, P23T, Overdrive
JO1,2	**JO1**	**JO2**	**JL2**	**CPU External Clock**
JL2	Short	Short	Open	25 MHz
	Open	Short	Open	33 MHz
	Short	Open	Short	40 MHz
	Open	Open	Short	50 MHz
JP12	1-3,2-4			5v CPU
	3-5,4-6			3.3v CPU
JC4,5	**JC4**	**JC5**	**JP9**	**Cache Size**
JP9	2-3	1-2	1-2	128K
	1-2	1-2	4-5	256K*
	2-3	2-3	1-2	512K

486EI v1.2

EISA/VESA

Jumper	*Position*			*Function*
J1-3	**J1**	**J2**	**J3**	**CPU Type**
J12	Open	Open	2-3	486SX
	Short	2-3	1-2	487SX
	Short	1-2	1-2	DX, DX2
	Short	1-2	1-2	DX4
JO1,2	**JO1**	**JO2**	**JL2**	**CPU External Clock**
JL2	Short	Short	Open	25 MHz
	Open	Short	Open	33 MHz
	Short	Open	Short	40 MHz
	Open	Open	Short	50 MHz
J12	1-3,2-4			5v CPU
	3-5,4-6			3.3v CPU
JC4,5,9	**JC4**	**JC5**	**JC9**	**Cache Size**
	1-2	1-2	4-5	256K*
	2-3	2-3	1-2	512K

486MI v1.0

Jumper	*Position*		*Function*
JP1-2	**JP1**	**JP2**	**CPU Type**
	1-2,3-4		DX, DX2
	2-3	1-2,3-4	487SX, ODPSX

Jumper	*Position*			*Function*
	Open	2-3		486SX
ID2	1-2			0 wait state write transfer
	2-3*			1 wait state write transfer
JP22-24	**JP22**	**JP23**	**JP24**	**IDE recovery time at 33 MHz or less**
	2-3	1-2	2-3	9T, Low Speed (Default)
	1-2	2-3	2-3	7T, Middle Speed
	2-3	2-3	2-3	5T, High Speed
	JP22	**JP23**	**JP24**	**IDE recovery time at 40 MHz or more**
	2-3	2-3	1-2	13T, Low Speed
	1-2	1-2	2-3	11T, Middle Speed
	2-3	1-2	2-3	9T, High Speed
JP29	1-2*			Enable onboard VL IDE
	2-3			Disable
JP30	1-2			LPT IRQ7
	2-3			LPT IRQ5

CPU External Clock

Speed	JP5	JP6	JP7	ID3	JP26	JP27	JP28
20 MHz	Short	Open	Open	1-2	2-3	2-3	1-2
25 MHz	Open	Short	Short	1-2	2-3	2-3	1-2
33 MHz	Open	Short	Open	1-2	2-3	2-3	1-2
40 MHz	Open	Open	Short	2-3	1-2	1-2	2-3
50 MHz	Open	Open	Open	2-3	1-2	1-2	2-3

Cache

Size	JP10	JP11	JP12	JP13	JP14	JP15
64K	1-2	1-2	1-2	2-3	1-2	1-2
128K	2-3	1-2	1-2	1-2	1-2	2-3
256K	2-3	2-3	1-2	2-3	2-3	2-3
256K	2-3	2-3	2-3	1-2	1-2	2-3

486MI v2.21

Jumper	*Position*				*Function*
JP1-2	**JP1**	**JP2**	**JP38**		**CPU Type**
JP38	1-2	1-2,3-4	1-2		DX, DX2
	1-2	1-2,3-4	Open		DX4
	Open	2-3	1-2		486SX
	2-3	1-2,2-3	1-2		487SX, ODPSX,P24T
JP3	Open				DX4 3x
	2-3				DX4 2.5x
	1-2				DX4 2x
JP5-7	**JP5**	**JP6**	**JP7**	**ID3**	**CPU Frequency**
ID3	Short	Short	Short	1-2	25 MHz
	Short	Short	Open	1-2	33 MHz*
	Short	Open	Short	2-3	40 MHz
	Short	Open	Open	2-3	50 MHz
JP8	1-2				Enable Fast Gate A20
	2-3				Disable

Jumper	*Position*			*Function*
JP9	1-2			SIM2 not accept 512Kx36, 2Mx36, 8Mx36
JP16	Open			EGA, VGA or mono display
	Short			CGA
JP17	1-2			Normal
	2-3			Enable Flash Programming
JP20	1-2			Normal
	2-3			Clear CMOS
JP22	1-2			Enable onboard IDE
	2-3			Disable
JP23,24	**JP23**	**JP24**		**IDE Speed**
	1-2	1-2		0
	2-3	1-2		2
	1-2	2-3		4
	2-3	2-3		6
JP25-27	**JP25**	**JP26**	**JP27**	**LPT ECP mode**
	Open	Open	2-3	Disable
	2-3	2-3	1-2	DMA1
	1-2	1-2	1-2	DMA3
JP28				Reserved
JP29				Reserved
JP30	1-2			LPT IRQ7
	2-3			LPT IRQ5
JP30	1-2			LPT IRQ7
	2-3			LPT IRQ5
JP31	1-2			IRQ4 wakes up system
	2-3			IRQ3 wakes up system
JP37				Reserved
ID2	2-3			1 VL bus wait state
	1-2			0 VL bus wait state
W1	1-3,2-4			5v CPU
	3-5,4-6			3.3v CPU

Cache Size	JP10	JP11	JP12	JP13	JP14	JP15
128K	2-3	1-2	1-2	1-2	1-2	2-3
256K*	2-3	2-3	1-2	2-3	2-3	2-3
512K	2-3	2-3	2-3	1-2	1-2	2-3

486MIS

Jumper	*Position*				*Function*
JP1-2	**JP1**	**JP2**	**JP18**		**CPU Type**
JP18	1-2	1-2,3-4	1-2		DX, DX2
	2-3	1-2,3-4	1-2		487SX, ODPSX
	Open	2-3	1-2		486SX
	Open	2-3	2-3		Cyrix 486 DLC
JP3-5	**JP3**	**JP4**	**JP5**	**ID3**	**CPU Frequency**
ID3	Open	Short	Short	1-2	20 MHz
	Short	Open	Short	1-2	25 MHz
	Short	Short	Open	1-2	33 MHz*
	Open	Open	Short	2-3	40 MHz
	Open	Short	Open	2-3	50 MHz

Jumper	*Position*		*Function*
JP16	Open		EGA, VGA or mono display
	Short		CGA
JP17	Open		Enable onboard VL IDE
JP22	1-2		LPT IRQ7
	2-3		LPT IRQ5
JP28	1-2		Normal
	2-3		Enable Flash Programming
JP29,30	**JP29**	**JP30**	**IDE recovery time**
	Short	Short	300ns
	Open	Short	240ns
	Short	Open	180ns
	Open	Open	120ns
JP32	Open		Normal
	Short		BIOS performs infinite loop and clears password – disable SCSI BIOS with I2 and E on W1.
W1	I1		IRQ10
I1,2	I2		IRQ11
W1	**B1**	**B2**	**SCSI BIOS segment location**
B1,2	In	In	DC00
	In	Out	D8000
	Out	Out	Disable
W1E	In		SCSI works
	Out		SCSI doesn't work
ID2	1-2		0 wait state write transfer
	2-3		1 wait state write transfer

Cache Size	JP7	JP8	JP9	JP10	JP11	JP12	JP13	JP14	JP15
64KB	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	2-3
128KB	1-2	1-2	2-3	2-3	2-3	1-2	1-2	1-2	1-2
256KB	2-3	1-2	2-3	2-3	2-3	2-3	2-3	1-2	2-3
512KB	2-3	2-3	2-3	2-3	2-3	1-2	2-3	2-3	1-2

486PH

PCI/VESA

Jumper	*Position*	*Function*
JP1	1-2	Normal
	2-3	Clear CMOS (CMOS RAM is in ODIN OEC12C887A)
JP2	Open	VGA, EGA or mono display
	Short	CGA
JP3	1-2	Reserved
JP14	1-2	Reserved

CPU Type	JP10	JP16	JP23	JP24	JP25
Intel 486SX	Short	Open	Open	2-3	1-2
Intel 486DX, DX2, DX4 (Default)	Short	Open	Open	1-2	1-2
AMD 486DX, DX4*	Short	Open	Short	1-2	2-3
AMD 486DX2*	Short	Open	Open	1-2	2-3
Cyrix 3.3v 486DX, DX2	Short	Short	Short	1-2	2-3
Cyrix 5v 486DX, DX2	Short	Open	Short	1-2	2-3

Chipset auto detects AMD 3.3-Volt and 5-Volt CPUs

Clock Speed	JP6	JP19	JP20	JP21
33 MHz	1-2	Open	Short	Short
25MHz	2-3	Short	Open	Open

Cache Size	JP8	JP9	JP11	JP12
128KB	Short	Open	Open	Open
256KB	Open	Short	Short	Open
256KB*	Short	Open	Short	Open
512KB	Short	Open	Short	Short

For 256K with 64Kx8 SRAM, in the CMOS Chipset Setup menu, set L2 Cache Configuration to N-Leaved.

486PI

Jumper	*Position*					*Function*
JP1	1-2					Normal operation
	2-3					Clear CMOS
JP2	1-2					Reserved
JP3	1-2					LPT IRQ7
	2-3					LPT IRQ5
JP5	Open					VGA, EGA or Mono
	Short					CGA
JP4,6-7	**JP4**	**JP6**	**JP7**			**ECP mode**
	Open	Open	1-2			Enable 4 floppies, No ECP
	1-2	1-2	2-3			DMA3
	2-3	2-3	2-3			DMA1
JP8-12	**JP8**	**JP9**	**JP10**	**JP11**	**JP12**	**Cache size**
	Short	Open	Open	Open	Open	128K
	Open	Short	Short	Short	Open	256K
	Short	Open	Open	Short	Short	512K
JP13	1-2					Reserved
JP14	1-2					Reserved
JP17	Short					Reserved
JP18	Open					Reserved
JP19-22	**JP19**	**JP20**	**JP21**	**JP22**		**CPU Speed**
	Open	Short	Short	1-2		33 MHz
	Short	Open	Open	2-3		25 MHz
JP23	2-3					Reserved
JP24	Open					Reserved
JP25	1-2					486DX4, DX2, DX, P24D, P24T, 487SX
	2-3					486SX
JP26	Short					Reserved
JP27	Open					Reserved
JP28	1-2					Reserved
JP29	Open					Reserved
JP30	Open					Reserved
Green	Open					Normal – power saving triggered by system timer
	Short					Force system into power saving

486SH

Jumper	*Position*					*Function*
JP1-3	**JP1**	**JP2**	**JP3**	**JP20**	**JP21**	**Cache size**
20-21	1-2	2-3	1-2	1-2	1-2	128K
	1-2	1-2	2-3	1-2	2-3	256K
	2-3	2-3	2-3	2-3	2-3	512K
JP4	2-3					1 wait state write transfer
	1-2					0 wait state write transfer
JP7	Open					VGA, EGA or monochrome
	Short					CGA
JP10	1-2					Normal
	2-3					Clear CMOS
JP13	Short					CPU clock 8 MHz when power saving
	Open					CPU full seed
JP11-12	**JP11**	**JP12**	**JP14**	**JP5**		**CPU Speed**
14,5	Open	Open	Short	1-2		20 MHz
	Short	Short	Open	1-2		25 MHz
	Short	Open	Open	1-2		33 MHz
	Open	Short	Open	2-3		40 MHz
	Open	Open	Open	2-3		50 MHz
JP15-16	**JP15**	**JP16**	**JP18**	**JP19**		**CPU Type**
18-19	1-2	1-2	Short	Short		486DX,DX2
	1-2	2-3	Short	Short		487SX, ODP486SX
	2-3	Open	Open	Short		486SX
	2-3	Open	Open	Open		QFP 486SX

486SH v3.1

VL Bus

Jumper	*Position*				*Function*
JP1-4	**JP1**	**JP2**	**JP3**	**JP4**	**Cache size**
	1-2	1-2	1-2,3-4	1-2	128K
	2-3	2-3	2-3,4-5	1-2	256K
	1-2	2-3	1-2,3-4	2-3	512K
J3	1-2				Turbo disabled
	2-3				Enabled
JP5-7,29	**JP5**	**JP6**	**JP7**	**JP29**	**CPU Speed**
	On	On	Off	1-2	25 MHz
	Off	On	On	1-2	33 MHz
	On	Off	Off	2-3	40 MHz
	Off	Off	On	2-3	50 MHz
JP8-9	**JP8**	**JP9**	**JP11**	**JP36**	**CPU Type**
11,36	1-2	On	3-4	1-2	486DX,DX2
	1-2	On	3-4	2-3	486DX4 3.3v
	2-3	Off	Off	1-2	486SX
	1-2	On	2-3	1-2	487SX,ODP 486SX,P24T
JP16	1-2				Normal
	2-3				Clear CMOS
JP17	Off				VGA, EGA or Mono
	On				CGA

486SH v3.1

Jumper	*Position*					*Function*
JP1-4	**JP1**	**JP2**	**JP3**	**JP4**	**JP33**	**Cache size**
33	1-2	1-2	1-2,3-4	1-2	2-3	128K
	2-3	2-3	2-3,4-5	1-2	2-3	256K
	1-2	2-3	1-2,3-4	1-2	1-2	256K
	1-2	2-3	1-2,3-4	2-3	2-3	512K
JP5-7,29	**JP5**	**JP6**	**JP7**	**JP29**		**CPU Speed**
	On	On	Off	1-2		25 MHz
	Off	On	On	1-2		33 MHz
	On	Off	Off	2-3		40 MHz
	Off	Off	On	2-3		50 MHz
JP8-9	**JP8**	**JP9**	**JP11**	**JP36**		**CPU Type**
11,36	1-2	On	3-4	1-3,2-4		486DX,DX2
	1-2	On	3-4	3-5,4-6		486DX4 3.3v
	2-3	Off	Off	1-3,2-4		486SX
	1-2	On	2-3	1-3,2-4		487SX,ODP 486SX,P24T
JP16	1-2					Normal
	2-3					Clear CMOS
JP17	Off					VGA, EGA or Mono
	On					CGA

486SH v3.1a

Jumper	*Position*					*Function*
JP1-4	**JP1**	**JP2**	**JP3**	**JP4**	**JP33**	**Cache size**
33	1-2	1-2	1-2,3-4	1-2	2-3	128K
	2-3	2-3	2-3,4-5	1-2	2-3	256K
	1-2	2-3	1-2,3-4	1-2	1-2	256K
	1-2	2-3	1-2,3-4	2-3	2-3	512K
JP5-7,29	**JP5**	**JP6**	**JP7**	**JP29**		**CPU Speed**
	On	On	Off	1-2		25 MHz
	Off	On	On	1-2		33 MHz
	On	Off	Off	2-3		40 MHz
	Off	Off	On	2-3		50 MHz
JP8-9	**JP8**	**JP9**	**JP11**	**JP36**	**JP30**	**CPU Type**
11,36	1-2	On	3-4	1-3,2-4	Off	486DX,DX2
	1-2	On	3-4	3-5,4-6	Off	AMD DX2, 486DX4 3.3v
	2-3	Off	Off	1-3,2-4	Off	486SX
	1-2	On	2-3	1-3,2-4	Off	487SX,ODP 486SX,P24T
	1-2	On	3-4	3-5,4-6	On	AMD 486DX4 3.3V
JP16	1-2					Normal
	2-3					Clear CMOS
JP17	Off					VGA, EGA or Mono
	On					CGA

486VP (D)

Jumper	*Position*	*Function*
JP2	1-2	Normal
	2-3	Clear CMOS

Jumper	*Position*			*Function*
JP5	Off			VGA, EGA or Mono
	On			CGA
JP6	Off			Reserved
JP9	2-3			Reserved
JP10A, B, C, D, J	Off			Reserved
JP11	2-3			Reserved
JP12	1-2			Disable flash programming
	2-3			Enable
JP20-21	**JP20**	**JP21**	**JP62**	**Cache size**
62	1-2	1-2	Off	256K
	2-3	2-3	Off	512K
	2-3	Off	2-3	1Mb – set CMOS
JP29	2-3			Reserved
JP30	2-3			Reserved
JP31	2-3			Reserved
JP32	2-3			Reserved
JP34	On			Reserved
JP35	1-2			Reserved
JP36	1-2			Reserved
JP38	1-2, 4-5, 7-8, 11-12			Reserved
JP40	Off			Reserved
JP41	1-2			Reserved
JP42	Off			Reserved
JP50	Off			Reserved
JP51	Off			Reserved
JP53	1-2,3-4			Reserved
JP54	1-2,3-4			Reserved
JP55	Off			Reserved
JP56	Off			Reserved
JP57	1-2			Reserved
JP58	2-3			Reserved
JP59	1-2			Reserved
JP60	1-2			Reserved
JP61	Off			Reserved
JP63	Off			Reserved
JP64	1-2			Reserved
JP65	1-2			Reserved
JP66	1-2			Reserved
JP68	1-2			Reserved
JP70	2-3			Reserved
JP71	Off			Reserved
JP80	1-3,2-4			5v CPU
	3-5,4-6			3.3v CPU
JP81	On			Reserved

External Clock Speed	JP26	JP27	JP28	JP7	JP33	JP8	JP8A	JP61	JP13
25 MHz	ON	1-2*	2-3	ON	OFF	1-2	2-3	2-3	OFF
33 MHz	ON	2-3	1-2*	OFF	OFF	1-2	2-3	2-3	OFF
40 MHz	OFF	1-2	2-3	OFF	ON	2-3	1-2	1-2	ON
50 MHz	OFF	2-3	1-2	OFF	ON	2-3	1-2	1-2	ON

For DX4, set JP27 off for 25MHz, JP28 off for 33MHz

CPU	JP19	JP69	JP15	JP37	JP52	JP18
486DX4, DX2, DX	OFF	OFF	1-2	2-3	OFF	1-2,3-4
486SX	OFF	OFF	1-2	OFF	OFF	2-3
487SX, P24T	OFF	OFF	1-2	1-2	OFF	1-2,3-4

SIM5-SIM8	SIM1-SIM4	SIM9	SIM10	JP22	JP23	JP24	JP25
BANK0 (1Mx9, 4Mx9)	BANK1 (1Mx9, 4Mx9)	NONE	NONE	1-2	1-2	2-3	2-3
NONE	NONE	BANK0 (1Mx36, 4Mx36)	BANK1 (1Mx36, 4Mx36)	2-3	2-3	1-2	1-2
BANK0 (1Mx9, 4Mx9)	NONE	NONE	BANK1 (1Mx36, 4Mx36)	1-2	2-3	1-2	2-3

SLOTS PCI0, PCI1, PCI2	SLOT PCI3 (IDE Controller)	JP10F	JP10G	JP10H	JP10I	JP10J	JP10K
IRQ9	N/A	1-2	OFF	OFF	OFF	OFF	OFF
IRQ10	N/A	OFF	1-2	OFF	OFF	OFF	OFF
IRQ11	N/A	OFF	OFF	1-2	OFF	OFF	OFF
IRQ12	N/A	OFF	OFF	OFF	1-2	OFF	OFF
IRQ15	N/A	OFF	OFF	OFF	OFF	1-2	OFF
N/A	IRQ14	OFF	OFF	OFF	OFF	OFF	2-4

54CDP v1.0

Dual Pentium EISA/PCI

Jumper	*Position*			*Function*
JS1,4	**JS1**	**JS4**		**Floppy**
	Open	Open		Normal (2)
	2-3	Short		Enhanced (4)
JS3	Open			Normal operation
	Short			Clear CMOS
JS5,7,8	**JS5**	**JS7**	**JS8**	**LPT ECP Mode**
	Open	Open	Open	Normal
	Short	1-2	1-2	DMA1
	Short	2-3	2-3	DMA3
JS6	2-3			LPT IRQ7
	1-2			LPT IRQ5
JS9	1-2			Flash BIOS programming
	2-3			Normal
JS11	Short			8/16-bit Fast Wide SCSI
	Open			8-bit Fast SCSI
	Short			16-bit Fast Wide SCSI
JS13	Short			Single CPU
	Open			Dual CPU
JS15	1-2			256K cache
	2-3			512K cache
JS16	Short			VGA, EGA or Mono
	Open			CGA
JS18	Open			90 MHz CPU

Jumper	*Position*	*Function*
	Short	100MHz

54CDP v2.21

Jumper	*Position*				*Function*
JS1,3	**JS1**	**JS3**			**Floppy**
	Open	Open			Normal (2)
	2-3	Short			Enhanced (4)
JS2	Short				Clear CMOS
JS4,6,7	**JS4**	**JS6**	**JS7**		**LPT ECP Mode**
	Open	Open	Open		Normal
	Short	1-2	1-2		DMA1
	Short	2-3	2-3		DMA3
JS5	1-2				LPT IRQ7
	2-3				LPT IRQ5
JS9	1-2				Flash BIOS programming
	2-3				Normal
JS10	Open				8-bit Ultra Fast SCSI
	Short				8/16-bit Ultra fast Wide SCSI
	Short				16-bit Ultra fast Wide SCSI
JS11,20	**JS11**	**JS20**	**JS21**	**JS23**	**Clock frequency**
21,23	Open	Open	Open	Open	75 MHz
	Open	Open	Short	Open	90 MHz
	Open	Short	Short	Open	100 MHz
	Short	Open	Short	Open	120 MHz
	Short	Short	Short	Open	133 MHz
	Short	Open	Short	Short	150 MHz
	Short	Short	Short	Short	167 MHz
JS12	Short				Single CPU
	Open				Dual CPU
JS13	1-2				256K cache
	2-3				512K cache
JS15	1-2				Flash programming mode
	2-3				Normal
JS17	1-2				VRE CPU (3.53v)
	2-3				STD & VR CPU (3.37v)
JS18,19	**JS18**	**JS19**			**Cache**
	1-2	1-2			3.3v cache
	2-3	2-3			5/3.3v cache
JS24	1-3,2-4				PCI SCSI sharing with PCI slot 4
	3-5,4-6				PCI SCSI sharing with PCI slot 1

54CEP v1.0

Item	**Description**	**Notes**
Form Factor		
CPU	Pentium	
Speeds (MHz)	90/100	
Chipset	Mercury	
BIOS	AMI	
Bus	4 EISA/5 PCI	All support busmastering

Memory (Mb)	128 Mb	72-pin SIMMs
Cache (K)	256/512 L2	
I/O	2S, PS/2, 1P	FW SCSI Adaptec 7870
Problems		Quantum 1 GB drives may not communicate at full speed with the 7870 – set communication to 8 MB/sec.

Jumper	*Position*	*Function*
JO1	Open	90 MHz CPU
	Short	100MHz
JP5	Open	8-bit Fast SCSI
	Short	8/16-bit Fast Wide SCSI
	Short	16-bit Fast Wide SCSI
JP6	Open	VGA, EGA or Mono display
	Short	CGA
JP8	Open	Normal
	Short	Clear CMOS
JP10	2-3	LPT IRQ7
	1-2	LPT IRQ5
JP16	1-2	256K cache
	2-3	512K cache

54CEP v1.2

Pentium EISA/PCI

Jumper	*Position*			*Function*
JO1	Open			90 MHz CPU
	Short			100MHz
JP5	Short			8/16-bit Fast Wide SCSI
JP6	Open			Colour Display
	Short			Mono
JP8	Open			Normal
	Short			Clear CMOS
JP10	2-3			LPT IRQ7
	1-2			LPT IRQ5
JP16	1-2			256K cache
	2-3			512K cache
JP17	1-2			Flash programming mode
	2-3			Normal
JP32,33	**JP32**	**JP33**		**Floppy**
	Open	Open		Normal (2)
	Short	2-3		Enhanced (4)
JP34-36	**JP34**	**JP35**	**JP36**	**ECP Mode**
	Open	Open	Open	Normal
	1-2	1-2	Short	DMA1
	2-3	2-3	Short	DMA3

54CSH

Pentium ISA/PCI

Jumper	*Position*	*Function*
JS2	Open	VGA, EGA or Mono

Jumper	*Position*			*Function*
	Short			CGA
JS3	1-2			Normal
	2-3			Flash BIOS programming
JS4	Open			Normal
	Short			Clear CMOS
JS7-9	**JS7**	**JS8**	**JS9**	**CPU Clock**
	Short	Open	Open	75 MHz
	Open	Short	Open	90 MHz
	Open	Short	Short	100 MHz
JS10	2-3			Reserved
JS11	1-2			Reserved
JS12	1-2			Reserved
JS13,14	**JS13**	**JS14**		**Cache size**
	1-2	1-2		256K
	1-2	2-3		512K
	2-3	2-3		1 Mb

SIMMs in SIM1, SIM2	SIMMs in SIM3, SIM4	JS5
256Kx36, 1Mx36, 4Mx36, 16Mx36	None	2-3*
256Kx36, 1Mx36, 4Mx36, 16Mx36	256Kx36, 1Mx36, 4Mx36, 16Mx36	1-2
512Kx36, 2Mx36, 8Mx36	None	2-3
512Kx36, 2Mx36, 8Mx36	256Kx36, 1Mx36, 4Mx36, 16Mx36	2-3
512Kx36, 2Mx36, 8Mx36	512Kx36, 2Mx36, 8Mx36	2-3

54CMI v1.1

Jumper	*Position*			*Function*
JO1-3	**JO1**	**JO2**	**JO3**	**CPU Frequency**
	Open	Open	Short	75 MHz
	Open	Short	Open	90 MHz
	Short	Short	Open	100MHz
JP4,5	**JP4**	**JP5**		**Cache size**
	Open	Open		256K
	Open	Short		512K
	Short	Short		1 Mb
JP6	2-3			Disable Flash programming
	1-2			Enable
JP14	2-3			Normal
	1-2			Clear CMOS
JP15	1			Controls VSYNC. Connect to pin 12 of VGA Feature connector.
	2			Controls HSYNC. Connect to pin 11 of VGA Feature connector.
	3			Enable/disable video signals. Connect to pin 18 of Feature connector.
JP29-31	**JP29**	**JP30**	**JP31**	**4 floppies/ECP**
	Open	Open	Open	Enable/No
	Short	1-2	1-2	No/DMA3
	Short	2-3	2-3	No/DMA1
JP32	1-2			LPT IRQ7
	2-3			LPT IRQ5
JP35	Open			Enable onboard IDE
	Short			Disable

54CPI

Jumper	*Position*				*Function*
JS1	1-2				LPT IRQ7
	2-3				LPT IRQ5
JS2,3	**JS2**	**JS3**			**ECP Mode**
	Open	Open			Disable
	2-3	2-3			DMA1
	1-2	1-2			DMA3
JS4	Open				Reserved
JS5	1-2				Reserved
JS6	1-2				Reserved
JS7	Open				VGA, EGA or Mono display
	Short				CGA
JS8	1-2				Normal
	2-3				Clear CMOS
JS9-12	**JS9**	**JS10**	**JS11**	**JS12**	**CPU Frequency**
	1-2	2-3	1-2	2-3	75 MHz
	2-3	1-2	1-2	2-3	90 MHz
	1-2	1-2	1-2	1-2	100MHz
	2-3	1-2	2-3	2-3	120 MHz
	1-2	1-2	2-3	1-2	133 MHz
JS13-14	**JS13**	**JS14**	**JS20**	**JS21**	**SRAM**
20-21	Short	Short	Open	Open	Mixed mode
	Open	Open	Short	Short	3.3v
JS15-17	**JS15**	**JS16**	**JS17**		**Cache size**
	1-2	1-2	1-2		256K
	2-3	2-3	2-3		512K
JS18	Open				Reserved
JS19	1-2				Reserved
JS22	Short				Reserved
JS23	Short				Reserved
JS24	Short				Reserved
JS25	Short				Reserved

54CPI v2.10

Jumper	*Position*					*Function*
JS1,7-8	**JS1**	**JS7**	**JS8**			**ECP Mode**
	Open	Open	Open			Normal
	Short	1-2	1-2			DMA3
	Short	2-3	2-3			DMA1
JS2,6	**JS2**	**JS6**				**Floppy Mode**
	Open	Open				Normal
	Short	2-3				Enhanced
JS3-4	**JS3**	**JS4**				**COM2 mode**
	1-2	1-2				Standard
	2-3	2-3				IR
JS5	1-2					LPT IRQ7
	2-3					LPT IRQ5
JS9-11	**JS9**	**JS10**	**JS11**	**JS25**	**JS32**	**CPU Frequency**
JS25,32	1-2	2-3	1-2	1-2	1-2	75 MHz
	1-2	1-2	2-3	1-2	1-2	90 MHz

Jumper	*Position*					*Function*
	2-3	2-3	2-3	1-2	1-2	100MHz
	1-2	1-2	2-3	1-2	2-3	120 MHz
	2-3	2-3	2-3	1-2	2-3	133 MHz
	1-2	1-2	2-3	2-3	2-3	150 MHz
	2-3	2-3	2-3	2-3	2-3	166 MHz
JS12-13	**JS12**	**JS13**	**JS23**	**JS24**		**SRAM**
23-24	Short	Short	Open	Open		Mixed mode
	Open	Open	Short	Short		3.3v
JS15	Open					VGA, EGA or mono display
	Short					CGA
JS16	**JS16**	**JS19**	**JS20**	**JS21**		**Cache size**
19-21	1-2	2-3	1-2	1-2		256K/async
	2-3	1-2	1-2	2-3		512K/async
	2-3	2-3	2-3	2-3		Module
JS17	1-2					12v flash programming
	2-3					5v flash programming
JS18	2-3					Clear CMOS
JS22	Open					Disable CPU pipeline mode
JS26-30	Short					Reserved
JS31	2-3					STD or VR CPU voltage
	1-2					VRE

54CPI v3

Jumper	*Position*				*Function*
JS5	1-2				LPT IRQ7
	2-3				LPT IRQ5
J03	Short				66 MHz CPU speed
	Open				60 MHz CPU speed
JS12-13	**JS12**	**JS13**	**JS23**	**JS24**	**SRAM**
23-24	Short	Short	Open	Open	Mixed mode
	Open	Open	Short	Short	3.3v
JS15	Open				VGA, EGA or mono display
	Short				CGA
JS17	1-2				12v flash programming
	2-3				5v flash programming
JS18	1-2				Normal
	2-3				Clear CMOS
JS31	2-3				STD or VR CPU voltage
	1-2				VRE

54TDP

Dual Pentium

Jumper	*Position*			*Function*
JP10-11	**JP10**	**JP11**	**JS14**	**CPU Type**
JS14	Open	Open	2-3	P55
	Short	Short	1-2	P54
JS7	1-2			Single CPU
	2-3			Dual CPU
JS8-9	**JS8**	**JS9**	**JS13**	**CPU Frequency**

Jumper	*Position*			*Function*
JS13	2-3	1-2	Open	75 MHz
	1-2	1-2	Open	90 MHz
	2-3	2-3	Open	100MHz
	1-2	1-2	2-3	120 MHz
	2-3	2-3	2-3	133 MHz
	1-2	1-2	1-2,2-3	150 MHz
	2-3	2-3	1-2,2-3	166 MHz
	1-2	1-2	1-2	180 MHz
	2-3	2-3	1-2	200 MHz
JS10	1-2			RAID support card not installed
	2-3			RAID support card installed
JS11	2-3			16-bit SCSI device
	1-2			8-bit SCSI device
JS12	1-2			Wide SCSI termination with low byte
	2-3			Always
CLCMOS	1-2			Clear CMOS
CLPSWD	1-2			Normal
	2-3			Clear Password
FLASH	1-2			12v Flash EPROM
	2-3			5v Flash EPROM
MONO	1-2			Colour Display
	2-3			Mono

54TPI

Jumper	*Position*				*Function*
JS2	2-3				Normal
	1-2				Clear CMOS
JS3	1-2				Enable PS/2 mouse
	2-3				Disable
JS4,5	**JS4**	**JS5**			**COM2**
	1-2	1-2			Normal
	2-3	2-3			IR
JS6-7	**JS6**	**JS7**			**Floppy Mode**
	2-3	1-2			Normal (2)
	1-2	2-3			Enhanced (4)
JS8	1-2				LPT IRQ7
	2-3				LPT IRQ5
JS9-11	**JS9**	**JS10**	**JS11**		**ECP Mode**
	2-3	Open	Open		Normal
	1-2	1-2	1-2		DMA1
	1-2	2-3	2-3		DMA3
JS12-14	**JS12**	**JS13**	**JS14**	**JS16**	**CPU Frequency**
JS16	1-2	2-3	2-3	Open	75 MHz
	1-2	1-2	1-2	Open	90 MHz
	2-3	2-3	1-2	Open	100MHz
	1-2	1-2	1-2	3-4	120 MHz
	2-3	2-3	1-2	3-4	133 MHz
	1-2	1-2	1-2	1-2,3-4	150 MHz
	2-3	2-3	1-2	1-2,3-4	166 MHz
	1-2	1-2	1-2	1-2	180 MHz
	2-3	2-3	1-2	1-2	200 MHz

Jumper	*Position*				*Function*
JS15	2-3				
	1-2				
JS18	2-3				3.3v CPU
	1-2				3.45v CPU
					Fast 8-bit SCSI
					Fast and Wide 16-bit SCSI
PSWD	1-2				Clear Password
	2-3				Normal
FLASH	1-2				12v Flash EPROM (Intel)
	2-3				5v Flash EPROM (SST)
MONO	1-2				Colour Display
	2-3				Mono

54TPI v5

Jumper	*Position*				*Function*
JS2	2-3				Normal
	1-2				Clear CMOS
JS3	1-2				Enable PS/2 mouse
	2-3				Disable
JS12-14	**JS12**	**JS13**	**JS14**	**JS16**	**CPU Speed**
JS16	1-2	2-3	2-3	Open	75 MHz
	1-2	1-2	1-2	Open	90 MHz
	2-3	2-3	1-2	Open	100MHz
	1-2	1-2	1-2	3-4	120 MHz
	2-3	2-3	1-2	3-4	133 MHz
	1-2	1-2	1-2	1-2,3-4	150 MHz
	2-3	2-3	1-2	1-2,3-4	166 MHz
	1-2	1-2	1-2	1-2	180 MHz
	2-3	2-3	1-2	1-2	200 MHz
JS15	2-3				Fast 8-bit CPU
	1-2				Fast and Wide 16-bit SCSI
JS18-21	**JS18**	**JS19**	**JS20**	**JS21**	**CPU Type**
	2-3	2-3	2-3	2-3	P55C (Inte)
	1-2	1-2	1-2	1-2	P54C (Intel)/Cyrix/AMD
PSWD	1-2				Clear Password
	2-3				Normal
FLASH	1-2				12v Flash EPROM (Intel)
	2-3				5v Flash EPROM (SST)
MONO	1-2				Colour Display
	2-3				Mono

586EP

Pentium EISA/PCI

Jumper	*Position*	*Function*
J03	Short	66 MHz CPU speed
	Open	60 MHz CPU speed
JP5	Open	8-bit Fast SCSI
	Short	16-bit Fast wide SCSI
	Short	Both 8-bit/16-bit SCSI

Jumper	*Position*		*Function*
JP6	Open		VGA, EGA or Mono
	Short		CGA
JP8	Open		Normal
	Short		Clear CMOS
JP10	1-2		LPT IRQ7
	2-3		LPT IRQ5
JP12,16	**JP12**	**JP16**	**Cache Size**
	1-2	1-2	256K
	2-3	2-3	512K

586MI

Jumper	*Position*				*Function*
JO1-3	**JO1**	**JO2**	**JO3**		**CPU Frequency**
	Open	Short	Open		60 MHz
	Short	Short	Open		66 MHz
	Open	Open	Short		50MHz
J05-7	**JO5**	**JO6**	**JO7**	**JP19**	**VL Bus speed**
JP19	Short	Open	Open	Open	33 MHz
	Open	Open	Open	Short	40 MHz
JP13	Open				Normal
	2-3				Flash programming
JP14	Open				VGA, EGA or mono
	Short				CGA
JP15	2-3				Normal
	1-2				Clear CMOS
JP18	Short				1 wait state write transfer
	Open				0 wait state write transfer
JP21-23	**JP21**	**JP22**	**JP23**		**VL Bus IDE Recovery Time**
	2-3	2-3	2-3		Speed 0 – High speed IDE
	1-2	2-3	2-3		Speed 1 – Medium speed
	2-3	1-2	2-3		Speed 2 – Slow speed
JP30	Open				Enable onboard VL-bus IDE
JP32	1-2				LPT IRQ7
	2-3				LPT IRQ5

Cache Size	JP1	JP2	JP3	JP4	JP5	JP6
64KB	1-2	1-2	1-2	Open	Open	Open
128KB	2-3	2-3	2-3	Open	Open	Short
256KB	1-2	1-2	1-2	Open	Short	Short
512KB	2-3	2-3	2-3	Short	Short	Short

P5TPI

Same as 54TPI.

P5TXA

Jumper	*Position*	*Function*
JP2	1-2	Normal

Jumper	*Position*	*Function*
	2-3	Clear CMOS
PWSELI	1-2	ATX power supply
	2-3	AT power supply

Voltage	#1	#2	#3	#4
3.5V	ON	ON	ON	ON
3.4V	OFF	ON	ON	ON
3.3V	ON	OFF	ON	ON
3.2V	OFF	OFF	ON	ON
3.1V	ON	ON	OFF	ON
3.0V	OFF	ON	OFF	ON
2.9V	ON	OFF	OFF	ON
2.8V	OFF	OFF	OFF	ON
2.7V	ON	ON	ON	OFF
2.6V	OFF	ON	ON	OFF
2.5V	ON	OFF	ON	OFF

CPU Speed	#1	#2	#3	#4	#5	#6
100MHz	ON	OFF	ON	OFF	OFF	ON
120MHz	OFF	ON	ON	ON	OFF	OFF
133MHz	ON	OFF	ON	ON	OFF	OFF
150MHz	OFF	ON	ON	ON	ON	OFF
166MHz	ON	OFF	ON	ON	ON	OFF
180MHz	OFF	ON	ON	OFF	ON	OFF
200MHz	ON	OFF	ON	OFF	ON	OFF
233MHz	ON	OFF	ON	OFF	OFF	OFF
266MHz	ON	OFF	ON	ON	OFF	ON

Ratio	#4	#5	#6
1.5x	OFF	OFF	ON
2.0x	ON	OFF	OFF
2.5x	ON	ON	OFF
3.0x	OFF	ON	OFF
3.5x	OFF	OFF	OFF
4.0x	ON	OFF	ON
4.5x	ON	ON	ON

Clock	#1	#2	#3
50MHZ	ON	ON	ON
55MHZ	ON	ON	OFF
60MHZ	OFF	ON	ON
66MHZ	ON	OFF	ON
75MHZ	OFF	ON	OFF

P5TXI

Socket 7

Switch	Position				Function
SW1	**S1**	**S2**	**S3**	**S4**	**CPU Voltage**
S1-4	On	On	On	On	3.54v
	Off	Off	Off	On	2.8v
	On	Off	Off	On	2.9v
	Off	Off	On	On	3.2v
	On	Off	Off	Off	2.1v
SW2	2, 6 On				150 MHz CPU Speed
S1-7	6 On				180 MHz CPU Speed
	2,3,6 On				200 MHz CPU Speed
	2,3 On				233 MHz CPU Speed
	4 On				266 MHz CPU Speed
S8	On				SCSI High and Low Byte Termination in setup
	Off				SCSI High Byte Termination always enabled
JP3	1-2				Normal
	2-3				Clear CMOS

P6NDI

Dual Pentium Pro ATX

CPU	JSS1	JSS2	JSS3	JSS4	JS1	JS2	JS3	JS4
150MHz	2-3	1-2	1-2	1-2	1-2	1-2	1-2	1-2
180MHz	1-2	2-3	1-2	1-2	1-2	1-2	1-2	1-2
200MHz	1-2	2-3	1-2	1-2	2-3	2-3	2-3	2-3

P6NDP

Dual Pentium Pro ATX

Jumper	Position	Function
HBYEN	1-2	Auto SCSI High Byte Termination
	2-3	Always
MONO	1-2	Colour display
	2-3	Mono
ECMOS	1-2	Normal
	2-3	Clear CMOS
FLASH	1-2	Intel Flash BIOS (12v)
	2-3	SST Flash BIOS (5v)
CLPSWD	1-2	Normal
	2-3	Clear Password

CPU	JSS1	JSS2	JSS3	JSS4	JS3	JS4	JS5	JS6
150MHz	1-2	1-2	1-2	2-3	1-2	1-2	1-2	1-2
180MHz	1-2	1-2	2-3	1-2	1-2	1-2	1-2	1-2
200MHz	1-2	1-2	2-3	1-2	2-3	2-3	2-3	2-3

P6NPI

Dual Pentium Pro ATX

Jumper	*Position*	*Function*
JS8	1-2	Auto SCSI High Byte Termination

Jumper	Position	Function
	2-3	Always
JS9	1-2	Normal
	2-3	ARO-1130 RAID Card installed
JS10	1-2	Fast 8-bit SCSI
	2-3	Fast and Wide 16-bit SCSI
CLCMOS	1-2	Normal
	2-3	Clear CMOS
CLPSWD	1-2	Normal
	2-3	Clear Password
MONO	1-2	Colour display
	2-3	Mono

CPU	JSS1	JSS2	JSS3	JSS4
2x	1-2	1-2	1-2	1-2
2.5	1-2	1-2	1-2	2-3
3 (Default)	1-2	1-2	2-3	1-2
3.5	1-2	1-2	2-3	2-3
4	1-2	2-3	1-2	1-2

CPU	JS4	JS5	JS6	JS7
133MHz	2-3	2-3	2-3	2-3
150MHz	1-2	1-2	1-2	1-2
180MHz	1-2	1-2	1-2	1-2
200MHz	2-3	2-3	2-3	2-3

P6BXI

Switch	Position				Function
S1-3	All Off				CPU external clock - Reserved
S4-7	**4**	**5**	**6**	**7**	**CPU multiplier**
	On	On	On	On	2x
	Off	On	On	On	2.5x
	On	Off	On	On	3x
	Off	Off	On	On	3.5x
	On	On	Off	On	4x
	Off	On	Off	On	4.5x

Alcom Group

See Micron Design Technology Ltd
www.alcom.com.tw

ALi

Acer Labs International

1429G

Switch	*Position*			*Function*					
JP1-3	**JP1**	**JP2**	**JP3**	**SMI CPU**					
	2-3	1-2	1-2	486/DX4					
	2-3	2-3	2-3	AMD 486DXL					
	1-2	4-5	4-5	Cyrix M6/M7					
	Open	Open	Open	Any 5v CPU					
JP4	Open			Cyrix CPU					
JP13-15	**CPU Type**			**JP13**	**JP14**	**JP15**	**JP17**	**JP20**	**JP48**
17,20,48	486DX/DX2			2-3	1-2	2-3	Close	1-2	1-2
	DX4/M7/486SX/M6			Open	1-2	1-2	Open	1-2	1-2
	486 Overdrive			1-2	1-2	2-3	Close	1-2	1-2
	P24T			1-2	2-3	2-3	Close	2-3	1-2
JP23,30	**JP23**		**JP30**	**SRAM (cache)**					
	6-7		Open	32K (8Kx8)					
	6-7,4-5		1-2	64K (16Kx8)					
	5-6		1-2	64K (8Kx8)					
	6-7,4-5,2-3	1-2,3-4		128K (32Kx8)					
	6-7,4-5,2-3	1-2,3-4		256K (64Kx8)					
	1-2,3-4,5-6	1-2,3-4		256K (32Kx8)					
	6-7,4-5,2-3	1-2,3-4,5-6		512K (128Kx8)					
JP27-28	**External Bus Speed**			**JP27**	**JP28**	**JP33**	**JP36**		
33,36	25 MHz			2-3	1-2	1-2,5-6	1-2		
	33 MHz			2-3	1-2	1-2,3-4	1-2		
	40 MHz			2-3	1-2	5-6	1-2		
	50 MHz			2-3	2-3	1-2,5-6	2-3		
JP32	1,3			2 Standby Mode output					
	5,7			2 Suspend Mode output					
	2,4,6,8			GND					
JP39	Close			Colour monitor					
	Open			Mono					
JP43	1-2			3.3v CPU					
	2-3			5v CPU					
JP49	2-3,3-5			Single density SIMMs					
	1-3,2-4			Double Density					
JP51	Close			AMD DX2-80					
	Open			AMD DX4-100					

J624

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	90	
Chipset	ALI	
BIOS	AMI WinBIOS	
Bus		

PCI P5-60/66

Item	Description	Notes
Form Factor		
CPU		
Speeds (MHz)		
Chipset	ALI	
BIOS		
Bus	4 ISA/4 PCI	1 each shared

ALR

Advanced Logic Research – makes stuff for Gateway

7200

Switch	*Position*	*Function*
JP22	3-4	200 MHz
	1-2,3-4	233 MHz
	5-6	266 MHz
	1-2, 5-6	300 MHz
	3-4, 5-6	333 MHz
	1-2, 3-4	350 MHz
	5-6	400 MHz
	1-2,5-6	450 MHz

8200

Switch	*Position*	*Function*
JP22	5-6	266 MHz
	1-2, 5-6	300 MHz
	3-4, 5-6	333 MHz
	1-2, 3-4	350 MHz
	3-4,5-6	366 MHz
	5-6	400 MHz

FlexCache 33/386

Switch	*Position*	*Function*
S1	On	Cache disabled
	Off*	Cache enabled
S2	Off*	Monochrome
	On	CGA
S3	Off*	RAM/ROM swap enabled
	On	RAM/ROM swap disabled
S4	Off*	80387-33 or 3167 installed
	On	80387-25 installed
S5	Off*	Memory upper limit is 15.875 Mb (FDFFFF)
	On	Memory upper limit is 15.5 Mb
S6		Reserved

Switch	*Position*	*Function*				
S7	Off*	Floppy slowdown disabled				
	On	Floppy slowdown enabled				
S8	Off*	HD slowdown disabled				
	On	HD slowdown enabled				
JP2,3,4	**Memory**	**Bank 0**	**Bank 1**	**JP2**	**JP3**	**JP4**
	2 Mb	256K		Out		Out
	4 Mb	256K	256K		Out	Out
	8 Mb	1 Mb		Out		In
	10 Mb	1 Mb	256K	In	Out	In
	10 Mb	256K	1 Mb	In	In	Out
	16 Mb	1 Mb	1 Mb	In	In	In
JP7-10	**Speed (ns)**	**J7**	**J8**	**J9**	**J10**	**Bank**
	120			Out	Out	0
	100			Out	In	0
	80/85			In	Out	0
	60			In	In	0
	120	Out	Out			1
	100	Out	In			1
	80/85	In	Out			1
	60	In	In			1
J1,3,4		Reserved				

FlexCache 16/20-386

Jumper	*Position*		*Function*
S1	Off*		Mono
	On		CGA
S2			Reserved
S3			Reserved
S4	On		2 Mb Onboard
	Off*		1 Mb Onboard
S5	On*		Cache enabled
	Off		Cache disabled
S6,7	**S6**	**S7**	**Maths copro**
	Off	Off	There
	Off	On	Not there*
S8	Off		High speed
	On		Low speed

386/220

Jumper	*Position*		*Function*
S1	Off*		Mono
	On		CGA
S2			Reserved
S3			Reserved
S4	On		2 Mb 32-bit memory Onboard
	Off*		1 Mb 32-bit memory Onboard
S5	On*		Shadow RAM enabled
	Off		Shadow RAM disabled
S6,7	**S6**	**S7**	**Maths copro**

Jumper	Position		Function
	On	Off	80287
	Off	On	Not there*
	Off	Off	80387
S8	Off		High speed
	On		Low speed

Flexcache 25/386(dt)

Jumper	Position	Function
S1	Off*	Cache enabled
	On	Cache disabled (slow speed)
S2	On	CGA
	Off*	Mono
S3	On	Shadow RAM disabled
	Off*	Shadow RAM enabled
S4	On	80387-20
	Off*	80387-25
S5	On	Reserved
	Off*	Factory setting
S6,7		Reserved
S8	Off*	Slow HD access time
	On	Fast HD access time

When the speed is set low, the cache is off, and vice versa, activating 0 wait states.

Standard version

Jumper	Position				Function
S1,2,7,8	**S1**	**S2**	**S7**	**S8**	**COM ports**
	On	Off	Off	On	COM1 IRQ4
	Off	On	On	Off	COM2 IIRQ3
	Off	Off	Off	Off	None
S3,4	**S3**	**S4**			**LPT IRQ**
	On	Off			7
	Off	On			5
	Off	Off			None
S5-6	**S5**	**S6**			**Floppy**
	Off	Off			Disabled
	On	On			Enabled

Alton

See PC Ware

Amaquest

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
A	AP 8548	BC-00	AP 8548
AC-00	AP 8548 rev 2		

American Megatrends

See AMI

American Predator

www.americanpredator.com

American Sunshine Technologies

www.sunshinetech.com

AMI

American Megatrends
www.megatrends.com

Apollo

Item	Description	Notes
CPU		
Speeds (MHz)	75-133	
Chipset	Triton	
Bus	4 PCI/4 ISA	1 each shared
Memory (Mb)	128 Mb	
Cache (K)	512	
I/O	2S, 1P, 1 Floppy	

Apollo II

Item	Description	Notes
CPU	Pentium	
Speeds (MHz)	166	
Chipset	430FX	2nd generation
Bus	4 PCI/3 ISA	None shared
Memory (Mb)	128 Mb	
Cache (K)	512	W/B or PB
I/O	2S, 1P, 1 Floppy	

ATLAS PCI

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	90/100	
Chipset	SiS	
BIOS	Green AMI	
Bus	4 PCI/4 ISA	All PCI are Busmasters. PnP 1.0A compliant
Memory (Mb)	128	72-pin SIMMs
Cache (K)	512	256 standard
I/O	2S, 1P, PS/2, EIDE	
Problems		Will not recognise S3-based cards (e.g. Stealth 64 Video VRAM unless a special BIOS is installed.

ATLAS PCI II

Item	Description	Notes
Form Factor		
CPU		
Speeds (MHz)		
Chipset	430HX	
BIOS	Green AMI	
Bus	4 PCI/4 ISA	All PCI are Busmasters
Memory (Mb)	256	72-pin parity
Cache (K)	512	asynchronous, synchronous, or pipelined burst
I/O	2S, 1P, PS/2, EIDE	
Comments		2nd generation Atlas

Excalibur PCI EISA

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	60	
Chipset	SiS	
BIOS		
Bus	3 PCI/6 EISA	None shared
Memory (Mb)	192	
Cache (K)	512 W/B	256K standard
I/O	2S, 1P	

Excalibur PCI II

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	60/66	
Chipset	Sis	

Item	Description	Notes
BIOS		
Bus	4 PCI/4 ISA	1 each shared
Memory (Mb)	128	
Cache (K)	512 W/B	256K standard
I/O	2S, 1P	

Goliath

Item	Description	Notes
Form Factor		
CPU	4 Pentium Pro	Main board takes 2, secondary board 2 more.
Speeds (MHz)	200	
Chipset	Orion	
BIOS	AMI	
Bus	6 PCI/4 EISA	2 PCI buses, 3 slots per bus
Memory (Mb)	1 Gb	8 slots. ECC. DIMMs
Cache (K)		
I/O	2S, 1P	

MegaPro

Item	Description	Notes
Form Factor		
CPU	2 Pentium Pro	
Speeds (MHz)	180/200	
Chipset	Natome	
Bus	6 PCI/4 EISA	1 each shared. 2 PCI buses, 3 slots per bus. All busmaster
Memory (Mb)	1 Gb	FPM, EDO or BEDO. Parity/ECC
Cache (K)		
I/O		2S, 1P

Merlin

Item	Description	Notes
CPU	Pentium Pro	
Speeds (MHz)	180/200	
Chipset	Natoma	
BIOS		
Bus	4 PCI/4 ISA	1 each shared, 1 PCI only takes ½ length card.
Memory (Mb)	512	FPM, EDO or BEDO. Parity/ECC
I/O	2 S, 1 P, 2 USB	

Super Voyager

Item	Description	Notes
Form Factor		
CPU	486	Pentium Overdrive
Speeds (MHz)		

Item	Description	Notes
Chipset		
BIOS	Green AMI Flash	WinBIOS
Bus	3 PCI/4 ISA	PnP 1.0A compliant. PCI 2.0. Busmasters
Memory (Mb)	128	72-pin SIMMs
Cache (K)	256	128 standard
I/O	2S, 1 P, Floppy	
Comments		

Titan II

Item	Description	Notes
Form Factor		
CPU	2 Pentium	
Speeds (MHz)	150	
Chipset	Neptune	
BIOS		
Bus	4 PCI/6 EISA	None shared, all busmasters
Memory (Mb)	512	8 rows
Cache (K)	512 W/B	256 standard

Titan III

Item	Description	Notes
Form Factor		
CPU	2 Pentium	
Speeds (MHz)	166	200?
Chipset	Triton II	
BIOS		
Bus	4 PCI/4 EISA	1 each shared, all busmasters
Memory (Mb)	384	6 rows
Cache (K)	512	Pipelined Burst. 256 standard

Amjet

See J-Mark Computer Corp

AMP

See Advance Micro Products

Amptron

www.amptron.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1-00	PM 7400	HC	PM 7600
4C	PM 7600	IC	PM 7700B
9C	PM 8400		

DX 6900

Item	Description	Notes
Form Factor	AT	
CPU	DX4/100	
Speeds (MHz)	120	
Chipset	UMC	
BIOS	AMI Win	
Bus	3 VESA/7 EISA	
Memory (Mb)		3 x 30, 2 x 72

Jumper	*Position*						*Function*
JP3	1-2						5v Flash ROM
	2-3						12v Flash ROM
JP6-8	**JP6**	**JP7**	**JP8**				**CPU Clock**
	Off	Off	On				25 MHz
	On	On	On				33 MHz
	Off	On	On				40 MHz
	On	Off	Off				50 MHz
JP16	Off						VESA <=33 MHz
	On						VESA > 33 MHz
JP17	Off						0 VESA WS
	On						1 VESA WS
JP21-24	**JP24**	**JP25**	**JP26**	**JP35**			**CPU Power**
35	2-3	2-3	2-3	Off			5v
	1-2	1-2	1-2	On			3.3v
	1-2	1-2	1-2	Off			4v
JP27-30	**JP27**	**JP28**	**JP29**	**JP30**	**JP32**	**JP33**	**CPU**
32, 33		2-3				2-3	486SX
		2-3			1-2	1-2.2-3	486DX/DX2 (Intel/AMD)
	1-2,2-3	1-2	1-2	5-6	1-2	1-2,2-3	486DX2/DX4
	1-2,2-3	1-2,4-5	1-2,4-5	3-4,5-6	1-2	1-2,2-3	P24D/enh AMD DX4, 5x86
	1-2,3-4	1-2	1-2	5-6	2-3	1-2.2-3	P24T
	2-3	1-2,3-4	1-2,3-4	2-3,4-5	1-2	1-2,3-4	Cyrix M7
		5-6	5-6				
		2-3	2-3	1-2	3-4	2-3	UMC U5
JP31	Off						CPU 3x
	1-2						CPU 2.5x
	2-3						CPU 2x
JP 34	Off						AMD DX4 3x
	On						AMD DX4 2x

DX-9500

Eurone M919 v1, from the same source.

DX-9700

Eurone M919 v3, from the same source.

PM 7400

Same as PC Chips 529

PM 7600

Fugutech M 507 in disguise.

Amtec

www.antec-inc.com

Anigma

Used by Gateway 2000.

Anscera

Anson

Antec

www.antec-inc.com

AOpen

AcerOpen
www.aopen.com
www.aopen-usa.com
www.aopenamerica.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C-00	AP5T	AC	AP65

AP 4

Jumper	*Position*			*Function*
JP1	1-2			Enable FDC and Super I/O chip
	2-3			Disable
JP2,3	**JP2**	**JP3**		**ECP DMA Channel**
	2-3	2-3		DMA 1
	1-2	1-2		DMA 3
JP4	1-2			12v Flash ROM
	2-3			5v EEPROM or Flash ROM
JP30-32	**JP30**	**JP31**	**JP32**	**OSC frequency**
	1-2	1-2	1-2	25 MHz
	2-3	1-2	1-2	33 MHz
	2-3	1-2	2-3	50 MHz
JP37	1-2			Normal
	2-3			Clear CMOS

Cache Size	JP24	JP25	JP26	JP27	JP29
32 KB x 4 = 128K	1-2	1-2	2-3	1-2	1-2, 3-4
32 KB x 8 = 256K	1-2	2-3	2-3	2-3	2-3, 4-5
64 KB x 4 = 256K	1-2	2-3	1-2	1-2	1-2, 3-4
64 KB x 8 = 512K	2-3	2-3	2-3	2-3	2-3, 4-5
128 KB x 4 = 512K	2-3	2-3	2-3	1-2	1-2, 3-4

5v CPU

	486SX SL	DX/DX2 SL	P24D	P24T
JP11	2-3	2-3	1-2	1-2
JP12	1-2	1-2	1-2	1-2
JP13	Open	Open	Open	1-2
JP14	Open	Open	1-2	Open
JP15	Open	Open	1-2	Open
JP16	Open	Open	1-2	1-2
JP17	3-4	3-4	1-2, 3-4	3-4
JP18	2-3	1-2, 3-4	1-2, 3-4	1-2, 3-4
JP19	Open	Open	Open	1-2
JP20	Open	3-4	3-4	2-3
JP21	4-5	4-5	4-5	1-2
JP22	1-2	1-2	2-3	Open
JP23	2-3	2-3	2-3	2-3
JP40	1-3, 2-4	1-3, 2-4	1-3, 2-4	1-3, 2-4

	486SX	486DX/DX2	CxDX/DX2
JP11	2-3	2-3	2-3
JP12	Open	Open	1-2
JP13	Open	Open	Open
JP14	Open	Open	Open
JP15	Open	Open	Open
JP16	Open	Open	2-3
JP17	Open	Open	2-3
JP18	2-3	1-2, 3-4	1-2, 3-4
JP19	Open	Open	2-3
JP20	Open	3-4	3-4
JP21	Open	Open	2-3
JP22	Open	Open	Open
JP23	Open	Open	1-2
JP40	1-3, 2-4	1-3, 2-4	1-3, 2-4

3.45v CPU

	Intel DX4 (W/T)	Intel DX4 (W/B)	AMD DX2	AMD DX4 (V8T)	AMD DX4-S (SV8B)	AMD DX4-S (SV8T)
JP11	2-3	1-2	2-3	2-3	1-2	2-3
JP12	1-2	1-2	Open	Open	1-2	1-2
JP13	Open	Open	Open	Open	Open	Open
JP14	Open	1-2	2-3	Open	1-2	Open
JP15	Open	1-2	Open	Open	1-2	Open
JP16	Open	1-2	Open	Open	1-2	Open
JP17	3-4	1-2, 3-4	Open	Open	1-2, 3-4	3-4
JP18	1-2, 3-4	1-2, 3-4	1-2, 3-4	1-2, 3-4	1-2, 3-4	1-2, 3-4
JP19	Open	Open	Open	Open	Open	Open
JP20	3-4	3-4	3-4	3-4	3-4	3-4
JP21	4-5	4-5	Open	Open	4-5	4-5
JP22	1-2	2-3	Open	Open	2-3	1-2
JP23	2-3	2-3	Open	Open	2-3	2-3
JP40	3-5, 4-6	3-5, 4-6	3-5, 4-6	3-5, 4-6	3-5, 4-6	3-5, 4-6

	Cyrix 486DX2	Cyrix DX4 (iDX4 P/O)	Cyrix DX4 (M7 P/O)	Cyrix 5X86	TI 486DX2
JP11	2-3	2-3	2-3	2-3	2-3
JP12	1-2	1-2	1-2	1-2	1-2
JP13	Open	Open	Open	Open	Open
JP14	Open	1-2	Open	1-2	Open
JP15	Open	1-2	Open	1-2	Open
JP16	2-3	1-2	2-3	1-2	2-3
JP17	2-3	1-2, 3-4	2-3	1-2, 3-4	2-3
JP18	1-2, 3-4	1-2, 3-4	1-2, 3-4	1-2, 3-4	1-2, 3-4
JP19	2-3	Open	2-3	Open	2-3
JP20	3-4	3-4	3-4	3-4	3-4
JP21	2-3	4-5	2-3	4-5	2-3
JP22	Open	2-3	Open	2-3	Open
JP23	1-2	2-3	1-2	2-3	1-2
JP40	3-5, 4-6	3-5, 4-6	3-5, 4-6	3-5, 4-6	3-5, 4-6

AP 43

Jumper	*Position*			*Function*
JP21	1-2			Enable FDC and Suoer I/O chip
	2-3			Disable
JP22,23	**JP22**	**JP23**		**ECP DMA Channel**
	2-3	2-3		DMA 1
	1-2	1-2		DMA 3
JP24	1-2			5v EEPROM or Flash ROM
	2-3			12v Flash ROM
JP25-27	**JP25**	**JP26**	**JP27**	**OSC frequency**
	2-3	1-2	1-2	25 MHz
	2-3	1-2	2-3	33 MHz
	1-2	1-2	1-2	50 MHz
JP28	1-2			Normal
	2-3			Clear CMOS

5v CPU

	486SX SL	DX/DX2 SL	P24D	P24T
JP6	Open	Open	Open	1-2
JP7	2-3	2-3	1-2	1-2
JP8	Open	Open	1-2	Open
JP9	Open	Open	1-2	Open
JP10	1-2	1-2	1-2	1-2
JP13	Open	Open	Open	1-2
JP14	2-3	2-3	2-3	2-3
JP15	2-3	1-2, 3-4	1-2, 3-4	1-2, 3-4
JP16	Open	3-4	3-4	2-3
JP17	3-4	3-4	1-2, 3-4	3-4
JP18	Open	Open	1-2	1-2
JP19	1-2	1-2	2-3	Open
JP20	4-5	4-5	4-5	1-2
JP29	2-3	2-3	2-3	2-3

	Intel/AMD 486SX	Intel/AMD 486DX/DX2	Cyrix 486DX/ DX2
JP6	Open	Open	Open
JP7	2-3	2-3	2-3
JP8	Open	Open	Open
JP9	Open	Open	Open
JP10	Open	Open	1-2
JP13	Open	Open	2-3
JP14	Open	Open	1-2
JP15	2-3	1-2, 3-4	1-2, 3-4
JP16	Open	3-4	3-4
JP17	Open	Open	2-3
JP18	Open	Open	2-3
JP19	Open	Open	Open
JP20	Open	Open	2-3
JP29	2-3	2-3	2-3

3.45V CPU

	Intel DX4 (W/T)	Intel DX4 (W/B)	AMD DX2	AMD DX4 (V8T)	AMD DX4-S (SV8T)	AMD DX4-S (SV8B)
JP6	Open	Open	Open	Open	Open	Open
JP7	2-3	1-2	2-3	2-3	2-3	1-2
JP8	Open	1-2	Open	Open	Open	1-2
JP9	Open	1-2	2-3	Open	Open	1-2
JP10	1-2	1-2	Open	Open	1-2	1-2
JP12	Open	Open	Open	Open	Open	Open
JP13	Open	Open	Open	Open	Open	Open
JP14	2-3	2-3	Open	Open	2-3	2-3
JP15	1-2, 3-4	1-2, 3-4	1-2, 3-4	1-2, 3-4	1-2, 3-4	1-2, 3-4
JP16	3-4	3-4	3-4	3-4	3-4	3-4
JP17	3-4	1-2, 3-4	Open	Open	3-4	1-2, 3-4
JP18	Open	1-2	Open	Open	Open	1-2
JP19	1-2	2-3	Open	Open	1-2	2-3
JP20	4-5	4-5	Open	Open	4-5	4-5
JP29	1-2	1-2	1-2	1-2	1-2	1-2

	TI DX2	Cyrix DX2/ DX4 (M7 /O)	Cyrix DX4 (iDX4 P/O) 5X86	TI DX4	AMD Am5x86
JP6	Open	Open	Open	Open	Open
JP7	2-3	2-3	2-3	2-3	1-2
JP8	Open	Open	1-2	Open	1-2
JP9	Open	Open	1-2	Open	1-2
JP10	1-2	1-2	1-2	1-2	1-2
JP12	Open	Open	Open	2-3	1-2
JP13	2-3	2-3	Open	2-3	Open
JP14	1-2	1-2	2-3	1-2	2-3
JP15	1-2, 3-4	1-2, 3-4	1-2, 3-4	1-2, 3-4	1-2, 3-4
JP16	3-4	3-4	3-4	3-4	3-4
JP17	2-3	2-3	1-2, 3-4	2-3	1-2, 3-4
JP18	2-3	2-3	1-2	2-3	1-2
JP19	Open	Open	2-3	Open	2-3
JP20	2-3	2-3	4-5	2-3	4-5
JP29	1-2	1-2	1-2	1-2	1-2

Cache Size	JP1	JP2	JP3	JP4	JP5
32 KB x 4 = 128 KB	1-2, 3-4	1-2	2-3	1-2	1-2
32 KB x 8 = 256 KB	2-3, 4-5	2-3	2-3	1-2	2-3
64 KB x 4 = 256 KB	1-2, 3-4	1-2	1-2	1-2	2-3
64 KB x 8 = 512 KB	2-3, 4-5	2-3	2-3	2-3	2-3
128 KB x 4 = 512 KB	1-2, 3-4	1-2	2-3	2-3	2-3

AP 5C

Jumper	Position	Function
JP3,4	1-2	ECP DMA Channel 3

Jumper	Position		Function
	2-3		ECP DMA Channel 1
JP5	1-2		Enable SMC 665GT Super I/O controller
	2-3		Disable
JP6	Closed		Enable PS/2 mouse
	Open		Disable
JP9-10	**JP9**	**JP10**	**CPU Type**
	1-2	1-2,3-4	P54-75
	2-3	1-2,3-4	P54C-90
	2-3	1-2,3-4	P54C-100
	2-3	3-4,5-6	P54C/CS/CQS-120
	2-3	3-4,5-6	P54C/CS/CQS-133
	2-3	5-6,7-8	P54CS/CQS-150
	2-3	5-6,7-8	P54CS/CQS-166
JP11	1-2,3-4		50 MHz host clock
	1-2		60 MHz host clock
	3-4		66 MHz host clock
JP12	1-2		256K cache
	2-3		512K cache
JP13	1-2		5v Flash ROM
	2-3		12v Flash ROM
JP14,16	**JP14**	**JP16**	**SRAM**
	Off	On	3.3V SRAM
	On	Off	3.3V/5V Mix Mode SRAM
JP15	1-2		Normal
	2-3		Clear CMOS

AP 5S

Jumper	Position			Function
JP1	1-2			Linear cache (Cyrix)
	2-3			Interleave cache (Intel)
JP6,7	1-2			ECP DMA Channel 3
	2-3			ECP DMA Channel 1
JP5,13	1-2, 3-4, 5-6			P54C CPU
JP8	1-2			12v Flash ROM
	2-3			5v Flash ROM
JP10	1-2			Enable PS/2 mouse
JP12	1-2			Normal
	2-3			Clear CMOS
JP16	1-2			Enable Super I/O controller
	2-3			Disable
JP18-20	**JP18**	**JP19**	**JP20**	**CPU voltage**
	Closed	Open	Open	VRE Type
	Open	Closed	Open	STD Type

CPU Frequency	JP3	JP4	JP14	JP15
75 MHz	2-3	2-3	2-3	2-3
90 MHz	2-3	1-2	2-3	2-3
100 MHz	1-2	2-3	2-3	2-3
120 MHz	2-3	1-2	2-3	1-2
133 MHz	1-2	2-3	2-3	1-2

CPU Frequency	JP3	JP4	JP14	JP15
150 MHz	2-3	1-2	1-2	1-2
166 MHz	1-2	2-3	1-2	1-2
200 MHz	1-2	2-3	1-2	2-3

AP 53

Jumper	*Position*		*Function*
JP3,13	**JP3**	**JP13**	**CPU Type**
	1-2,3-4	Open	Single voltage CPU
	Open	1-2,3-4	Dual voltage CPU
JP11	1-2		3.45v CPU core (default for P54C)
	3-4		3.52v
	5-6		2.5v
	7-8		3.2v
	9-10		2.8v
	11-12		2.9v
JP12	1-2		3.43v CPU I/O voltage
	3-4		3.52v

AP 55CS

Jumper	*Position*			*Function*
JP1	1-2			Linear cache (Cyrix)
	2-3			Interleave cache (Intel)
JP3	1-2,3-4,5-6			Reserved
JP4,6,7	**JP4**	**JP6**	**JP7**	**VGA**
	1-2	1-2	2-3	Enable
	Open	2-3	3-4	Disable
JP8	1-2			Reserved
JP11,12	2-3			ECP DMA 1
	1-2			ECP DMA 3
JP13	1-2,3-4,5-6			Reserved
JP14	1-2			Enable FDC and Super I/O chip
JP18	2-3,5-6			5v Flash ROM
	1-2,5-6			12v Flash ROM
	2-3,4-5			EEPROM
JP19	1-2			Normal
	2-3			Clear CMOS

CPU Type	JP9	JP10	JP22	JP23
P54C-75	2-3	2-3	2-3	2-3
P54C-90	2-3	1-2	2-3	2-3
P54C-100	1-2	2-3	2-3	2-3
P54C/CS/CQS-120	2-3	1-2	1-2	2-3
P54C/CS/CQS-133	1-2	2-3	1-2	2-3
P54CS/CQS-150	2-3	1-2	1-2	1-2
P54CS/CQS-166	1-2	2-3	1-2	1-2
Cyrix 6x86-P120+	2-3	2-3	Open	Open
Cyrix 6x86-P150+	2-3	1-2	Open	Open
Cyrix 6x86-P166+	1-2	2-3	Open	Open

AP 57

Jumper	*Position*			*Function*
JP7	1-2			3.45v CPU core (default for P54C)
	3-4			3.52v
	5-6			2.5v
	7-8			3.2v
	9-10			2.8v
	11-12			2.9v
JP8	1-2			3.43v CPU I/O voltage
	3-4			3.52v
JP9-11	**JP9**	**JP10**	**JP11**	**CPU Type**
	Close	Open	Close	Single voltage CPU
	Open	Close	Open	Dual voltage CPU

AP 65-1

Pentium Pro

Jumper	*Position*		*Function*
JP3	1-2		3x CPU clock
	2-3		2.5x CPU clock
JP5-6	**JP5**	**JP6**	**External bus clock**
	1-2	1-2	66 MHz
	2-3	2-3	60 MHz
JP7	1-2,3-4,5-6,7-8		3.5v
	3-4,5-6,7-8		3.4v
	1-2,5-6,7-8		3.3v
	5-6,7-8		3.2v
	1-2,3-4,7-8		3.1v
	3-4,7-8		3v
	1-2,7-8		2.9v
	7-8		2.8v
	1-2,3-4,5-6		2.7v
	3-4,5-6		2.6v
	1-2,5-6		2.5v
	5-6		2.4v
	1-2,3-4		2.3v
	3-4		2.2v
	1-2		2.1v
	Open		Auto
JP14	1-2		Normal
	2-3		Clear CMOS
JP18	1-2		Enable Super I/O controller
	2-3		Disable
JP20	2-3		Disable PS/2 mouse
	1-2		Enable

AX59 Pro

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium/K6	Super Socket 7

Item	Description	Notes
Cache	1 Mb	
Chipset	Via MVP3	
BIOS	Award	
Bus	4 PCI/2 ISA	UDMA/33
Memory (Mb)	768 Mb	3 DIMM sockets – 2 SIMM
I/O	2 EIDE, floppy	
Video		AGP
Performance		
Comments		

AX6BC Pro Gold

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III	Slot 1
Cache		
Chipset	440BX	
BIOS	Award	
Bus	5 PCI/2 ISA	UDMA/33
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2 EIDE, floppy, ser, par etc	
Video		AGP
Performance		
Comments		

AX63 Pro

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III	Slot 1
Speeds		133 FSB
Chipset	Via Apollo Pro 133	
BIOS	Award	
Bus	5 PCI	UDMA/33
Memory (Mb)	768 Mb	3 RIMM sockets
I/O	2 EIDE, floppy, ser, par etc	
Video		AGP 2x
Sound		
Comments		

AX6C

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III	Slot 1
Speeds		133 FSB
Chipset	820	
BIOS	Award	

Item	Description	Notes
Bus	5 PCI/1 AMR	UDMA/33
Memory (Mb)	768 Mb	3 RIMM sockets
I/O	2 EIDE, floppy, ser, par etc	
Video	AGP	
Sound		AC97 or AD 1881 onboard
Comments		

AX 65

Pentium Pro

Jumper	*Position*			*Function*
JP1	1-2,3-4,5-6,7-8			3.5v
	3-4,5-6,7-8			3.4v
	1-2,5-6,7-8			3.3v
	5-6,7-8			3.2v
	1-2,3-4,7-8			3.1v
	3-4,7-8			3v
	1-2,7-8			2.9v
	7-8			2.8v
	1-2,3-4,5-6			2.7v
	3-4,5-6			2.6v
	1-2,5-6			2.5v
	5-6			2.4v
	1-2,3-4			2.3v
	3-4			2.2v
	1-2			2.1v
	Open			Auto
JP3-4	**JP3**	**JP4**	**JP5**	**CPU Frequency**
	3-4	3-4,5-6,7-8	3-4	150 MHz
	1-2	3-4,5-6,7-8	1-2	166 MHz
	3-4	1-2,3-4,7-8	3-4	180 MHz
	1-2	1-2,3-4,7-8	1-2	200 MHz
JP6	2-3			Enable Super I/O controller
	1-2			Disable
JP7	2-3			Keyboard clock as ISA clock
	1-2			12 MHz
JP8	2-3			Disable PS/2 mouse
	1-2			Enable
JP10	2-3			Normal
	1-2			Clear CMOS
JP11,12	**JP11**	**JP12**		**Flash ROM boot block programming**
	1-2	1-2		Enable
	2-3	2-3		Reserved
JP14	2-3			Toggle type power switch
	1-4			Momentary type

AX 63

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1

Item	Description	Notes
Speeds (MHz)	500	
Chipset	VIA Apollo Pro Plus	
BIOS	Award 4.51PGM	
Bus	5 PCI/2 ISA	
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	UDMA/66
Video		AGP

AX 6B(C)(Pro)

Pentium II – Jumperless, except for:

Jumper	*Position*	*Function*
JP14	1-2	Normal
	2-3	Clear CMOS
JP23	1-2	Auto AGP Turbo
	2-3	Enabled

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Speeds (MHz)	500	
Chipset	440BX	
BIOS	Award 4.51PGM	
Bus	5 PCI/2 ISA	8x CPU clock multiplier
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	
Video		AGP
Performance		Good – better than Gigabyte GA-6BXF

AX 6C

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Speeds (MHz)		
Chipset	Intel 820	
BIOS	Award 4.51PGM	
Bus	5 PCI	
Memory (Mb)	768 Mb	3 RIMM sockets (RDRAM)
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	UDMA/66
Video		AGP 4x

AX 6F

Pentium II

Jumper	*Position*			*Function*
JP1-2	**JP1**	**JP2**	**JP3**	**Clock Multiplier**
	2-3	1-2	2-3	1.5x

Jumper	Position			Function
	1-2	1-2	1-2	2x
	1-2	1-2	2-3	2.5x
	1-2	2-3	1-2	3x
	1-2	2-3	2-3	3.5x
	2-3	1-2	1-2	4x
	2-3	1-2	2-3	4.5x
	2-3	2-3	1-2	5x
	2-3	2-3	2-3	5.5x
	1-2	1-2	1-2	6x
	1-2	1-2	2-3	6.5x
	1-2	2-3	1-2	7x
	1-2	2-3	2-3	7.5x
	2-3	1-2	1-2	8x
JP5,6	**JP5**	**JP6**		**CPU External clock**
	1-2	1-2		66 MHz
	2-3	2-3		60 MHz
JP14	1-2			Normal
	2-3			Clear CMOS

AX 6L(C)

As for AX 6B(C), except no JP23

MX3W

Item	Description	Notes
Form Factor	Micro-ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		100 FSB
Chipset	Intel 810	
BIOS	Award	
Bus	3 PCI 1 AMR	
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy, joystick, audio	

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Apricot

Xen-I 386

Jumper	Position	Function
J1	In	256K ROM
	Out*	512K ROM

Jumper	*Position*		*Function*		
J3	In		Disable reset		
	Out*		Enable reset		
J4	In		Non-latched mode		
	Out*		Latched mode		
J5	In		Disabled ROM		
	Out*		Enabled ROM		
J6	ST 506 interface		Not used		
J7	ST 506 interface		Step rate selected		
S1	On*		Enable parallel port		
	Off		Disable parallel port		
S2	On*		Enable serial port		
	Off		Disable serial port		
S3	On*		Colour display		
	Off		Mono display		
S5,6	**Memory**		**5**	**6**	**PAL Type**
	1 Mb	256K	Off	On	LEP8047VA
	2 Mb	256K	On	Off	LEP8047VA
	4 Mb	1 Mb	Off	On	L4M047VA
	5 Mb	1 Mb/256K	On	Off	L4M047VA
	8 Mb	1 Mb	Off	Off	L4M047VA
S7,8			Reserved – do not use		

Xen-S

Jumper	*Position*	*Function*		
SW1,2	**Processor**	**SW1**	**SW2**	
	80386sx	On	Off	
	80286	Off	On	
SW3,5,6	**Monitor**	**SW3**	**SW5**	**SW6**
	Enable colour	On	On	On
	Disable colour	Off	Off	Off
SW4	On	12.5 MHz		
	Off	16 MHz		
SW7		Processor 20 MHz override		
SW8		Corpocessor speed select		
SW9-S1	On	Enable password		
	Off	Disable password		
SW9-S2	On	Enable COM1		
	Off	Disable COM1		
SW9-S3	On	Enable floppy		
	Off	Disable floppy		
SW9-S4	On	Enable HD controller		
	Off	Disable HD controller		
SW9-S5	On	Enable COM2		
	Off	Disable COM2		
SW9-S6	On	Enable Ethernet		
	Off	Disable Ethernet		
SW9-S7	On	Enable LPT1		
	Off	Disable LPT1		
SW9-S8	On	Enable colour		
	Off	Disable colour		

Jumper	Position	Function
SW10	On	Enable thick Ethernet cable
	Off	Disable thick Ethernet cable

Aprocom

www.aprocom.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
AC	Nex586v		

Nex586v

Fordlian 5IVXA

Arche

Parade 88

Jumper	Position	Function
JP15	Out	Parallel port=LPT1
	In	Parallel port=LPT2
JP11	In	Enable game port
	Out	Disable game port
JP16	1-2	Enable floppy
	2-3	Disable floppy
JP10	In	Composite signal monitors
	Out	Colour/multiscan monitors
JP12	1-2	Clock 1 enable
	2-3	Clock 2 disable

Rival 386

Jumper	Position	Function	
JP1,2	**CoProcessor**	**JP1**	**JP2**
	There	Out	In
	Not there*	In	Out
JP3	In	Colour display	
	Out	Mono display	
JP4(P4)	1-2*	Power Good from Power Supply	
	2-3	Power Good generated on board	
JP5	In*	Onboard rechargeable battery	

Jumper	*Position*	*Function*
	Out	External battery on J4

Parade 286

ATM 1260V

Jumper	*Position*	*Function*		
J1	Out	Other BIOS 27128 x 2 (U28L/U27H)		
	In	DTK BIOS or other 27256 x 2 (U28L/U27H)		
J9,15,17	**Parallel Port**	**J15**	**J17**	**J9**
	LPT1 enabled	In	In	1-2
	LPT2 enabled	Out	Out	2-3
	LPT1 disabled	Out	In	
	LPT2 disabled	In	Out	
J18,21	**Serial Port 1&3**	**J18**	**J21**	
	COM1 enabled	In	In	
	COM3 enabled	Out	Out	
	COM1 disabled	Out	In	
	COM3 disabled	In	Out	
J19,20	**Serial Port 2&4**	**J18**	**J21**	
	COM2 enabled	In	In	
	COM4 enabled	Out	Out	
	COM2 disabled	Out	In	
	COM4 disabled	In	Out	
J22	In	Colour display		
	Out	Mono display		
J8	In	1 wait state		
	Out	0 wait state		
J16	In	Enable floppy		
	Out	Disable floppy		
J10,11	Display	J10	J11	
	Enable Mono	In	In	
	Disable Mono	Out	Out	

Parade 286 Plus

AMA1240V3

Jumper	*Position*	*Function*				
S3	On	Parity check enabled				
	Off	Parity check disabled				
S4	On	EMS port address 0E8-0EFH				
	Off	EMS port address 098-09FH				
S6-8	**Memory Size**	**S6**	**S7**	**S8**	**Bank0**	**Bank1**
	512K	On	On	On	512K	None
	640K	On	On	Off	512K	
	640+384K	On	Off	On	512K	512K
	640+384K (24 EMS)	On	Off	Off	512K	512K
	640+1408K	Off	On	On	2Mb	None

Jumper	*Position*	*Function*				
	640+1408K (88 EMS)	Off	On	Off	2Mb	None
	640+3456K	Off	Off	On	2Mb	2Mb
	640+3456K (216 EMS)	Off	Off	Off	2Mb	2Mb
JP7,9	**Clock speed**	**JP7**	**JP9**			
	External	In	1-2			
	Low speed	Out				
	High speed	Out				
JP12	1-2	IRQ7				
	2-3	IRQ5				
JP13	1-2	IRQ4				
	2-3	IRQ5				
JP14	1-2	IRQ3				
	2-3	IRQ5				
JP15	1-2	COM1 address 3E8-3EF				
	2-3	COM1 address 3F8-3FF				
JP16	1-2	COM2 address 2E8-2EF				
	2-3	COM2 address 2F8-2FF				
JP17	1-2	LPT1 address 378-37F				
	2-3	LPT1 address 278-27F				
JP18	1-2	Floppy address 3F0-3F7				
	2-3	Floppy address 370-377				
JP19	1-2	2-speed drive				
	2-3	Fixed speed drive				
J20	1-2	Enable floppy				
	2-3	Disable floppy				
J23-25	**HD Status**	**J23**	**J24**	**J25**		
	Enabled	1-2	1-2	1-2		
	Disabled	2-3	2-3	2-3		

AMA232C-16S

Jumper	*Position*	*Function*	
JP1	1-2*	Normal ops	
	2-3	Clear CMOS	
JP3	1-2*	Enable floppy	
	2-3	Disable floppy	
JP4	1-2*	Enable COM2	
	2-3	Disable COM2	
JP5	1-2*	Enable parallel port	
	2-3	Disable parallel port	
JP6	1-2*	Enable COM1	
	2-3	Disable COM1	
JP7	In*	Enable Onboard HD	
	Out	Disable Onboard HD	
JP11	1-2	1 VGA BIOS	
	2-3	2 VGA BIOS	
JP13	1-2	Non-interlaced monitor	
	2-3	Interlaced monitor	
JP14	In	Enable IRQ9	
	Out	Disable IRQ9	
JP15,16	**Display type**	**JP15**	**JP16**
	Enable VGA	In	In

Jumper	*Position*	*Function*	
	Disable VGA	Out	Out
JP17	1-2	256K BIOS	
	2-3	128K BIOS	
JP23	1-2	1 VGA BIOS	
	2-3	2 VGA BIOS	

KMA232F-12S

Jumper	*Position*	*Function*					
S1-1	On*	Reserved – do not change					
S1-2	Off	48-49KHz horizOntal scan (non-interlaced)					
	On	Lower scan rates (interlaced)					
S1-3	Off	Fast address decode					
	On	Slow address decode					
S1-4	Off*	16-bit data path (VGA)					
	On	8-bit data path (VGA)					
JP1	Out	Disable HD					
	In	Enable HD					
JP3,J3	**LPT address**	**J3**	**JP2**				
	378	LPT1	2-3				
	278	LPT2	278				
JP4	1-2	Enable COM2					
	2-3	Disable COM2					
JP3	1-2*	Enable floppy					
	2-3	Disable floppy					
JP6	Out*	Normal ops					
	In	Allows use of network cards without IRQ9 conflict					
JP7	In*	Enable CGA					
	Out	Enable Mono					
JP8-13	1-2	SIMMs					
	2-3	DIP DRAM					
JP14-16	**DRAM size**	**Base**	**Ext**	**Shad**	**JP14**	**JP15**	**JP16**
		512			In	In	In
		640	384		In	In	Out
		640			In	Out	In
		640	256	128	In	Out	Out
		640	1408		Out	In	In
		640	1280	128	Out	In	Out
		640	3328	128	Out	Out	Out
JP18		**2 DRAM**	**4 DRAM**				
			3-4				
		2-4	1-2				
JP17	1-2	Maths copro 12 MHz					
	2-3	Maths copro 8 MHz					
	All in	Maths copro 4 MHz					

Parade 386sx

AMA1600V

Jumper	*Position*	*Function*
JP1	In*	CGA
	Out	Mono

Jumper	Position	Function
JP3	In*	Enable HD
	Out	Disable HD
JP6	1-2	Enable floppy
	2-3*	Disable floppy
JP11	In*	Pipeline operation
	Out	Non-pipeline
JP19	In*	Floppy IRQ enabled
	Out	Floppy IRQ disabled

Parade 386sx

KMA932C-16S

Jumper	Position	Function	
JP2,17	**Floppy**	**JP2**	**JP17**
	Enable	In	Out
	Disable	Out	In
JP16	In*	Primary display VGA	
	Out	Primary display Mono	
JP18	In*	Enable 1st serial port	
	Out	Enable 1st serial port	
JP19	In*	Enable 2nd serial port	
	Out	Enable 2nd serial port	
JP20	In*	Enable HD	
SW1-S1	On	Multifrequency display timing	
	Off	Standard frequency timing	
SW1-S2	On	PS/2 style - all VGA modes	
	Off	AT style – colour modes on colour monitors, Mono on Mono	
SW1-S3		Reserved	
SW1-S4	On	16-bit video memory path – autosense 16-bit BIOS	
	Off*	8-bit video memory path and BIOS	

Rival 386sx

AMA2000

Jumper	Position	Function
JP1	In	Mono display
	Out	Colour display
JP2	1-2	Clear CMOS
	2-3*	Normal ops
JP4	In*	Pipeline operation
	Out	Non-pipeline

Rival 386-20

PAT386+

Jumper	Position	Function
JP1	In*	Onboard battery
	Out	External battery on J2
JP2	In*	Colour display
	Out	Mono display

JP4	1-2*	Power good generated on board		
	2-3	Power good from power supply		
JP5	1-2	CPU Clock (SCLK)		
	2-3	Oscillator 3		
JP6,7	**Maths copro**	**JP6**	**JP7**	
	Not there	In*	Out	
	There	Out	In	
J4	1-2*	Turbo mode		
	3-4	Deturbo (emulate 10MHz AT)		

Rival 386-25C

KMA300G-25

Jumper	*Position*	*Function*		
JP3	1-2	Clear CMOS		
	2-3*	Normal ops		
JP4	In*	Pipeline		
	Out	Non-pipeline		
JP5	1-2*	Enable CPU NMI pin		
	2-3	Disable CPU NMI pin		
JP6	1-2*	Enable CPU hold (Bus hold request) pin		
	2-3	Disable CPU hold (Bus hold request) pin		
JP7	1-2*	Enable CPU INIR		
	2-3	Disable CPU INIR		
JP8	1-2*	ATCLK from ICLK/2		
	2-3	ATCLK from 14.318 MHz OSC/2		
JP10		Reserved		
JP12,13,20	**Cache**	**JP12**	**JP13**	**JP20**
	32K	Out	1-2	1-2
	64K	In	2-3	2-3
JP18	In*	Colour display		
	Out	Mono display		

Rival 386-25

AMA2530

Jumper	*Position*	*Function*
W1	1-2	128K EPROM
	2-3*	256K EPROM
W19	In*	8 MHz bus speed
	Out	12.5 MHz bus speed
JP1	In	256K SIMM DRAM
	Out*	1Mb SIMM DRAM
W21	1-2	Cache mode
	2-3*	Page mode
SW1-1		Reserved
SW1-2	On	Maths copro installed
SW1-3	On	CKM=0, CLK divided internally by 3 by 80287
	Off	CKM=1, 1/3 duty cycle CLK connect to 80287
SW1-4,5		Reserved
SW1-6	On	CGA
	Off	Mono

Jumper	*Position*	*Function*
SW1-7	On	80387 installed, if SW1-2 is On
	Off	80287 installed, if SW1-2 is On
SW1-8		Reserved

Arima

Aristo

www.aristo-world.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C-00	AM 430TX	EC-00	AM 439VX
EC	AM 430TX+	GC	AM 430TX+

AM 430TX

Vtech/PC Partner MB 540N/Yellow Dragon TX

AM 439VX

VTech/PC Partner MB 520NH

Arvida

See also Seanix
www.arvida.ca
www.seanix.com

ASI

Aquarius Systems Inc
(818) 369 3690

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0	MB 4D33/50NR-02	1-00	MB 4DUVC

Code	Motherboard	Code	Motherboard
0-30	MB 4D33/50NR-02	2	MB 54VP v2.1
1	MB 5DVP/54VP v2.1	9C-00	MB 4DSP 1.1
1	MB 4DUPM/E v3.0	KC-00	MB 4DUPC

ASK Technology

www.asiansources.com/asktech.co

Aspen Systems

www.aspsys.com

AST

Advantage! 4/33s

Jumper	*Position*	*Function*				
E1	1-2*	Parallel port IRQ7				
	2-3	Parallel port IRQ5				
E2	On	25 MHz CPU external speed				
	Off	33 MHz CPU external speed				
E3	On*	Enable VGA				
E4	On	Primary display Mono				
	Off*	Primary display colour				
E5	On	Override password (borrow jumper at E1)				
	Off*	Enable password				
E6-10	**CPU**	**E6**	**E7**	**E8**	**E9**	**E10**
	80486SX (PQFP)	1-2	On	2-3	1-2	2-3
	80486SX (PGA)	1-2	Off	1-2	2-3	1-2
	80487SX/ODP	1-2	On	2-3	1-2	2-3
	80486DX/DX2/ODPR	1-2	On	1-2	2-3	2-3
	Pentium Overdrive	2-3	On	2-3	1-2	2-3
E14	On*	Enable game port (501540 only)				

Advantage! 4/50(s)(d)

As for Advantage! 4/33s

Advantage! Adventure 4/33s

As for Advantage! 4/33s

Advantage! Adventure 4/50(s)(d)

As for Advantage! 4/33s

Advantage! 4050d

As for 4066d.

Advantage! 4066d

Jumper	486SX	486DX 486DX2	487SX	486SX 486SL	486DX DX2/SL	Cyrix DX2-SL	AMD DX2-SL
1201	Off	On	On	Off	On	On	On
1202	2-3	1-2	1-2	2-3	1-2	1-2	1-2
1203	Off	Off	Off	On	On	Off	Off
1204	Off	Off	Off	On	On	Off	Off
1205	Off	Off	Off	Off	Off	Off	Off
1206	Off	2-3	1-2	Off	2-3	2-3	2-3
1207	Off	Off	Off	On	On	Off	Off
1208	Off	Off	Off	2-3	2-3	2-3	1-2
1209	Off	Off	Off	Off	Off	Off	On
1210	Off	Off	Off	Off	Off	Off	On
1211	Off	Off	Off	Off	Off	Off	On*
1212	Off	Off	Off	Off	Off	On	Off
1213	Off	Off	Off	Off	Off	On	Off
1301	1-2	1-2	1-2	1-2	1-2	2-3	2-3
1302	1-2	1-2	1-2	1-2	1-2	2-3	2-3

* on means that pins 1-2, 3-4 and 5-6 are covered by a jumper.

Jumper	25/50 MHz	33/66 MHz
1171	Off	On
1172	Off	On
1173	On	On

Jumper	5v	3.3v
1214	On	Off
1215	Off	On
1216	2-3	2-3
1217	Off	On

Advantage! 4075p

Jumper	*Position*			*Function*
1020				Test – leave Off
1104				Test – leave Off
1152-4	**1152**	**1153**	**1154**	**CPU speed**
	On	Off	Off	50/75 MHz*
	Off	On	Off	60/90 MHz
	On	Off	On	66/100 MHz
1350	Off*			Standard LPT
	2-3			ECP
1351	Off*			Standard LPT
	2-3			ECP

Jumper	*Position*	*Function*
1505		See table
1506		Test – leave Off
1961	Off*	Normal boot
	On	Clear CMOS at boot

Total	1501 (Bk 0)	1502 (Bk 1)	1503 (Bk 1)	1504 (Bk 1)	1505
2	1	1	-	-	Off
4	1	1	1	1	1-2
4	2	2	-	-	Off
8	2	2	2	2	2-3
8	4	4	-	-	Off
16	4	4	4	4	1-2
16	8	8	-	-	Off
20	2	2	8	8	2-3
32	8	8	8	8	2-3
32	16	16	-	-	Off
36	16	16	8	8	1-2
40	4	4	16	16	1-2
48	8	8	16	16	2-3
64	16	16	16	16	1-2
64	32	32	-	-	Off
80	8	8	32	32	2-3
128	32	32	32	32	2-3

Advantage! 6033s

Jumper	*Position*	*Function*				
E1	1-2*	Parallel port IRQ 7				
	2-3	Parallel port IRQ 5				
E2	On	CPU external speed 25 MHz				
	Off	CPU external speed 25 MHz				
E3	On*	Enable VGA				
E4	On	Mono				
	Off*	CGA				
E5	On	Override password				
	Off*	Allow password				
		To override a password, borrow the jumper at E1 (don't forget to replace it).				
E6-10	**CPU**	**E6**	**E7**	**E8**	**E9**	**E10**
	80486SX (PQFP)	1-2	On	2-3	1-2	2-3
	80486SX (PGA)	1-2	Off	1-2	2-3	1-2
	80487SX; ODP	1-2	On	2-3	1-2	2-3
	80486DX; DX2; ODPR	1-2	On	1-2	2-3	2-3
	Pentium Overdrive	2-3	On	2-3	1-2	2-3
E14	On	Update BIOS at boot				
	Off*	Normal boot				
E17		Reserved – leave on 2-3				
E18		Microphone input – leave Off				

Advantage! 6060p

Jumper	*Position*	*Function*					
E1	1-2	Future upgrades					
	2-3*	Pentium 75/90/100					
E2,3,7	**Bus Speed (MHz)**	**E2**	**E3**	**E7**	**E2**	**E3**	**E7**
	50 (P75)	Off	On	On	Off	On	Off
	60 (P90)	Off	On	Off	Off	On	On
	66 (P100)	On	On	Off	On	On	On
		Left set of figures apply if an IMI415 is at U7. Right set apply if an IMI470 is installed.					
E4		Manufacturer test					
E5		Manufacturer test					
E6		Manufacturer test					
E8		Manufacturer test					
E9	On*	Colour					
	Off	Mono					
E10	On*	Enable access to setup					
	Off	Disable access to setup					
E11	On*	Enable video					
	Off	Disable video					
E12	On*	Allow password					
	Off	Override Password					
E13	On*	Normal boot					
	Off	Force flash update at boot					

Advantage! 6066d

As for Advantage! 610/611

Advantage! 6075p

As for Advantage! 6060p, except E14 (On=update BIOS at boot. Off=normal).

Advantage! 610

Jumper	*Position*	*Function*				
E1	Off*	Reserved				
E2	Off*	Reserved				
E3	On*	Enable VGA				
	Off	Disable VGA				
E4	On	Mono				
	Off*	CGA				
E5	On	Override password				
	Off*	Allow password				
E6-10	**CPU**	**E6**	**E7**	**E8**	**E9**	**E10**
	80486SX	1-2	Off	Off**	2-3	1-2
	80487SX; ODP	1-2	On	Off**	1-2	2-3
	80486DX; DX2; ODPR	1-2	On	Off**	2-3	2-3
	Pentium Overdrive	2-3	On	Off**	2-3	2-3
		** E8 is reserved – always Off				
		Socket set for 3.345v				

Jumper	*Position*	*Function*
E14	On	Update BIOS at boot
	Off*	Normal boot
E17		Reserved – leave on 2-3
E18		Microphone input – leave Off

To override a password or force a flash BIOS update, borrow the jumper from E7 (don't forget to replace it).

Advantage! 611

As for 610, except:

CPU	E6	E7	E9	E10
Cyrix 5x86	1-2	Off	2-3	2-3
486DX4/100	1-2	Off	2-3	2-3
OverDrive	1-2	Off	1-2	2-3

Advantage! 612

Jumper	*Position*	*Function*		
J4 K1	1-2	ISA bus 1/3 PCI clock speed		
	2-3*	ISA bus ¼ PCI clock speed		
	4-5*	Allow access to setup		
	5-6	Deny access to setup		
J5 J1-2	**CPU speed**	**PCI**	**J1**	**J2**
	75	25	1-2,4-5	1-2,4-5
		30	1-2,5-6	1-2,4-5
	90	33	2-3,4-5	1-2,4-5
	100	30	1-2,5-6	2-3,4-5
	120	33	2-3,4-5	2-3,4-5
	133	30	1-2,5-6	2-3,5-6
	150	33	2-3,4-5	2-3,5-6
	166			
J5 K2	1-2*	Normal boot		
	2-3	Clear CMOS at boot		
	4-5*	Enable password		
	5-6	Clear and disable password		
J6 A2	1-2*	Standard CPU voltage (3.3v)		
	2-3	VRE CPU voltage (3.6v)		

Advantage! 613e

As for Advantage! 611

Advantage! 614

As for Advantage! 612

Advantage! 621

As for Advantage! 612

Advantage! 623/624

As for Advantage! 612

Advantage! 625/626

As for Advantage! 612

Advantage! 628

As for Advantage! 612

Advantage! 7301

Jumper	*Position*		*Function*	
J1F1A	1-2*		Normal boot	
	2-3		Erase password	
	4-5*		Normal boot	
	5-6		Reset CMOS at boot	
J1F1B	1-2*		Allow access to CMOS setup	
	2-3		Deny access	
	4-5		Standard CPU voltage (3.3v)	
	5-6		VRE CPU voltage (3.6v)	
J1F1	**CPU**	**PCI**	**J1F1C**	**J1F1D**
	25		2-3,5-6	1-2,4-5
	30		2-3,4-5	1-2,4-5
	100	33	1-2,5-6	1-2,4-5
	120	30	2-3,4-5	2-3,4-5
	133	33	1-2,5-6	2-3,4-5
	150	30	2-3,4-5	2-3,5-6
	166	33	1-2,5-6	2-3,5-6
	180	30	2-3,4-5	1-2,5-6
	200	33	1-2,5-6	1-2,4-5
J5G1	1-2,4-5*		Manufacturer's test	

60 ns EDO RAM is installed at the factory. You can mix EDO and FPM but not within banks

Advantage! 7302

As for 7301.

Advantage! 7303

As for 7301, but with J9B1 for Flash BIOS recovery in position 2-3 (1-2 is default for normal boot).

Advantage! 8066d

Switch	*Position*	*Function*
S1	On	Force flash BIOS update at boot
	Off*	Normal boot
S2	On*	Allow password
	Off	Override password
S3	On*	Primary display colour
	Off	Primary display is Mono
S4	On	Deny access to setup
	Off*	Allow access
S5	On*	Enable VGA
	Off	Disable
S6		Reserved
S7		Reserved
S8		Reserved

Advantage! 8090p

As for 6075p.

Advantage! 810

As for 612.

Advantage! 811

As for 612.

Advantage! 812

As for 612.

Advantage! 814

As for 612.

Advantage! 816

As for 612.

Advantage! 818

As for 612.

Advantage! 821

As for 612.

Advantage! 822

As for 612.

Advantage! 823

As for 612.

Advantage! 824

As for 612.

Advantage! 826

As for 612.

Advantage! 828

As for 612.

Advantage! 9303

As for 7301, but with J9B1 for Flash BIOS recovery in position 2-3 (1-2 is default for normal boot).

Advantage! 9304

As for 7301.

Advantage! 9306

As for 7301.

Advantage! Adventure 8060p

As for Advantage! 6060p except E4-E6 depend on the board version – look under the AST logo for a part number with an extension of either –3-1 or –302. For the former, E4-E6 should be Off. For the latter, E4 in means cache is installed. E4-E6 on means no external cache.

Advantage! Adventure 8066d

Jumper	*Position*	*Function*
E1	On	Overdrive L1 cache write through
	Off	Overdrive L1 cache write back
E2	1-2	Disable PQFP CPU
	2-3	Enable
E3	1-2	Standard 486SX or DX
	2-3	Pentium Overdrive or w/b 486DX

Jumper	*Position*	*Function*
		see also E10
E4	Off	3x internal CPU speed (DX4)
	1-2	2.5x
	2-3	2x
E5	On	256K L2 cache
	Off	64K L2 cache
E6		Reserved – leave on 1-2
E7	1-2	25 MHz PCI bus speed
	2-3	33 MHz PCI bus speed
E8	On	Clear CMOS at boot
	Off	Normal boot
E9	On	25 MHz host bus speed
	Off	33 MHz
		See also E7
E10	On	Standard 486 PGA CPU (w/t cache)
	Off	Enhanced 486 PGA CPU (w/b cache)
E11	1-2	Intel CPU
	2-3	Cyrix CPU
E12	1-2	Intel CPU
	2-3	Cyrix CPU
E13	1-2	Intel CPU
	2-3	Cyrix CPU
E14	1-2	Intel CPU
	2-3	Cyrix CPU
E15	On	Intel CPU
	Off	Cyrix CPU
E16	Off	5v Intel/Cyrix CPU
	1-2	3v Cyrix
	2-3	3v Intel

Switch	*Position*	*Function*
S1	On	Force flash BIOS update at boot
	Off*	Normal boot
S2	On*	Allow password
	Off	Override password
S3	On*	Primary display colour
	Off	Mono
S4	On	Deny access to setup
	Off*	Allow access
S5	On*	Enable VGA
	Off	Disable
S6		Reserved – leave On
S7		Reserved – leave On
S8		Reserved – leave On

Advantage! Adventure 8075p

As for Advantage! 6060p.

Advantage! Adventure 8090p

As for Advantage! 6060p except E4-E6 depend on the board version – look under the AST logo for a part number with an extension of either –3-1 or –302. For the former, E4-E6 should be Off. For the latter, E4 in means cache is installed. E4-E6 on means no external cache.

Advantage! Adventure 8100p

Jumper	*Position*		*Function*
S1			Reserved – leave On
S2			Reserved – leave On
S3	On		Override password
	Off*		Allow password
S4	On		Clear CMOS
S5	On		Deny access to setup
	Off*		Allow access
S6	Off		CPU speed external x 1.5
	On		CPU speed external x 2
S7-8	**7**	**8**	**CPU external speed**
	Off	Off	75 MHz
	On	Off	90 MHz
	Off	On	100 MHz
	On	Off	120 MHz
	Off	On	133 MHz

J5J1 should left on 1-3 and 5-7 and J9C1 on 2-3 for 100/133 MHz. Change J9C1 to 1-2 for 120 MHz (VRE). For a failed BIOS update, force a read of an update file from floppy by moving J5J1 to position 1-2.

Advantage! Adventure 8120p

As for Adventure 8100p.

Advantage! Adventure 8133p

As for Adventure 8100p.

Advantage! EXP P/60

Jumpers are in 3-pin blocks, grouped in pairs, positioned front-rear looking from the front.

230822-001 board

Jumper	*Position*	*Function*
J7A1	Rear L Pair	Enable video
	Front L Pair	Disable
	Rear R Pair	60 MHz
	Front R Pair	66 MHz
J13H3	Rear L Pair	Primary display colour
	Front L Pair	Primary display Mono

Jumper	*Position*	*Function*
	Rear R Pair	Disable access to CMOS
	Front R Pair	Enable access
J13H1	Rear L Pair	Clear CMOS at boot
	Front L Pair	Disable
	Rear R Pair	Disable password
	Front R Pair	Enable password
J12H1	Rear L Pair	Disable flash BIOS recovery
	Front L Pair	Enable flash BIOS recovery
	Rear R Pair	Disable flash BIOS write protect
	Front R Pair	Enable

230822-002 board

Jumper	*Position*	*Function*
J7A1		Inactive
	Rear R Pair	60 MHz
	Front R Pair	66 MHz
J12G5	Rear L Pair	Primary display colour
	Front L Pair	Primary display mono
	Rear R Pair	Disable access to CMOS
	Front R Pair	Enable access
J12G1	Rear L Pair	Clear CMOS at boot
	Front L Pair	Disable
J12H1	Rear R Pair	Disable password
	Front R Pair	Enable password
	Rear L Pair	Disable flash BIOS recovery
	Front L Pair	Enable flash BIOS recovery
	Rear R Pair	Disable flash BIOS write protect
	Front R Pair	Enable

Advantage! Plus 4/25

Jumper	*Position*	*Function*			
E1	Off	Reserved			
E2	Off	Reserved			
E3	On*	Enable video			
	Off	Autosense add-in video			
E4	On	Primary display Mono			
	Off*	Primary display colour			
E5	On	Override password (borrow jumper at E7)			
	Off*	Enable Password			
E6,7,9,10	**CPU**	**E6**	**E7**	**E9**	**E10**
	80486SX	1-2	Off	2-3	1-2
	80486DX/DX2	1-2	On	2-3	2-3
		Upgrades are not supported			
E8	Off	Reserved			
E14	On	Update BIOS at boot			
	Off*	Normal ops			
E16	Off	Reserved			

Advantage! Plus 4/33 (Mylex)

Jumper	*Position*				*Function*
JP1	On*				Colour display
	Off				Mono
JP8-10	**JP8**	**JP9**	**JP10**		**CPU Type**
	Off	2-3	Off		486SX
	2-3	1-2	On		487SX
	1-2	1-2	On		DX, DX2
	2-3	1-2	On		ODP
	1-2	1-2	On		ODPR
JP7, 11-13	**JP7**	**JP11**	**JP12**	**JP13**	**Cache Size**
	Off	Off	Off	Off	64K/none
	On	On	Off	On	256K
JP14-17	**JP14**	**JP15**	**JP16**	**JP17**	**CPU Speed**
	2-3	2-3	1-2	2-3	25/50 MHz
	2-3	1-2	1-2	2-3	33/66 MHz
JP18	Off				Reserved
JP19	1-2				LPT IRQ5
	2-3*				LPT IRQ7
JP20	1-2*				Enable I/O
	2-3				Disable
JP21	Off				External battery at JP22
	1-2				Clear CMOS
	2-3*				Internal battery

Advantage! Plus 4/33 (MT)

Jumper	*Position*					*Function*
S1	On					Disable video
S2	Off					Reserved
S3	On					Force flash BIOS update at boot
	Off*					Normal boot
S4	On					Override password
	Off*					Enable password
S5	On*					Primary display colour
	Off					Mono
S6	Off					Reserved
S7	Off					Reserved
S8	On					Deny access to setup
	Off*					Allow access
E5	On					Clear CMOS at boot
	Off*					Normal boot
E6-8	**E6**	**E7**	**E8**			**Cache size**
	1-2	Off	Off			64K/none
	2-3	On	On			256K
E9-13	**E9**	**E10**	**E11**	**E12**	**E13**	**CPU Type**
	Off	2-3	1-2	Off	2-3	486SX
	1-2	1-2	2-3	On	2-3	487SX
	2-3	1-2	1-2	On	2-3	DX, DX2
	1-2	1-2	2-3	On	2-3	Overdrive (ODP)
	2-3	1-2	1-2	On	2-3	Overdrive (ODPR)
	1-2	1-2	2-3	On	1-2	Pentium Overdrive

Jumper	*Position*	*Function*
E14	1-2	Reserved
E15	1-2*	LPT IRQ7
	2-3	LPT IRQ5
E16	On	CPU external speed 33 MHz
	Off	CPU external speed 25 MHz
E800		Reserved – leave on 2-3
E801		Reserved – leave on 1-2
E802	1-2	Enable monitor power conservation
	2-3*	Disable
E803		Reserved – leave on 1-2
E804		Reserved – leave on 1-2

Advantage! Plus 4/50d

As for Advantage Plus 4/25

Advantage! Plus 4/50d (Mylex)

As for Advantage! Plus 4/33 (Mylex).

Advantage! Plus 4/66d

As for Advantage Plus 4/25

Advantage! Plus 4/66d (Mylex)

As for Advantage! Plus 4/33 (Mylex).

Advantage! Plus 4/66d (MT)

As for Advantage! Plus 4/33 (MT).

Advantage! Plus 5/100

Jumper	*Position*		*Function*				
JP1	On		VGA IRQ enabled				
	Off*		VGA IRQ disabled				
JP3-5	**CPU**	**Bus (MHz)**	**JP3**	**JP4**	**JP5**	**BF0**	**BF1**
BF0,BF1	50		Off	Off	Off	1&2	Off
	66		On	Off	On	1&2	Off
	50		On	Off	Off	2&3	Off (Cyrix M1)
	60		On	On	Off	2&3	Off (Cyrix M1)
	66		On	Off	On	2&3	Off
	60		On	On	Off	2&3	On
	166	66	On	Off	On	2&3	On
JP8	1-2*		Asynchronous L2 cache				
	2-3		Synchronous Pipeline Burst L2 cache				
JP9	On		CPU VR voltage (3.3-3.4v)				
	Off		CPU VRE voltage (3.4v-3.6v)				

Jumper	*Position*	*Function*
JP14	On*	Allow password
	Off	Override password

Advantage! Plus 5/75

Jumper	*Position*	*Function*						
JP1,19	**CPU Ext Speed (MHz)**	**JP1**	**JP19**					
	20	1-2						
	25	3-4						
	33*	1-2	5-6					
JP2	On*	Allow password						
	Off	Override and erase password						
JP3-9	**CPU Type**	**JP3**	**JP4**	**JP5**	**JP6**	**JP7**	**JP8**	**JP9**
	i486/Cyrix 5x86*	Off	On	On	On	Off	On	Off
	Cyrix 486	On	Off	Off	Off	Off	Off	On
		See also JP20-23						
JP11	1-2*	DX CPU						
	2-3	SX CPU						
JP16	1-2*	128K L2 cache						
	2-3	256K L2 cache						
JP17	1-2*	Leave on pins 1-2 (L2 cache size)						
JP20-23	**CPU Type**	**JP20**	**JP21**	**JP22**	**JP23**			
	i486/Cyrix 5x86*	Off	Off	Off	Off			
	Cyrix 486	On	Off	On	Off			
		See also JP 3-9						
JP29	On*	Enable video						
JP30	On*	Primary display colour						
	Off	Primary display Mono						
JP31	On*	Normal boot						
	Off	Force flash update at boot						
V1-V4	On	5v						
	Off*	3.45v						

Advantage! Plus EXP P/60

Jumper	*Position*	*Function*
S1		Reserved – leave Off
S2	On*	Colour adapter
	Off	Mono
J17,25	None	No DMA channel for EPP
	1-2	Channel 0
	3-4	Channel 1
	5-6	Channel 2
J18	1-2*	LPT IRQ7
	2-3	LPT IRQ5
J19	1-2*	COM1 IRQ4
	2-3	COM1 IRQ3
J20	1-2*	COM2 IRQ3
	2-3	COM2 IRQ4
J28	1-2*	Enable mouse

Jumper	*Position*	*Function*				
	2-3	Disable				
J30,31	**Cache size**	**J30**	**J31**	**J52**	**J53**	**J54**
52-54	256K	Off	Off	1-2	1-2	1-2
	512K	On	On	2-3	2-3	2-3
J38	1-2,5-6	60 MHz				
	3-4	66 MHz				
J51	Off*	Write protect flash BIOS				
	On	Allow update				

Advantage! Pro 4/100t

Jumper	*Position*	*Function*			
E1,6,20	Cache	**E1**	**E6**	**E20**	
	Write-through	1-2	1-2	Off	
	Write-back	2-3	2-3	On	
		E1=VL Bus; E6=Pentium Overdrive; E20=Cyrix DX2			
E2	1-2*	Parallel port IRQ7			
	2-3	Parallel port IRQ5			
E3,4,5,13	CPU	**E3**	**E4**	**E5**	**E13**
	80486SX (LIF socket)	1-2	1-2	1-2	On
	80486 (PQFP)	2-3	2-3	2-3	Off
	Pentium Overdrive	2-3	1-2	2-3	On
	All other (168/169 pin)	2-3	2-3	2-3	On
		DX2 boards support 5v only; DX4 boards support 3v only			
E7	On*	Enable VGA			
E8	On*	Primary display colour			
	Off	Primary display Mono			
E9	On*	Reserved – leave On			
E10	On*	Enable password			
	Off	Disable password			
E11	Off*	Reserved – leave Off			
E12,14	Cache size	E12	E14		
	256K cache	On	On		
	64K or no cache	Off*	Off*		
E15	On	25 MHz CPU external speed			
	Off	33 MHz CPU external speed			
E16	Off*	Reserved – leave Off			
E17,18,19	**CPU Brand**	**E17**	**E18**	**E19**	
	Intel	1-2	1-2	1-2	
	Cyrix	2-3	2-3	2-3	

Advantage! Pro 4/25s

Jumper	*Position*	*Function*		
E1,2,3	**Cache size**	**E1**	**E2**	**E3**
	256K cache	On	On	On
	64K or no cache	Off*	Off*	Off*
E4	On*	Primary display colour		
	Off	Primary display Mono		
E5	On*	Enable VGA/autosense		

Jumper	*Position*	*Function*					
E6	On*	Enable password override (disable and erase)					
	Off	Disable password override (allow password)					
E9,10	**CPU speed**	**E9**	**E10**				
	33 MHz	Off	Off				
	25 MHz	On	On				
E12	1-2*	Parallel port IRQ7					
	2-3	Parallel port IRQ5					
E11,13-17	**CPU**	**E11**	**E13**	**E14**	**E15**	**E16**	**E17**
	80486SX (PQFP)	Off	Off	1-2	1-2	1-2	1-2
	80486SX (LIF socket)	On	Off	1-2	1-2	1-2	1-2
	80486DX/DX2/ODPR	On	On	2-3	1-2	2-3	1-2
	ODP/80487SX	On	On	1-2	1-2	2-3	1-2
	Pentium Overdrive	On	On	2-3	2-3	2-3	Off
		5v processors only					

Advantage! Pro 4/33(s)

As for Advantage! Pro 4/25s

Advantage! Pro 4/50d

As for Advantage! Pro 4/25s

Advantage! Pro 4/66d

As for Advantage! Pro 4/25s

Advantage! Pro Adventure 4/25s

As for Advantage! Pro 4/25s

Advantage! Pro Adventure 4/33s

As for Advantage! Pro 4/25s

Advantage! Pro Adventure 4/50d

As for Advantage! Pro 4/25s

Bravo 286

Jumper	*Position*	*Function*
E1	Out*	Reserved
E2	Out*	Reserved
SW2	Colour	CGA, EGA or VGA installed
	Mono	
SW3	1-2	Normal ops

Bravo 286/386sx

Jumper	*Position*	*Function*
S1	On*	Enable VGA
S2	Off*	Set password override
	On	Inhibit password override
S3	Off*	Reserved
S4	Off*	Reserved
S5	On*	Reserved
S6	On*	Reserved
S7	On*	PS/2 video
	Off	AT video
S8	Off*	VGA or fixed frequency monitors
	On	Multi-frequency monitors
S9	Off*	Reserved
S10	Off*	Reserved

Bravo 286/386sx

Jumper	*Position*	*Function*
E1	Out	Reserved
	In*	Enable memory parity
E2,3		Reserved
S1	On*	Enable VGA
S2	Off*	Set password override
	On	Inhibit password override
S3	Off*	Reserved
S4	Off*	Reserved
S5	On*	Reserved
S6	On*	Reserved
S7	On*	PS/2 video
	Off	AT video
S8	Off*	VGA or fixed frequency monitors
	On	Multi-frequency monitors
S9	Off*	Reserved
S10	Off*	Reserved

Bravo LC 4/33(s)

As for Advantage! Pro 4/100t, except use SL enhanced for all 3x 168- or 169-pin 486, except SX. DX2 system boards support only 5v CPUs, DX4 support only 3v. The 94 Cyrix model supports only 3v SL-enhanced CPUs.

Bravo LC 4/50(s)(d)

As for Bravo LC 4/33(s).

Bravo LC 4/66d

As for Bravo LC 4/33(s).

Bravo LC 4/100t

As for Bravo LC 4/33(s).

Bravo LC 5100

As for Advantage! Plus 5/100.

Bravo LC 5133

As for Advantage! Plus 5/100.

Bravo LC 5166

As for Advantage! Plus 5/100.

Bravo LC P/75

Jumper	*Position*		*Function*						
JP1,19	**JP1**	**JP19**	**CPU speed**						
	1-2	1-2	20 MHz						
	1-2	3-4	25 MHz						
	1-2	5-6	33 MHz*						
JP2	On*		Allow password						
	Off		Override and erase						
JP3-9	**CPU**		**JP3**	**JP4**	**JP5**	**JP6**	**JP7**	**JP8**	**JP9**
	i486/Cyrix 586		Off	On	On	On	Off	On	Off
	Cyrix 486		On	Off	Off	Off	Off	Off	On
JP11	1-2*		DX CPU						
	2-3		SX CPU						
JP16	1-2*		128K cache						
	2-3		256K cache						
JP17	1-2		Leave on 1-2 (external cache size)						
JP20-23	**CPU type**		**JP20**	**JP21**	**JP22**	**JP23**			
	i486/Cyrix 5x86*		Off	Off	Off	Off			
	Cyrix 486		On	Off	On	Off			
JP29	On*		Enable video						
	Off		Disable						
JP30	On*		Primary display colour						
	Off		Primary display Mono						
JP31	On*		Normal boot						
	Off		Force flash update at boot						
V1-4	On		5v CPU						
	Off*		3.45v CPU						

Bravo LC (LC2) 4/25s

As for Advantage! Pro 4/25s

Bravo LC (LC2) 4/33s

As for Advantage! Pro 4/25s

Bravo LC (LC2) 4/50d

As for Advantage! Pro 4/25s

Bravo LC (LC2) 4/66d

As for Advantage! Pro 4/25s

Bravo LC3/33s

Jumper	*Position*	*Function*
E1	1-2*	Reserved
E2	Out*	Clear CMOS
	In	Reserved
E3	Out	Reserved
	In*	LPT on IRQ7
SW1-S1	On*	Enable VGA
SW1-S2	Off*	Set password override
	On	Inhibit password override
SW1-S3	Off*	Reserved
SW1-S4	Off*	Reserved

Bravo LC P/100

As for MS P/75.

Bravo LP 4/25s

As for Advantage! Plus 4/33 (MT)

Bravo LP 4/33(s)

As for Advantage! Plus 4/33 (MT)

Bravo LP 4/50s

As for Advantage! Plus 4/33 (MT)

Bravo LP 4/66d

As for Advantage! Plus 4/33 (MT)

Bravo MS 4/33s

As for Advantage! Adventure 8066d.

Bravo MS 4/50s

As for Bravo MS 4/33s.

Bravo MS 4/66d

As for Bravo MS 4/33s.

Bravo MS 4/100t

As for Bravo MS 4/33s.

Bravo MS 5100 (Vixen)

Jumper	*Position*		*Function*	
J4G1	1-2,4-5*		2 PCI slots on riser	
	2-3,5-6		2 PCI slots on riser	
J4L1A	1-2*		Normal boot	
	2-3		Erase password	
	4-5*		Normal boot	
	5-6		Reset CMOS at boot	
J4L1B	1-2*		Allow access to CMOS	
	2-3		Prevent access	
	4-5*		Factory setting	
J4L1C,D	**C**	**D**	**CPU**	**Bus speed**
	2-3,5-6	1-2,4-5	75	25
	2-3,4-5	1-2,4-5	90	30
	1-2,5-6	1-2,4-5	100	33
	2-3,4-5	2-3,4-5	120	30
	1-2,5-6	2-3,4-5	133	33
	2-3,4-5	2-3,5-6	150	30
	1-2,5-6	2-3,5-6	166	33
J6C2	1-2*		Factory setting	
J6C2	1-2*		Factory setting	
	4-5		VRE (3.6v)	
	5-6		Standard voltage (3.3v)	

Bravo MS 5133

As for Bravo MS 5100 (Vixen).

Bravo MS 5166

As for Bravo MS 5100 (Vixen).

Bravo MS P/60

As for Advantage!6060p.

Bravo MS P/75

As for Advantage! 6060p

Bravo MS P/75 (Eagle)

Jumper	*Position*	*Function*
E1	On*	Onboard speaker
	Off	External speaker
E2	On	VR voltage (3.3-3.4v)
	Off	VRE voltage (3-4-3.6v)
E4	On*	Normal boot
	Off	Force flash update at boot
E5	On*	Allow password
	Off	Override password
E7	On*	Enable access to setup
	Off	Disable access to setup
E12		Reserved – leave Off
E13		Reserved – leave Off
E14		Reserved – leave Off
E15	1-2*	Output to speaker
	2-3	Output to line
E16	1-2*	Output to speaker
	2-3	Output to line
E17		Reserved – leave Off
E19		Reserved – leave Off

Int CPU	Ext CPU	E3	E6	E8	E10	E11	E18	E20
60	40	2-2	On	On	Off	On	Off	Off
75	50	2-3	On	On	Off	Off	Off	On
80	40	1-2	Off	On	Off	On	Off	Off
90	60	2-3	On	On	On	Off	Off	On
100	50	1-2	Off	On	Off	Off	Off	On
100	66	2-3	On	On	On	On	Off	On
120	60	1-2	Off	On	On	Off	Off	On
133	66	1-2	Off	On	On	On	Off	On
150	60	1-2	On	Off	On	Off	On	On
166	66	1-2	On	Off	On	On	On	On

Bravo MS P/75 (Morrison)

As for Advantage! 612.

Bravo MS P/90

As for Advantage! 6060p.

Bravo MS P/100

As for Advantage! 6060p.

Bravo MS P/100 (Eagle)

As for Bravo MS P/75 (Eagle).

Bravo MS P/100 (Morrison)

As for Advantage! 612.

Bravo MS P/120

As for Bravo MS P/75 (Eagle).

Bravo MS P/133 (Eagle)

As for Bravo MS P/75 (Eagle).

Bravo MS P/133 (Morrison)

As for Advantage! 612.

Bravo MS P/166 (Morrison)

As for Advantage! 612.
Bravo MS-T 4/66
As for Bravo MS 4/33s

Bravo MS-T P/75

As for Advantage! 6060p

Bravo MS-T P/90

As for Advantage! 6060p

Bravo MS-T P/100

As for Bravo MS P/75 (Eagle)

Bravo MS-T P/133 (Eagle)

As for Bravo MS-T P/75 (Eagle)

Bravo MS-T P/133 (Morrison)

As for Advantage! 612

Bravo MS-T 5100 (Vixen)

As for Bravo MS 5100 (Vixen)

Bravo MS-T 5133 (Vixen)

As for Bravo MS 5100 (Vixen)

Bravo MS-T 6150

Denali

Jumper	*Position*				*Function*
J29	On				CPU 3.1v
	Off				Autodetect
J25A-D	**A**	**B**	**C**	**D**	**CPU speed**
	Up	Up	Up	Up	133 MHz
	Down	Down	Down	Up	150 MHz
	Up	Up	Down	Up	166 MHz
	Down	Down	Up	Down	180 MHz
	Up	Up	Up	Down	200 MHz
J25E	Up*				Allow password
	Down				Override password
J25F	Up*				Normal boot
	Down				Erase CMOS at boot
J25G	Up*				Enable access to setup
	Down				Disable
J25H	Up*				BIOS write-protected
	Down				Allow BIOS flash update
J25I	Up				60 ns SIMMs
	Down				70 ns SIMMs

Bravo MS-T P/166

As for Advantage! 612

Bravo MS-T 5166 (Vixen)

As for Bravo MS 5100 (Vixen)

Bravo MS-L 4/66d

As for Bravo MS 4/33s

Bravo MS-L P/75

As for Advantage! 6060p

Bravo MS-L P/90

As for Advantage! 6060p

Bravo MT 4/33(s)

As for Advantage! Plus 4/33 (MT)

Bravo MT 4/50(s)

As for Advantage! Plus 4/33 (MT)

Bravo MT 4/66d

As for Advantage! Plus 4/33 (MT)

Bravo MT P/60

As for Advantage! Plus EXP P/60

Cupid ISA

Jumper	*Position*	*Function*
E1	PWD*	Enable password
	1-2	Override password
E2	Out*	Reserved
E3	Out*	Reserved

Cupid Clem ISA

Jumper	*Position*	*Function*
S1	Off*	Set password override
	On	Inhibit password override
S2	Off*	Reserved
S3	Off*	Reserved
S4	Off*	Analogue or VGA display
	On	Multifrequency display
S5	On*	Enable VGA

Cupid EISA

Jumper	*Position*	*Function*
E1	In*	Reserved
E2	In*	Reserved
E3	Out*	Reserved
E4	1-2	Disable password override
	2-3	Enable password override
E5	Out*	Enable VGA
E6	Out*	Reserved
E7	2-3*	Reserved

Cupid Tower ISA

Jumper	*Position*	*Function*
S1	Off*	Reserved
S2	Off*	Set password override
	On	Inhibit password override
S3	Off*	Reserved
S4	Off*	Boot without keyboard

Cupid Tower EISA

Jumper	*Position*	*Function*
E1	Out*	Reserved
E2	1-2	Inhibit password
	2-3*	Set password
E3	Out*	Reserved
E4	In*	Reserved
E5	In*	Reserved
E6	Out*	Reserved

Manhattan G560

As for Advantage! 6060p.

Manhattan G590

As for Advantage! 6060p.

Manhattan P5090

As for Manhattan S6200.

Manhattan P5100

As for Manhattan S6200.

Manhattan P5133

As for Manhattan S6200.

Manhattan S6200

SW2 on mainboard and SW1 on processor board are for reporting revision information to diagnostics.

Switch	*Position*	*Function*
S1	On	Force BIOS update at boot
	Off*	Normal operation
S2	On	Override password
	Off*	Allow password

Switch	Position	Function
S3	On	Mono display
	Off*	Colour display
S4	On	Clear EISA CMOS at boot
	Off*	Normal boot
S5	On	Deny access to setup
	Off*	Allow access to setup
E1		Clear CMOS

Manhattan V5090

As for Manhattan S6200.

Manhattan V5100

As for Manhattan S6200.

Power Premium

Switch	Position	Function
S1	Off*	Clear CMOS memory
	On	Clear CMOS
S2	Off	Allow password
	On*	Inhibit password
S3	Off*	Flash BIOS update
	On	Force BIOS update
S4	Off	Disable video
	On*	Enable video
E1	In*	Reserved
E2	1-2*	Reserved
E3	In*	Reserved
E4	Out*	Reserved
E5	Out*	Reserved

Premium II ISA

Switch	Position	Function
S1	On*	Enable VGA
S2	Off*	Set password override
	On	Inhibit password override
S3	Off*	Reserved
S4	Off*	Reserved
S5	On*	Reserved
S6	On*	Reserved
S7	On*	PS/2 video
	Off	AT video
S8	Off*	VGA or fixed frequency monitors
	On	Multi-frequency monitors

Premium III 4/25s (LC2)

As for Advantage! Pro 4/25s.

Premium III 4/33(s) (LC2)

As for Advantage! Pro 4/25s.

Premium III 4/50d (King)

As for Advantage! Pro 4/100t.

Premium III 4/50d (LC2)

As for Advantage! Pro 4/25s.

Premium III 4/66d (King)

As for Advantage! Pro 4/100t.

Premium III 4/66d (LC2)

As for Advantage! Pro 4/25s.

Premium III+ P/75

As for Advantage! 6060p.

Premium III+ P/100

As for Bravo MS P/75 (Eagle).

Premium III+ P/133

As for Bravo MS P/75 (Eagle).

Premium 286

Jumper	*Position*	*Function*
E3	In	ROM BIOS 0 wait state
	Out*	Reserved
E4	In	Enable A15 for 27256 devices
	Out*	Disable A15 for 27256 devices
E5	In	Reserved
	Out*	27256 address F000-FFFF
E6	In	Reserved
	Out*	27128 address F800-FFFF
E7	In	Reserved
	Out*	Latched PROM BIOS

Jumper	*Position*	*Function*
E8	In	Latched PROM BIOS for optional ROMs
	Out*	Reserved
E9	In	0 wait state for optional ROMs
	Out*	Reserved
E10	In	Enable A15 for 27256 devices
	Out*	Disable A15 for 27256 devices
E11	In	Reserved
	Out*	E000-EFFFh
E12	In	Reserved
	Out*	F000-F7FFh
E13	In	Reserved
	Out*	E800-EFFFh
E14	In	Reserved
	Out*	Latched PROM for optional devices
E18	In	Reserved
	Out*	Latched PROM for optional ROMs
E20	In*	AT Bus 2 wait states at 10 MHz
	Out	AT Bus 1 wait state at 10 MHz
E21		Reserved
E24	In	COM2 at 2F8h
	Out*	Reserved
E25	In*	COM1 at 3F8h
	Out	Reserved
E31	In*	IRQ4
	Out	Reserved
E32	In	IRQ3
	Out*	Reserved
E27	Out	Reserved
	In*	LPT1 at 378h
E28	Out*	Reserved
	In	LPT2 at 278h
E29	Out	Reserved
	In*	IRQ7
E30	Out*	Reserved
	In	IRQ5

Premium 386/16

Jumper	*Position*	*Function*		
E1,15,16	**Maths copro**	**E1**	**E15**	**E16**
	5 MHz	In	Out	In
	8 MHz	Out	In	Out
E2	In	ROM BIOS 0 wait state		
	Out*	Reserved		
E3	In	Enable A15 for 27256 devices		
	Out*	Disable A15 for 27256 devices		
E4	In	Reserved		
	Out*	27256 address F000-FFFF		
E5	In	Reserved		
	Out*	27128 address F800-FFFF		
E6	Out	Reserved		
	In*	Latched PROM BIOS		

Jumper	*Position*	*Function*
E7	In	Latched PROM BIOS for optional ROMs
	Out*	Reserved
E8	In	0 wait state for optional ROMs
	Out*	Reserved
E9	In	Enable A15 for 27256 devices
	Out*	Disable A15 for 27256 devices
E10-13	In	Reserved
	Out*	Address select
E14	In	Reserved
	Out*	Latched PROM for optional ROMs
E18,32	Out*	Reserved
E20,2,31	In*	Reserved
E17	Out	Reserved
	In*	AT Bus 2 wait states at 10 MHz
E33	In	Disable floppy
	Out*	Enable floppy
E40	In*	ALE sampled earlier than standard
	Out	Reserved
E22	In	COM2 at 2F8h
	Out*	Reserved
E23	In*	COM1 at 3F8h
	Out	Reserved
E28	Out	Reserved
	In*	IRQ4
E29	Out*	Reserved
	In	IRQ3
E24	Out	Reserved
	In*	LPT1 at 378h
E25	Out*	Reserved
	In	LPT2 at 278h
E26	Out	Reserved
	In*	IRQ7
E27	Out*	Reserved
	In	IRQ5

Premium 386/C

Jumper	*Position*	*Function*
E1	In*	Reserved
E2	In*	Reserved
E3	In*	Reserved
E4	Out*	Reserved
E5	In*	Reserved
E6	Out*	Reserved

Premium SE

Jumper	*Position*	*Function*
E1	Out*	Reserved
E2	1-2	Inhibit password
	2-3*	Set password

Jumper	Position	Function
E3	Out*	Reserved
E4	In*	Reserved
E5	In*	Reserved
E6	In*	Reserved

Premium Exec

Jumper	Position	Function
S1	Off*	Set password override
	On	Inhibit password override
JP1	Out*	Reserved

Premium Workstation

Jumper	Position	Function					
JP1-6	**SIMM type**	**JP1**	**JP2**	**JP3**	**JP4**	**JP5**	**JP6**
	256K	1-2*	1-2*	1-2*	1-2*	1-2*	1-2*
	1 Mb	2-3	2-3	2-3	2-3	2-3	2-3
JP7	1-2	27128K EPROM					
	2-3	27256K EPROM					
JP8	Out*	Reserved					

Premmia 4/33(s)

Switch	Position	Function
S1	On*	Enable VGA
	Off	Disable
S2		Reserved
S3	On	Erase EISA CMOS at boot
	Off*	Normal boot
S4	On	Force flash BIOS update at boot
	Off*	Normal boot
S5	On	Override password
	Off*	Allow password
S6		Reserved – leave Off
S7		Reserved – leave Off
S8		Reserved – leave Off
S9	On*	Super I/O register address 398h
	Off	Super I/O register address 26Eh
S10	On*	Primary display colour
	Off	Mono

Jumper	Position				Function
E1,4,6,7	**E1**	**E4**	**E6**	**E7**	**CPU**
	2-3	1-2	1-2	1-2	486SX (U12)
	1-2	Off	2-3	2-3	486SX (U13)
	2-3	1-2	1-2	1-2	487SX, ODP (U13)
	1-2	2-3	1-2	1-2	DX, DX2, ODPR (U13)
	1-2	1-2	1-2	1-2	P60 (if in J17, remove CPU in U13)
E2					Reserved – leave Off

Jumper	*Position*	*Function*
E3	On*	Enable RAM parity checking
	Off	Disable
E5	2-3	Flash voltage – leave on 2-3

Premmia 4/50d

As for Premmia 4/33(s).

Premmia 4/66d

As for Premmia 4/33(s).

Premmia GX P/90 (IDE)

As for Premmia GX P/90 (SCSI) except:

Jumper	*Position*		*Function*
E1,2	**E1**	**E2**	**CPU speed**
	Off	On	75 (50)
	Off	On	90 (60)
	Off	Off	100 (50)
	On	On	100 (66)

Premmia GX P/90 (SCSI)

Switch	*Position*	*Function*
1	On	Force flash BIOS at boot
	Off*	Normal boot
2	On	Override password
	Off*	Allow password features
3	On	Mono display
	Off*	Colour
4	On	Clear EISA CMOS at boot
	Off*	Normal boot
5	On	Deny access to setup
	Off*	Allow access
6	Off	Reserved
7	On	Enable parity
	Off*	Disable
8	On	Dual processor (also install E5)
	Off*	Single processor (also install E4)

Jumper	*Position*		*Function*
E1,2	E1	E2	CPU speed
	Off	On	90 (60)
E3	On		Clear ISA CMOS at boot
	Off		Normal boot
E4	On		Single processor
	Off		Dual processor
E5	On		Dual processor
	Off		Single processor

Only install E4 *or* E5 – see also S8.

Premmia GX P/100

As for Premmia GX P/90 (IDE).

Premmia GX P/133

As for Premmia GX P/90 (IDE) except:

Jumper	*Position*		*Function*
E1,2	**E1**	**E2**	**CPU speed**
	On	On	100 (66)
	Off	Off	133 (66)

Premmia LX P/60

As for Advantage! EXP P/60.

Premmia MTE 4/33

As for Premmia 4/33(s), except:

Switch	*Position*	*Function*
S7	On	Deny access to CMOS setup
	Off*	Allow access
E10	2-3	Reserved
E800	Off	Reserved

Remove CPU from ZIF socket at U84 before installing Pentium upgrade board.

Premmia MTE 4/66d

As for Premmia MTE 4/33.

Premmia MTE P/60

As for Premmia MTE 4/33.

Premmia MX 4/66d

As for Advantage! Adventure 8060d except S5 is reserved.

Premmia MX 4/100t

As for Advantage! Adventure 8060d except S5 is reserved.

Premmia MX P/60

As for Advantage! 6060p.

Premmia MX P/75

As for Advantage! 6060p.

ASUS

ASUSTeK Computer Inc
(408) 474 0567
www.asus.com

All ID numbers (just above the memory count)contain 401A0-XXXX. A0 indicates the manufacturer, while XXXX is the BIOS revision level.

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
5C	P/I-XP6NP5		

K7M

Item	Description	Notes
Form Factor	ATX	
CPU	Athlon	Slot A
Speeds (MHz)		100 FSB
Chipset	AMD 751/VIA VT82C686A	
BIOS	AMI	
Bus	5 PCI/1 ISA	
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	
Video		AGP
Performance		

MB-586A-PCI60C

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	60/66	
Chipset	Mercury	
BIOS	Award Flash	
Bus	3 PCI/4 ISA	
Memory (Mb)	192	6 x 32 Mb 72-pin
Cache (K)	512 W/T	256 standard

MEW

Item	Description	Notes
Form Factor	ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		
Chipset	Intel 810	
BIOS		
Bus	5 PCI/2 ISA	
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	
Video		
Performance		

P2B

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Speeds (MHz)	500	
Chipset	440BX	
BIOS	Award 4.51PG	
Bus	4 PCI/3 ISA	1 shared
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)		
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	
Video		AGP
Audio		
Performance		Up to 8x, but slower than Soyo SY-6BA+
Problems		Awkward jumper positions. Few features.
Comments		

P2B-S

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Speeds (MHz)	500	
Chipset	440BX	
BIOS	Award 4.51PG	
Bus	4 PCI/3 ISA	1 shared
Memory (Mb)	1 Gb	4 DIMM sockets
Cache (K)		
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	Adaptec AIC-7890 LVD SCSI
Video		AGP
Performance		Fast – better than Gigabyte GA-6BXF
Problems		
Comments		AOpen AX6B slightly slower but much cheaper

P2L97-DS

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II x 2	Slot 1
Speeds (MHz)	550 MHz	366 MHz for stability
Chipset		
ISA	2	
PCI	4	
Memory (Mb)	512 Mb EDO/SDRAM	3.3v only
I/O	EIDE, floppy, UltraWide SCSI (AIC 7880P)	50 and 68-pin connectors.
Video		AGP
Performance		100 MHz, but slow.

P3B-F

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III/Celeron	Slot 1
Speeds (MHz)		100 FSB
Chipset	440BX	
BIOS	Award 4.51PG	
Bus	6 PCI/1 ISA	1 shared
Memory (Mb)	1 Gb	4 DIMM sockets
Cache (K)		
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	UDMA/33
Video		AGP
Comments		

P3C-E

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III/Celeron	Slot 1
Speeds (MHz)		133 FSB
Chipset	820	
BIOS	Award 4.51PG	
Bus	5 PCI/1 ISA/1 AMR	1 shared
Memory (Mb)		2 RIMM sockets
Cache (K)		
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	UDMA/33
Audio	Yamaha 744	
Video		AGP Pro

P3W

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III/Celeron	Slot 1

Item	Description	Notes
Speeds (MHz)		100 FSB
Chipset	Intel 810	
BIOS	Award 4.51PG	
Bus	6 PCI 1 AMR	
Memory (Mb)		3 DIMM sockets
Cache (K)		
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy, joystick, audio	UDMA/33
Video		
Comments		

P5A

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium – K62	Socket 7
Speeds (MHz)	500	
Chipset	ALi Aladdin V	
BIOS	Award 4.51PG	
Bus	5 PCI/2 ISA	1 shared
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)	512K	
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	
Video		AGP
Audio		
Performance		Slow – TMC T15VG+ much faster
Problems		
Comments		

P/E-P6RP7D

Item	Description	Notes
Form Factor	Full AT	
CPU	2 Pentium Pro	
Speeds (MHz)	200	
Chipset	Orion	
BIOS	AMI Flash	NCR/Symbios SCSI supported
Bus	6 PCI/1 EISA	EISA shared with Asus mediabus slot
Memory (Mb)	1 Gb	Non-EDO. 8 sockets
I/O	2S, 1P, IR	

P/E-P6P4S

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	133/150/166	
Chipset	Orion	
BIOS	Award Flash	

Item	Description	Notes
Bus	4 PCI/3 ISA	1 each shared
Memory (Mb)	512	Non-EDO. 4 sockets
I/O	2S, 1P, IR, 2 EIDE	

P/I-P6NP5

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium Pro	
Speeds (MHz)	200	
Chipset	Natoma (440 FX)	
BIOS	Award Flash	NCR/Symbios SCSI supported
Bus	5 PCI/3 ISA	1 ISA shared with Asus mediabus slot
Memory (Mb)	256	Non-parity, parity, ECC FPM, EDO, BEDO. 4 sockets
Cache (K)		
I/O	2S, 1P	
Video		

P/I-XP6NP5

ATX version of P/I-P6NP5.

P/I-P6RP4

Item	Description	Notes
Form Factor		
CPU	Pentium Pro	
Speeds (MHz)	200	
Chipset	Mars (450 KX)	
BIOS	AMI Flash	NCR/Symbios SCSI supported
Bus	4 PCI/3 ISA	1 ISA shared with Asus mediabus slot
Memory (Mb)	512	Non-parity, parity, ECC, either FPM or EDO
Cache (K)		
I/O	2S, 1P, IR	

PVI/486AP4

Item	Description	Notes
Form Factor		
CPU	486	DX4, Pentium Overdrive (P24T)
Speeds (MHz)		
Chipset	Aries	Rev 2
BIOS	Green Award	NCR SCSI supported
Bus	3 PCI/3 ISA	
Memory (Mb)	128	4 x 32 Mb 72-pin SIMMs
Cache (K)	256 W/B	
Problems		Rev 1.6 requires reset button to reboot if you have a SCSI controller installed. May be more stable if

Item	Description	Notes
		you disable the VL slot. Set cache timing to Normal (that is, not Fast) for stability.
Comments		

PVI-486SP3

5 slightly different versions, depending on the SiS chipset:

- **A4** SIS 496 MU, SIS 497 MW. Supports up to PIO mode 2.
- **B2** SIS 496 NU, SIS 497 NS. Supports PIO mode 3 and above, but apparently not Mode 3 very well.
- **B3** SIS 496 NV, SIS 497 NS. Supports PIO mode 3 and above.
- **B4** SIS 496 NV, SIS 497 NU. Supports PIO mode 3 and above.
- **B5** SIS 496 OR, SIS 497 OT. Supports PIO mode 3 and above.

Item	Description	Notes
Form Factor		
CPU	486	Does not work with a DX4-50/100
Speeds (MHz)		
Chipset	SiS	See below
BIOS	Award Flash	NCR SCSI supported after v1.2
Bus	3 PCI/3 ISA/VL	1 shared PCI/VL
Memory (Mb)	128	
Cache (K)		
I/O	2S, 1P, PS/2, Fl, 2 VL IDE	
Problems		Adaptec 2940UW may not work, but 2940W will. Don't try to use v1.21 of the Adaptec BIOS. You might also need to turn IDE prefetch off for a 3c590 PCI Ethernet adapter.

PCI/I-486 SP3G (D)

Item	Description	Notes
Form Factor		
CPU	486	DX4, Intel/Cyrix, P24T/D (Pentium Overdrive). Set up AMD DX4 (3x33) as non-SL enhanced DX4, with J36 to 1&2 rather than 2&3. For AMD DX4 to run in 4x mode, pin B13 must be tied high - tying to ground will make chip run as DX2-66.
Speeds (MHz)		
Chipset	Green Saturn 4	
BIOS	Award Flash	4.50g
Bus	3 PCI/4 ISA	1 each shared
Memory (Mb)	128	4 sockets
Cache (K)	512 W/T	256 standard
I/O	2S, 1P, IDE, Floppy, PS/2	On-board NCR 53c810 SCSI with 50-pin socket. Use EIDE in slot for more than 2 drives.
Performance		
Problems		On-board SCSI controller may have problems with OS/2 2.1 and a Quantum Prodrive 540S, as synchronous communication must be disabled for the system to boot. You may also need to turn off tagged command queueing to avoid data corruption with a Micropolis 4110

PCI/I-P54NP4

Item	Description	Notes
Form Factor		
CPU	2 Pentium	P54C/CT. Socket 5
Speeds (MHz)	90/100	
Chipset	Intel 82430N (Neptune)	
BIOS	Flash	NCR SCSI supported
Bus	4 PCI/4 ISA	
Memory (Mb)	512	4 72-pin non-parity SIMMs
Cache (K)	512 W/B	256 standard.
I/O	2S, 1P, IDE, Floppy	

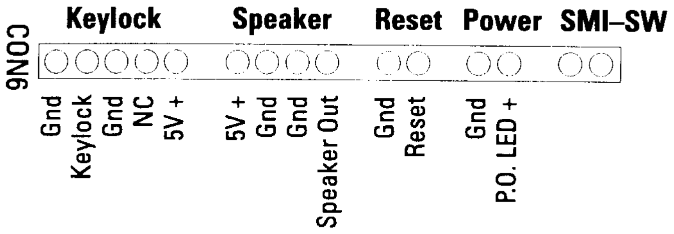
Jumper	*Position*			*Function*
JP1	**JP1**	**JP2**		**PCI SC200 SCSI Card INT Assignment**
	1-2			INT A
	2-3			INT B
		1-2		INT C
		2-3		INT D
JP5	Open			Enable PCI SC200 SCSI Card Termination
	Short			Disable
JP 11	1-2*			Enable PS/2 mouse port
	2-3			Disable
JP12,13	**JP12**	**JP13**		**DMA Channel for ECP**
	1-2	1-2		Ch 1
	2-3	2-3		Ch 2
JP16	1-2*			Enable I/O
	2-3			Disable
JP17	1-2*			5v BIOS flash voltage
	2-3			12v BIOS flash voltage
JP18	Open			Host bus frequency 2/3 internal clock
	Short			Half internal clock
JP20	Open*			L1 cache writeback
	Short			L1 cache writethrough
JP21	1-2*			CPU-PCI Bus Clock Ratio 2:1
	2-3			CPU-PCI Bus Clock Ratio 3:2
JP22,23	**JP22**	**JP23**		**L2 Cache Size**
	1-2	2-3		256K
	2-3	2-3		512K
JP24-26	**JP24**	**JP25**	**JP26**	**Clock Frequency (AV9154A-27 clock generator)**
	1-2	2-3	1-2	66 MHz
	2-3	1-2	2-3	60 MHz
	1-2	2-3	2-3	50 MHz
JP24-26	**JP24**	**JP25**	**JP26**	**Clock Frequency (MX8315 clock generator)**
	2-3	1-2	2-3	66 MHz
	1-2	2-3	1-2	60 MHz
	2-3	1-2	1-2	50 MHz

IRQ Settings for Edge-Triggered Cards

Set IRQ in Setup as well. Jumpers are at the back somewhere near the centre, just behind the PCI slots. Defaults are all at 2-3.

IRQ	PCI 1	PCI 2	PCI 3	PCI 4
5	JP2 1-2	JP2 3-4	JP9 1-2	JP9 3-4
9	JP1 1-2	JP1 3-4	JP10 1-2	JP10 3-4
11	JP3 1-2	JP3 3-4	JP8 1-2	JP8 3-4
14	JP4 1-2	JP4 3-4	JP7 1-2	JP7 3-4
15	JP5 1-2	JP5 3-4	JP6 1-2	JP6 3-4

Case Connectors



PCI/I-P54NP4D

As for PCI/I-P54NP4, except Dual Pentium. P54C/CT in No 1 socket, P54CM in the other, and:

Jumper	*Position*	*Function*
JP19	1-2*	Dual Pentium
	2-3	Single pentium
JP31	Open	Disable address pipeline
	Short	Enable

P/E-P54NP4

Item	Description	Notes
Form Factor		
CPU	2 Pentium	
Speeds (MHz)		
Chipset	Neptune	
BIOS	Award Flash	
Bus	4 PCI/4 EISA	1 each shared
Memory (Mb)	512	FPM, 8 banks
Cache (K)	512	Asynchronous
I/O		D version has built-in I/O

Jumper	*Position*	*Function*
JP1	1-2	Power Card 1.2 3.5v (1.1 supported by default)
	2-3	Power Card 1.2 3.4v
JP11	Open	1.5x clock
	Short	2x clock
JP14	1-2	Dual CPU
	2-3	Single CPU

Jumper	*Position*		*Function*
JP20	Open*		L1 cache writeback
	Short		L1 cache writethrough
JP22,23	**JP22**	**JP23**	**L2 cache size**
	2-3	1-2	256K
	2-3	2-3	512K

P/I-P54SP4

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	75/90/100	
Chipset	SiS	older versions used the 5501/2/3; newer ones the 5511/12/13
BIOS	Award Flash	NCR SCSI supported
Bus		
Memory (Mb)		4 72-pin SIMMs
Cache (K)	1 Mb	
I/O	2S, 1P, 2 EIDE, 1 Floppy	CMD 640B
Problems		Possibly disable green BIOS to boot with PCI SCSI
Comments		

P/E-P55T2P4D

Item	Description	Notes
Form Factor		
CPU	2 Pentium	
Speeds (MHz)	200	
Chipset	430 HX (T II)	
BIOS	Award Flash	NCR/Symbios SCSI supported
Bus	4 PCI/4 EISA/1 ISA	
Memory (Mb)	512	8 slots for non-parity, parity, or ECC FPM?EDO. 60 ns for 66 MHz CPUs and above.
Cache (K)	512	Pipeline Burst
I/O	2S, 1P	

P/E-P5MP3

PCI/EISA. Aside from EISA slots, identical to MB-586A-PCI60C. Older versions had a bug in the serial I/O.

P/I-P55SP3AV

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	200	
Chipset	Sis	5511/12/13
BIOS	Award Flash	NCR/Symbios SCSI supported
Bus	3 PCI/4 ISA	1 each shared

Item	Description	Notes
Memory (Mb)	512	EDO/FPM
Cache (K)	512	Pipeline Burst. 256 standard
I/O	2S, 1P, Game	Wavetable Upgrade
Video	SiS 6205	Integrated, uses up to 2 Mb System DRAM.
Audio	ESS 1788	

P/I-P55T2P4

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	75-200	
Chipset	430 HX	Trition II
BIOS	Award	NCR/Symbios SCSI supported.
Bus	4 PCI/3 ISA	1 each shared
Memory (Mb)	128	non-parity, parity or ECC, FPM or EDO
Cache (K)	512	256 standard. CELP socket for upgrade.

P/I-XP55T2P4

As for P55T2P4, but ATX.

P/I-P54TP4(D)

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	75-200 MHz	
Chipset	Triton	
BIOS	Award	NCR SCSI
Bus	4 PCI/4 ISA	1 each shared
Memory (Mb)	8-128 FPM/EDO	
Cache (K)	256-512 Kb sync/async	
I/O	IDE 0/1, Floppy, 2 serial, 1 parallel SMC super I/O controller Mouse port	Mode 4 data transfers and DMA mode 2. Needs triton.exe
Performance		A board equipped with 256k Burst-SRAM and EDO-RAM achieved transfer rates of 65 MB/sec to 2nd level Cache (K), 39 MByte/s on a direct Memory (Mb) access, 53 MByte/s on a write operation (STOSD), and 54 MByte/s on a Memory (Mb) to PCI transfer.
Problems		You may need to remove old asynchronous Cache (K) before the boards recognize new pipeline burst Cache (K). Doesn't like RAM chips labelled Ti - 60 TMS417400DJ VBP 440230. Certain revisions do a PCI bus reset after the SCSI BIOS scans its bus, which causes problems for QLogic SCSI controllers (ISP1020 firmware level should be 1.27 or greater). 8-bit ISA networking cards will not work properly. These revisions of the floppy controller (SMC 37C665IR multi-I/O chip) are defective:

Item	Description	Notes
		B9519/5-AIC, 6J75692-1 B9519/5-AIC, 6J75693-8 B9519/5-AIC, 6J75690-5 B9519/5-AIC, 6J75697-0 B9521/5-AIC, 6J75735-7 B9521/5-AIC, 6J75730-0 B9521/5-AIC, 6J75732-5

P/I-P55TP4(D)

As for P/I-P54TP4(D)

P/I-P55TP4XE(D)

As for P/I-P54TP4(D)

P/I-P55TP4N**

As for P/I-P54TP4(D)

P/I-P55TVP4

Item	Description	Notes
Form Factor		
CPU	Intel/AMD Pentium	60 ns RAM required for CPUs with an external clock of 66 MHz
Speeds (MHz)		
Chipset	Triton III (430VX)	
BIOS	Award 1 Mbit flash	Supports NCR/Symbios SCSI
Bus	3 PCI/4 ISA	1 each shared
Memory (Mb)	Up to 128 FPM/EDO parity/non-parity	
Cache (K)	256-512 Kb pipeline burst	
I/O	IDE 0/1, Floppy, 2 serial, 1 parallel	Includes IR TX/RX header

PVI-486AP4

Rev 1.3, 1.6

Jumper	*Position*		*Function*
JP17	4-5		2x CPU internal clock
	3-4		2.5x CPU internal clock
	Open		3x CPU internal clock
JP17(?)	Open		CPU L1 cache writethrough
	1-2		CPU L1 cache writeback
JP18,19	**JP18**	**JP19**	**CPU type**
Rev 1.6	2-3,4-5	1-2,3-4	SL Enh 486DX & ODP, DX2 & ODP, DX4 & ODP
	1-2,4-5	1-2,3-4	DX & ODP, DX2 & ODP,SX, Cx486DX,DX2(-V)
	2-3,4-5	1-2,4-5	SL Enhanced 486SX & SX2, Cx486s
	1-2,4-5	1-2,4-5	486SX,SX2
	2-3,5-6	1-2,3-4	Pentium OverDrive, P24T,P24CT,P24D
	1-2,4-5	3-4	Am486DX2-66 (JP17-2 & 18-3 for 2x clock)

Jumper	*Position*		*Function*
	1-2,4-5	3-4	Am486DX2-80 (3x), Am486DX4-100(3x)
	1-2,4-5	3-4	Am486DXL, Am486DX2L
	1-2,4-5	4-5	Am486SXL
			Cx5x86(M1sx)-133 MHz, Am5x86-P75(x5-133 MHz), AMD486DX4-SV8B(120 MHz), UMC-U5S not supported.
JP18,19	**JP18**	**JP19**	**CPU type**
Rev 1.3	2-3,4-5	1-2	SL Enh 486DX & ODP, DX2 & ODP, DX4 & ODP
	1-2,4-5	1-2	DX & ODP, DX2 & ODP,SX, Cx486DX,DX2(-V)
	2-3,4-5	2-3	SL Enhanced 486SX & SX2, Cx486s
	1-2,4-5	2-3	486SX,SX2
	2-3,5-6	1-2	Pentium OverDrive, P24T,P24CT,P24D
			Am486DX2-66(2x clock), Am486SXL, Am486SX2L Am486DX2-80(3x clock), Am486DX4-100(3x clock), Am486DXL, Am486DX2L, UMC-U5S, Cx5x86(M1sc)-133MHz, Am5x86-P75(x5-133MHz), AMD486DX4-SV8B(120MHz not supported

SP97(-V)

Jumper	*Position*				*Function*
RTC RAM	1-2*				Normal
RTCLR	2-3				Clear CMOS
FS0-3	**FS0**	**FS1**	**FS2**	**FS3**	**CPU host bus speed**
	1-2	2-3	1-2	2-3	75 MHz
	2-3	1-2	2-3	1-2	66 MHz
	1-2	2-3	2-3	1-2	60 MHz
	2-3	2-3	2-3	1-2	50 MHz
BF0,1,2	**BF0**	**BF1**	**BF2**		**CPU-Bus frequency A, B, C, D, E, F**
	2-3	2-3	2-3		-, -, -, -, 4, 1.5
	2-3	1-2	2-3		-, -, -, -, 4.5, 1.5
	1-2	2-3	1-2		3, 3, -, -, 3, -
	2-3	2-3	1-2		2.5x, 2.5, 2.5, 1,2, 2.5, 2
	2-3	1-2	1-2		2x, 2, 2, 2, 2, 2
	1-2	1-2	1-2		1.5x, 3.5, 3, 3, 3.5, -
					P54C=A, P55C=B, 6x86PR=C, 6x86L-PR*=D, K6=E, 6x86L-P200+=F
					*Only version of M1 supported is 2.7 or later. Serial number on bottom of chip should be G8DC6620A or higher.
VID0-2	**VID0**	**VID2**	**VID3**		**CPU Voltage**
	1-2	2-3	2-3		3.5v (VRE)
	2-3	2-3	2-3		3.4v (STD)
	2-3	2-3	1-2		3.2v (Dual)
	1-2	2-3	2-3		2.9v (Dual)
	2-3	2-3	2-3		2.8v (Dual)
	1-2	2-3	2-3		2.1v (Dual)
VGA_SEL1	Out*				Enable VGA
	In				Disable VGA
VGA_SEL	1-2				Disable VGA
	2-3*				Enable VGA
VGA_INT	1-2				VGA Interrupt by chipset (video capture cards)
	2-3*				VGA Interrupt disabled

VL/I-486SVG0(X4)

Rev 1.1,1.2

Jumper	*Position*			*Function*
RN	1			30-pin memory sockets used
	2			72-pin SIMMs only
JP1	1-2*			Internal lithium battery
	2-3			External lithium battery
JP5,6	**JP5**	**JP6**		**Memory**
	1-2*	1-2*		Single-sided module in SIMM5
	2-			Double-sided module in SIMM5
	3	2-3		
JP7,8	**JP7**	**JP8**		**CPU Type (Hardware Trap)**
	1-2	2-3		Intel 486SX, DX(2), SL, DX4
	2-3	1-2		Cyrix S(2), DX(2), DX2-V, AMD 486D(S),XL/L2
	1-2	1-2		P24D, P24T, P24CT, AMD 486D(S) X+
JP9	1-2			Cyrix CPU
	2-3			Intel CPU
JP10	1-2*			Enable PS/2 mouse (IRQ 12 not available)
	2-3			Disable
JP14,15,27	**JP14**	**JP15**	**JP27**	**Cache Size**
	Open	2-3	1-2	128K (32K8x4)
	Open	1-2	1-2	256K (32K8x8)
	1-2	2-3	1-2	256K (64K8x4)
	4-5	1-2	2-3	512K (64K8x8)
	1-2	2-3	2-3	512K (128K8x4)
	2-3	1-2	2-3	1 Mb (128K8x8)
JP23-25	**JP23**	**JP24**	**JP25**	**CPU Clock Speed**
	1-2	1-2	1-2	20 MHz
	2-3	1-2	1-2	25 MHz
	2-3	2-3	2-3	33 MHz
	2-3	2-3	1-2	40 MHz
	1-2	1-2	2-3	50 MHz
JP26	1-2*			VESA clock delay
	2-3			No delay
JP28	1-2			VL bus 0 wait state
	2-3			VL bus 1 wait state
JP29	1-2			CPU external speed <=33 MHz
	2-3			CPU external speed >33 MHz

CPU	JP18	JP19	JP20	JP21	JP22
486SX				2-3	2-3
DX(2),487SX,ODP				1-2	2-3
SL486SX	3-4,5-6		4-5	2-3	2-3
SL486DX(2), SLOD (169 pin)	3-4,5-6		4-5	1-2	2-3
SLOD (237 pin)	5-6		4-5	1-2	2-3
P24T	5-6		4-5	1-2	1-2
P24CT 56			4-5	1-2	1-2,4-5
DX4 3x clock	3-4,5-6		4-5	1-2	2-3,4-5
DX4 2.5x clock	3-4,5-6	4-5	4-5	1-2	2-3,4-5
DX4 2x clock	3-4,5-6	5-6	4-5	1-2	2-3,4-5

CPU	JP18	JP19	JP20	JP21	JP22
Cyrix CX486S	2-3,4-5	1-2	1-2,3-4	2-3	2-3
Cyrix DX/DX2	2-3,4-5	1-2	1-2,3-4	1-2	2-3

Rev 1.5 and later

Jumper	*Position*			*Function*
RN	1			30-pin memory sockets used
	2			72-pin SIMMs only
JP1	1-2*			Internal battery
	2-3			
JP2-4				SMI out connector
JP5,6	**JP5**	**JP6**		**Memory**
	1-2	1-2		Single-sided module in SIMM5
	2-3	2-3		Double-sided module in SIMM5
JP7,8	**JP7**	**JP8**		**CPU Type (Hardware Trap)**
	1-2	2-3		Intel 486SX, DX(2), SL, DX4
	2-3	1-2		Cyrix S(2), DX(2), DX2-V, AMD 486D(S),XL/L2
	1-2	1-2		P24D, P24T, P24CT, AMD 486D(S) X+
JP9	1-2			Cyrix CPU
	2-3			Intel CPU
JP10	1-2*			Enable PS/2 mouse
	2-3			Disable
JP11				DMA selection - reserved
JP12	1-2*			Mono/VGA
	2-3			CGA
JP13	1-2			Disable SMI switch (JP32) control
	2-3*			Enable
JP14,15,29	**JP14**	**JP15**	**JP29**	**Cache Size**
	Open	2-3	1-2	128K (32K8x4)
	Open	1-2	1-2	256K (32K8x8)
	1-2	2-3	1-2	256K (64K8x4)
	4-5	1-2	2-3	512K (64K8x8)
	1-2	2-3	2-3	512K (128K8x4)
	2-3	1-2	2-3	1 Mb (128K8x8)
JP23	2-3			Writeback L1 cache
	3-4			Writethrough L1 cache
JP25-27	**JP25**	**JP26**	**JP27**	**CPU Clock Speed**
	1-2	1-2	1-2	20 MHz
	2-3	1-2	1-2	25 MHz
	2-3	2-3	2-3	33 MHz
	2-3	2-3	1-2	40 MHz
	1-2	1-2	2-3	50 MHz
JP28	1-2*			VESA clock delay
	2-3			No delay
JP30,31	**JP30**	**JP31**		**Wait state/VL bus clock**
	1-2	1-2		0 wait state, <=33 MHz
	2-3	2-3		1 wait state, >33 MHz
JP34	1-2*			Intel DX4 (3.45v)
	2-3			Cyrix DX2-V (3.6v)

CPU	JP18	JP19	JP20	JP21	JP22	JP24
486SX/2/SL	5-6	1-2,5-6	1-2,5-6	1-2		2-3

CPU	JP18	JP19	JP20	JP21	JP22	JP24
DX/2,487SX,ODP,DX4 (3 x clock)	1-2,5-6	1-2,5-6	1-2,5-6	1-2		1-2
DX4 (2.5 x clock)	1-2,5-6	1-2,5-6	1-2,5-6	1-2	5-6	1-2
DX4 (2 x clock)	1-2,5-6	1-2,5-6	1-2,5-6	1-2	1-2	1-2
P24D	4-5	1-2,5-6	1-2,5-6	1-2,3-4,5-6		1-2,4-5
P24CT	1-2,4-5	1-2,5-6	5-6	1-2		1-2
P24T (237 pin SL ODP)	4-5	1-2,5-6	5-6	1-2		1-2
DX4 ODP 3x clock	5-6	1-2,5-6	1-2,5-6	1-2		1-2
DX4 ODP 2.5x clock	5-6	1-2,5-6	1-2,5-6	1-2	5-6	1-2
DX4 ODP 2x clock	5-6	1-2,5-6	1-2,5-6	1-2	1-2	1-2
AMD486SXL, SX2L	5-6	4-5	4-5		4-5	2-3
AMD486DXL, DX2L	5-6	4-5	4-5		4-5	1-2
AMD486DXL4 3x clock	1-2,5-6	4-5	4-5		4-5	1-2
AMD486DXL4 2x clock	1-2,5-6	4-5	4-5		4-5	1-2,4-5
Cyrix 486DX,DX2	2-3,5-6	2-3,5-6	2-3	2-3	2-3	1-2
Cyrix 486DX2-V (JP23 1-2,4-5)	2-3,5-6	2-3,5-6	2-3	2-3	2-3	1-2
Cyrix DX5 3x clock	1-2,4-5	1-2,5-6	1-2,5-6	1-2,3-4,5-6		1-2
Cyrix DX5 2x clock	1-2,4-5	1-2,5-6	1-2,5-6	1-2,3-4,5-6	1-2	1-2

VL/ISA-486SV2 Rev 1.7

Jumpers marked TP are factory set and must not be changed. The defaults are given below because the board will not work if they are in the wrong position.

TP2	TP5	TP13	TP14	TP15	TP17	TP25	TP26	TP27
Short	Open	1-2	1-2	1-2	2-3	1D	Open	1D

Jumper	*Position*			*Function*
BJP1	Ext			External battery at BCON1
	Int			Internal battery
JP2	CGA			CGA display
	Mono/other			Mono or other display
JP22	Intel			Intel CPU
	Cyrix			Cyrix CPU
CJ1-3	**CJ1**	**CJ2**	**CJ3**	**Cache size**
	2-3	2-3	Open	64K (8Kx8x8)
	1-2	Open	Short	128K (32Kx8x4)
	1-2	1-2	Open	256K (32Kx8x8)
CPJ1-3	**CPJ1**	**CPJ2**	**CPJ3**	**PGA CPU Type**
	Open	2-3	1-2	486SX PGA
	1-2	1-2,3-4	1-2	486DX/DX2
	2-3	2-3	1-2,3-4	487SX/Overdrive/486SX-PQFP
CS1-3	**CS1**	**CS2**	**CS3**	**CPU External clock speed (with clock generator)**
	1-2	1-2	1-2	20 MHz
	1-2	1-2	2-3	25 MHz
	2-3	2-3	2-3	33 MHz
	1-2	2-3	2-3	40 MHz
	2-3	1-2	1-2	50 MHz

VL/I-486SV2G(GX4)

Rev 2.0 and later.

Jumper	Position			Function
JP5,6	**JP5**	**JP6**		**CPU Type (Hardware Trap)**
	1-2	2-3		486DX24ODP,487SX,SL
	1-2	2-3		486SX,DX,DX2,DX4,AM486DX4-NV8T,DX2-NV8T
	2-3	1-2		Cyrix DX(2),DX2-V,DX4,5x86
	2-3	1-2		AM486DXL4,DXL2,Ti486DX-G
	1-2	1-2		i486DX4-&EW,P24D,P24T,AM486DX4-SV8B
JP11	1-2			Cyrix CPU
	2-3			AMD/Intel CPU
JP23-25	**JP23**	**JP24**	**JP25**	**CPU external clock speed**
	1-2	1-2	1-2	20 MHz
	2-3	1-2	1-2	25 MHz
	2-3	2-3	2-3	33 MHz
	2-3	2-3	1-2	40 MHz
	1-2	1-2	2-3	50 MHz
JP32,33	**JP32**	**JP33**		**CPU Voltage**
	1-2	Open		3.45
	2-3	Open		3.6
	Open	1-2		4
	Open	2-3		3.3

CPU	JP16	JP17	JP18	JP19	JP20	JP21	JP22
AMDX4-SV8B, iDX4-EW iDX2-&EW(P24D)	1-2,5-6	1-2,5-6	1-2	1-2,3-4,5-6	Open*	Short	1-2,4-5
AMDX4-NV8T, DX2-NV8T DXL4,DXL2	1-2,5-6	4-5	4-5	Open	4-5	Open ***	1-2,4-5
i486DX4ODP	5-6	1-2,5-6	1-2,5-6	1-2	Open*	Open	1-2
iSL486SX,SX2, NonSL486SX,SX2	5-6	1-2,5-6	1-2,5-6	1-2	Open	Open	2-3
Cx486DX4(3.45V) Cx286DX2-V(3.6V/4V) Ti486DX2-G(3.45V) Cx486DX,DX2	2-3,5-6	2-3,5-6	2-3	2-3	2-3	1-2 ****	1-2
Cx486DX4-P/O Cx5X86(M1sc)	1-2,5-6	1-2,5-6	1-2	1-2,3-4,5-6	Open*	Open	1-2
iSL(NonSL)486DX,DX2 iSL(NonSL)487SX,ODP i486DX4	1-2,5-6	1-2,5-6	1-2,5-6	1-2	Open*	Open	1-2
P25T & 237-Pin SL ODP	4-5	1-2,5-6	5-6	1-2	Open	2-3	1-2
AM5x86-P75(x5-133MHz)	1-2,5-6	1-2,5-6	1-2	1-2,3-4,5-6	Open**	2-3	1-2,4-5
Cx5x86(M1sc)-133MHz	1-2,5-6	1-2,5-6	1-2	1-2,3-4,5-6	Open**	Open	1-2

* Open (3x) 1-2 (2x) 5-6 (2.5x) **Open (3x) 1-2 (4x) ***Open (3x) 2-3 (2x) ****open DX/2

Astar

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9	P55-SA	AC	P55-TH

P55-TH

Epox P55-TH

AT&T

See also Olivetti

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1	1455	1-00	GIS Globalyst 330-360

1455

Same as Mitac LH4077C?

ATI

SX

Requires BIOS upgrade for Windows enhanced mode. Set J8 & J9 to 32K page memory allocation, not 16K.

Atima Technology

See Gemlight
www.atima.com

ATC

www.atc.co.jp
See A-Trend

A-Trend

www.a-trend.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1-00	ALI 1762 or 1442G	AC-00	ATC 5000
4C	ATC 1000	BC-00	ATC 1425B
9C	ATC 1000/2000/5000	H	ATC 1425B
9C	ATC 1020	HC-00	ATC 1425A

ATC 1000+

430VX. Aka Fugutech M 507

Jumper	*Position*		*Function*
JP3,4	**JP3**	**JP4**	**Host clock**
	Open	Open	50 MHz
	Close	Close	55 MHz
	Close	Open	60 MHz
	Open	Close	66 MHz
JP5	1-2		VRE CPU voltage (3.4-3.6v)
	3-4		STD CPU voltage (3.31-3.6v)
	1-2		3.5v CPU core
	3-4		3.3v CPU core
	5-6		2.9v CPU core
	7-8		2.8v CPU core
	9-10		2.7v CPU core
JP6	1-2		Single voltage CPU (P54C, 6x86, K5)
	2-3		Dual Voltage (P55C)
JP8,9	**JP8**	**JP9**	**Clock multiplier**
	1-2	1-2	1.5x
	1-2	2-3	2x
	2-3	2-3	2.5x
	2-3	1-2	3x

ATC 5000

430VX

Jumper	*Position*	*Function*
JP2	2-3,4-5	2x
	2-3,5-6	2.5x
	1-2,5-6	3x

Jumper	Position	Function	
JP3	1-2,5-6	60 MHz host clock	
	1-2,4-5	66 MHz host clock	
	2-3,4-5	75 MHz host clock	
JP6	1-2	VRE CPU voltage (3.4-3.6v)	
	3-4	STD CPU voltage (3.31-3.6v)	
	1-2	3.5v CPU core	
	3-4	3.3v CPU core	
	5-6	2.9v CPU core	
	7-8	2.8v CPU core	
	9-10	2.7v CPU core	Unable to verify core voltages!

ATC 6220

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Speeds (MHz)	500	
Chipset	440BX	
BIOS	Award 4.51PG	
Bus	4 PCI/3 ISA	1 shared
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)		
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	
Video		AGP
Audio		
Performance		Good, but SuperMicro P6SBA is faster
Problems		
Comments		133 MHz bus – stable when overclocked

ATC 6254M

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Speeds (MHz)		
Chipset	440BX	
BIOS	Award 4.51PG	
Bus	4 PCI/2 ISA	1 shared
Memory (Mb)	1 Gb	4 DIMM sockets
Cache (K)		
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	
Video		3Dfx Voodoo3 2000 (16 Mb)
Audio		Yamaha YMF740C
Performance		
Problems		
Comments		

FW-6280BXDR/155

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	SMP Slot 1
Cache		
Chipset	Intel 440BX	
BIOS		
Bus	6 PCI	
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2 EIDE, floppy USB, IR	
Video		AGP 2x
Performance		
Comments		SuperMicro P6DGU is better

Attractive Computer Technology

Auhau Electronics (Sukjung)

www.computersources.com.hk/auhau

AVT Industrial

Formerly Concord

Azza

www.azzaboard.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0C-00	4SIG	BC-00	PT 51V
2C	4SPI	DC-00	5IW
9C	PT 51H	EC-00	PT 5IV
9C-00	PT 51V	FC	PT 5IVH
AC-00	PT 5IS/VL		

4SIG

Same as Kaimei KM-S4-1 PCI rev 5.1 or Rectron RT 4S3

B

BCM

BCM Advanced Research Inc, or GVC
(714) 470 1888
www.bcmgvc.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
A	SQ 599	HC	SQ 595
AC	SQ 593 or 594	HC-00	LX 770 486 PCI
AC-00	SQ 599/P54SB	IC	SQ 595/575
BC	SQ 576	KC	FR 550
DC	SQ 591 or 594		

BCOM

Bestkey

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
CC	5725		

Biostar

(510) 226 6678
www.biostar-usa.com
www.biostar.com.tw
www.biostar.net

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1	MB 1566PAT-B VIP	A-00	MB 8500 URC
3	MB 8433/40 UUC	B(C)	MB 8500SAC
8	MB 8433UUD-A v3.1	BC	M6TBC (BX)
8C-00	MB 8433UUD	DC	M6TLC (LX)
9C	MB-8500TEC	YC-00	MB 8433 /40 /50UUC-A v2.1
9C-00	M5ATA		

8433UUD

Item	Description	Notes
Form Factor	AT	
CPU	486	Including AMD 5x86/P75
Speeds (MHz)	25, 33 or 40	
Chipset	UMC 888X	
BIOS	Award	
Bus	3 PCI/4 ISA	PCI bus can use 25, 26.67 or 33 MHz
Memory (Mb)		72-pin only. Will use EDO with the UUD960326I BIOS. May not like TI memory.
Cache (K)		
I/O	2S, 1P, PS/2	May not use 3 parallel ports. May be problems with built-in PS/2 mouse.
Performance		
Problems		May not be able to use more than PIO Mode 3, despite BIOS
Comments		Also known as Quantex MBD-4PB2 or 4MB2

CPU Selection	JP16, JP37, JP39, JP45, JP46, RN11-15
CPU Speed Selection	Remove JP15 for 40 MHz.
Cache (K) Selection	JP5, 6, 7
Flash ROM Selection	J13, Intel (12 v) or SST (5 v).
DMA Channel Selection	JP8, 9

8500TVX

Jumper	*Position*		*Function*
JP3	1-2		5v Flash ROM
	2-3		12v Flash ROM
JP4	Open		Normal
	Closed		Clear CMOS
JP5	3-4		66 MHz bus clock
	1-2		60 MHz
	1-2.3-4		50 MHz
	Both Open		55 MHz
JP8-9	**JP8**	**JP9**	**Clock Multiplier**
	Open	Open	1.5
	Open	Closed	2*
	Closed	Closed	2.5
	Closed	Open	3
	Open	Open	3.5
			v2.3 + - otherwise both open
JP6, 11	**JP6**	**JP11**	**CPU Type**
	1-2	1-2,3-4	Single Voltage
	2-3	open	Dual Voltage
JP7	Open		256K cache
	Closed		512K cache
JP12	Open		3.5v CPU (VRE)
	Closed		3.45v CPU (Std & VR)
JP14	Open		2.9v (Dual Voltage CPU)
	Closed		2.6v

Password recovery: Power off – Close JP4 – Power On, then off after memory count
Open JP4 – Power On – reset password

M6TBA

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/III	Slot 1
Speeds (MHz)		
Chipset	440BX	
BIOS	Award	
Bus	4 PCI/3 ISA	
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)		
I/O	2S, 1P, PS/2, USB, EIDE	
Video		AGP

Item	Description	Notes
Problems		
Comments		Supermicro P6SBA a better choice

M6TWC

Item	Description	Notes
Form Factor	Micro-ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		
Chipset	Intel 810	
BIOS		
Bus	3 PCI	
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	PS/2 Mouse and Keyboard, 2 USB, 2 serial, 1 parallel, 2 EIDE, floppy	
Video		onboard

M7MKA

Item	Description	Notes
Form Factor	ATX	
CPU	Athlon	Slot A
Speeds (MHz)		
Chipset	AMD 751/756	
BIOS	Award	
Bus	5 PCI/2 ISA	UDMA/66
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2 EIDE, floppy	
Video	AGP	2x
Performance		
Comments		

Bioteq

European name for Biostar.
www.bioteq.com

BJMT Technology

www.bjmt.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
AC	Nimble VX	BC	Nimble Triton-III VX

82430VX

Same as FYI 82430VX P55C

Jumper	*Position*				*Function*
JP1,2	**JP1**	**JP2**			**IR function**
	1-2	1-2			COM2
	2-3	2-3			IR
JP7-9	**JP7**	**JP9**	**JP17**	**JP18**	**Cache size**
17-18	1-2	2-3	2-3	1-2	256K (onboard)
	1-2	2-3	2-3	1-2	256K (module)
	2-3	2-3	2-3	1-2	512K (onboard)
	2-3	2-3	2-3	1-2	512K (module)
	2-3	1-2	2-3	2-3	512K (onboard + module)
JP8	1-3,2-4				5v DIMM
	3-5,4-6				3.3v DIMM
JP12,13	**JP12**	**JP13**			**Host bus clock**
	On	On			50 MHz
	Off	Off			55 MHz
	Off	On			60 MHz
	On	Off			66 MHz
J14,15	**J14**	**J15**			**BIOS type**
	1-2	1-2			EPROM
	1-2	2-3			5v Flash
	2-3	2-3			12v flash
JP19,20	**JP19**	**JP20**			**Clock multiplier**
	Off	Off			1.5x
	On	Off			2x
	On	On			2.5x
	Off	On			3x
JP26	1-2,3-4				3.3v CPU
	1-2				3.45v CPU
	3-4				3.52v CPU
	All off				3.6v CPU voltage

Nimble Triton-III VX

FYI board.

Bluepoint Technology

BMA

USA name for Biostar.

Boser

Brother

BC 3286

Jumper	*Position*			*Function*
J9,26	**J9**	**J26**	**SW2-1**	**Display**
SW2-1	In	In	Off	Onboard Mono
	Out	Out	Out	External
J13	1-2			RAS delay 100ns
	2-3			RAS delay 80ns
J17	1-2			1.5ns RAS via F08 delay
	2-3			2.2ns RAS via F08 delay
J18	In			Turbo mode
	Out			Normal ops
J19				Reserved
SW1	3-4			512K base memory
	2-3			640K base memory
	4			1 Mb base memory
SW2	1			Enable COM2
	2			Enable LPT
	3			Enable COM1

BC 3386sx

Jumper	*Position*		*Function*
J1	In		80387sx installed
J8	1-2		27512K BIOS size
	2-3*		27256K BIOS size
J12	In*		External delay for timing
	1-2		Access time 85ns
	2-3		Access time 90ns
J20	1-2		Enable IRQ9
J21	4-2		44256 in U39, U57 for 256K memory
	3-4	1-2	44256 in U39, U38 & U52 for 512K memory
J22	1-6*		Enable COM2
	2-5*		Enable LPT
	3-4*		Enable COM1
J23	1-2		256K DRAM clock select
	2-3		512K DRAM clock select
J25	Out		Normal ops
	In*		Turbo
J31,32			Reserved
J33	1-2		Non-interlaced monitor
	2-3*		Interlaced monitor
J36	Out*		VGA 16-bit data path
	In		VGA 8-bit data path

BC 5386sx

Jumper	*Position*	*Function*		
JP2	1-2	512K BIOS size (27512 x 2)		
	2-3	256K BIOS size (27256 x 2)		
JP4,5	**DRAM type**	**JP4**	**JP5**	**Wait state**
	100 ns FPM	1-2	1-2	0 or 1
	100ns FPM	1-2	2-3	0 or 1
	All 100 ns	2-3	1-2	1 or 2
	120 ns	2-3	2-3	2 or 3
JP6	1-2	CGA display		
	2-3	Mono display		
JP10	1-2	ROM type 512K (27512)		
	2-3	ROM type 256K (27256)		
JP11	In	Copro clock asynchronised		
	Out*	Copro clock synchronised		
JP102	1-2	Power good signal from power supply		
	2-3	Power good signal by main board		

BC 5386dx

Jumper	*Position*	*Function*
JP1	In*	Colour display
	Out	Mono display
JP3	1-2	27512K BIOS size
	2-3	27256K BIOS size
JP5	1-2	80ns DRAM
	2-3	100ns DRAM
JP6	1-2*	Copro not installed
	2-3	Copro installed
JP8	In*	High speed
	Out	Low speed

SW1

S2	S3	S6	S7	S8	Bank 1	Bank 2	Bank 3	Bank 4	Total
Off	Off	Off	Off	Off	256Kx9				1 Mb
Off	On	Off	Off	Off	256Kx9				2 Mb
Off	On	On	Off	Off	256Kx9	256Kx9			3 Mb
Off	On	On	On	Off	256Kx9	256Kx9	256Kx9		4 Mb
On	Off	Off	Off	Off					4 Mb
On	On	Off	Off	Off	1 Mbx9				8 Mb
On	On	On	Off	Off	1 Mbx9	1 Mbx9			12 Mb
On	On	On	On	Off	1 Mbx9	1 Mbx9	1 Mbx9		16 Mb

When S8 is On, only 14 Mb is detected. The additional 2 Mb is for add-On cards with their own memory.

APW

Jumper	*Position*	*Function*
J5	In	Disable HD
	Out*	Enable HD
J7		Reserved
J07	1-2*	Onboard battery
	2-3	External battery
J10	1-2	5¼" and 3½" floppies
	2-3*	3½" floppy only
J14	1-2*	Mono display
	2-3	Colour display
	Out	Display card in 16-bit slot
J16		Reserved

AP-M45/Micral 45

Jumper	*Position*	*Function*				
SWD1	Display	1-1	1-2	1-3	1-4	JDO1
JDO1	Mono	Off	Off	Off	Off	2-3
	Colour	On	Off	Off	Off	2-3
	EGA	Off	On	On	Off	1-2

SW1

Switch	*Position*	*Jumper*	
1,2	**Memory**	**S1**	**S2**
	640K	On	Off
	1152K	Off	Off
	Bank 2=2 Mb	On	On
	Extended memory	Off	Off
3		Reserved	
4	On	Add-On Mono	
	Off	Add-On CGA	
5	Off	Enable video	
6,7,8		Reserved	

SW2

Switch	*Position*	*Function*
1	Off*	Enable mouse
2	Off*	Disable mouse IRQ5
3	On*	Enable mouse IRQ3
4	On	CP8 interface address 0370-0377h
		Parallel address 278-27Fh
		Serial address 2F8-2FFh
5	Off*	SCSI address 320-327h
	On	SCSI address 328-32Fh
6	Off*	Enable SCSI IRQ7
7	On*	Enable SCSI IRQ15
8	Off*	Enable parallel IRQ5
9	Off*	Enable parallel IRQ7

Switch	*Position*	*Function*
10	On*	Enable IRQ3 CP8 interface

BM 200

JMP1

Jumper	*Position*	*Function*
ST11	Out	27256 EPROM-1 (170ns) 2 WS
ST5	In	8 MHz bus
ST2	Out	RAM: 1 WS
ST3	In	ROM: 2WS
ST7	In	1 Mb DRAM 120ns
ST8	In	4 x 256 x 9
ST9	Out*	
ST4	Out	Fast mode

JMP2

Jumper	*Position*	*Function*	
ST34	In	Precomp 187 ns	
ST35	In	DRQ2 sent (DMA for floppy)	
ST48,49	CTS	**ST48**	**ST49**
	CP8-CP8	Out	In
		In*	Out*
ST50,51	DSR	**ST50**	**ST51**
	CP8-CP8	Off	On
		On*	Off*
ST52,53	RXD	**ST52**	**ST53**
	CP8-CP8	Out	In
		In*	Out*

JMP3

Jumper	*Position*	*Function*
ST30	In	HDCS1 1F0-1F7h
ST29	In	HDCS2 3F6-3F6h
ST27	In	SERICS (COM2-CP8) 2F8-2FFh 390-397h 370-377h
ST26	In	SEROCS (COM1) 3F8-3FF
ST32	In	FLPCS3 (floppy) 3F7h
ST31	In	FLPCS2 (floppy) 3F2h
ST28	In	PRTCS (parallel) 278-27Fh, 378-37Fh
ST33	In	FLPCSI (floppy) 3F4h/3FS

JMP4

Jumper	*Position*	*Function*
ST10	Out	DRAM 120/150ns
ST38	In*	
ST43	In	VGA DRAM memory selected – off for EGA

Jumper	*Position*	*Function*
ST13	In	VGA I/O selected
ST47	In	IRQ7 selected
ST46	Out*	
ST24	In	2F8-2FFh V24 (9 pin)/CP8
ST25	In	3F8-3FFh V24 SEROCS 378-37Fh PARALL-PRTCS

JMP5

Jumper	*Position*	*Function*
ST22	Out*	
ST19		
ST18	Out	Reserved
ST20	Out*	
ST21	Out	VGA
ST56	Out*	
ST6	In	48 MHz system clock connected
ST12	In Out	Colour display Mono display
ST14	In	14.832 MHz clock connected
ST15	In	36 MHz VGA clock
ST16	In	25.175 MHz VGA clock
ST17	In	28.322 MHz VGA clock
ST36	In	16 MHz clock
ST37	In	9.6 MHz floppy interface
ST40	Out	Link from P6 mechanical grd to 0v not established
ST41	In	MEMCS16 disabled (no video 16-bit access)
ST42	In	IOCHRDY (HD connected)
ST44	In	IRQ14 only
ST45	Out*	
ST54	In	Power supply +5v
ST55	Out	Serial/parallel I/O address

For non-VGA monitors, remove JMP4 ST13 and 43 and add JMP5 ST23 and 21.

Add ST21 for Mono.

EP Main Logic

Jumper	*Position*	*Function*					
W2	**Video**	**1**	**2**	**3**	**4**	**5**	**6**
	Enable	Off*	Off*	Off*	On*	On*	On*
	Disable	On	On	On	Off	Off	Off
U158	**Memory**	**S1**	**S2**	**S3**			
	256K	On	On	Off			
	512K	On	Off	Off			
	640K	Off*	Off*	Off*			
U173	**Bank Address**	**S1**	**S2**	**S3**	**S4**		
	C0000-C3FFF	On	On	On	On		
	C4000-C7FFF	On	On	On	Off		
	C8000-CBFFF	On	On	Off	On		

Jumper	*Position*	*Function*			
	CC000-CFFFF	On	On	Off	Off
	D0000-D3FFF	On	Off	On	On
	D4000-D7FFF	On	Off	On	Off
	D8000-DBFFF	On	Off	Off	On
	DC000-DFFFF	On	Off	Off	Off
	E0000-E3FFF	Off	On	On	On
	E4000-E7FFF	Off	On	On	Off
	E8000-EBFFF	Off	On	Off	On
	EC000-EFFFF	Off	On	Off	Off
	Disabled	Off*	Off*	Off*	Off*
U178	On*	8087-2 not installed			
1	Off	8087-2 installed			
2	On*	Reserved			
3	On*	Enable Onboard HD			
4	On*	One floppy			
	Off	Two floppies			
5,6	Video	6			
	Not used	On	On		
	80x25 colour	Off	On		
	40x25 colour	On	Off		
	Mono	Off*	Off*		

Micral 600

Jumper	*Position*			*Function*			
SW1	On*			Sets EPROM and I/O recovery delay			
SW2	On*			25 pin=COM1 * 9 pin=COM2			
S1	Off			9 pin=COM1 * 25 pin=COM2			
S2	Off*			Enable COM1			
S3	Off*			Enable COM2			
S4	Off*			Enable LPT1			
S5-7	**Printer port**			**S5**	**S6**	**S7**	
	LPT1			Off	Off	On*	
	LPT2			On	On	Off	
S8	On			ROM BIOS			
	Off*			BIOS in RAM			
S9	On			Primary display CGA			
	Off*			Primary display Mono			
S10	On*			Enable 2nd SIMM block (B)			
JP6-8	**Maths copro**			**JP6**	**JP7**	**JP8**	
	80387 installed			2-3	2-3	2-3	
	Not installed			1-2	1-2	1-2	
JP12	1-2*			Relocate RAM at 0A0000-0Dffff to FA0000-FDFFFF			
JP13-16	**RAM**	**Type**	**Block**	**JP13**	**JP14**	**JP15**	**JP16**
	2 Mb	512x9	A	2-3	2-3	1-2	1-2
	4 Mb	512x9	A&B	2-3	2-3	1-2	1-2
	6 Mb	512x9	A	1-2	1-2	1-2	1-2
		1Mx9	B				
	4 Mb	1Mx9	A	1-2	1-2	2-3	2-3
	8 Mb	1Mx9	A&B	1-2	1-2	2-3	2-3

SP-16 Processor Card

Jumper	*Position*	*Function*
S1	1-2*	Colour display
	2-3	Mono display
SW2-1	On*	80387 installed
SW2-2	Off*	Reserved
SW2-3	Off*	Video DMA
SW2-4	Off*	NMI failsafe timer disabled
SW2-5	Off*	INT 10 not selected
SW2-6	Off*	INT 11 not selected
SW2-7	Off*	INT 12 not selected
SW2-8	On	Normal system speed during floppy access
	Off	Emulate 8MHz during floppy access

SP-SX V16 Processor Card

Jumper	*Position*	*Function*				
S1	1-2*	Colour display				
	2-3	Mono display				
S2	1-2*	16 MHz CPU				
	2-3	8 MHz CPU				
S3-1	Out*	4 wait states				
	In	3 wait states				
S3-2	Out*	Autoswitch mode				
	In	8 MHz mode				
S3-3	Out*	0-512K				
	In	0-256K				
S3-4	Out*	512K-1Mb enabled				
S3-5,6,7,8	**Memory**	**Mapping Area**	**S5**	**S6**	**S7**	**S8**
	Deselected		In	In	In	In
	0	100000-160000	Out*	In*	In*	In*
	1	200000-260000	In	Out	In	In
	2	300000-360000	Out	Out	In	In
	3	400000-460000	In	In	Out	In
	4	500000-560000	Out	In	Out	In
	5	600000-660000	In	Out	Out	In
	6	700000-760000	Out	Out	Out	In
	7	800000-860000	In	In	In	Out
	8	900000-960000	Out	In	In	Out
	9	A00000-A60000	In	Out	In	Out
	10	B00000-B60000	Out	Out	In	Out
	11	C00000-C60000	In	In	Out	Out
	12	D00000-D60000	Out	In	Out	Out
	13	E00000-E60000	In	Out	Out	Out
	14	F00000-F60000	Out	Out	Out	Out

SP-20 Processor Card

Jumper	*Position*	*Function*
S1	1-2*	Colour display
	2-3	Mono display

Jumper	*Position*	*Function*
SW2-1	On*	80387 installed
SW2-2	On	Auxiliary Input Device port enabled
SW2-3	Off	Video RAM shadowed
SW2-4	Off	NMI failsafe timer disabled
SW2-5	Off*	INT 10 not selected
SW2-6	Off*	INT 11 not selected
SW2-7	Off*	INT 12 not selected
SW2-8	On	Normal system speed during floppy access
	Off	Emulate 8MHz during floppy access

Notes

C

Caliber Computer Corp

www.calibercorp.com

California Graphics & Peripherals

www.californiagraphicsusa.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C-00	Sunray VIA	TC	Sunray II Pro rev D
LC-00	Sunray II Pro rev A1		

Sunray II Pro

Rev A1 - Soyo 5TC2?
Rev D – Wintec MP064?

Sunray VIA

Epox P55-VP

ChainTech

ELT
(562) 906 1698
www.chaintech.com.tw

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0	486SLB	A	Chaintech 5SEM
1-00	5UBM or 4SLE	AC-00	5HTM rev M101/586SEM
2-B2	486SPM	AC	586IEM/0/0.1
9C	6BTM (BX)/ 6LTM (LX)/5IFM	BC	5IEM
9-01	5SBM2	C-00	486SPM M1.02
9C-00	5SEM M102	DC	6FTM
9C-01	5IDM2 M105 (FX)	I	486SPM
9C	5VGM/5IFM/5IGM M 101		

CT-3AGM2

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium/K6	Super Socket 7
Cache	512 Kb	
Chipset	Via MVP3	
BIOS		
Bus	3 PCI/3 ISA	UDMA/33
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2 EIDE, floppy USB, IR	
Video		AGP 2x
Performance		
Comments		

CT-5AGM2

Item	Description	Notes
Form Factor	Baby AT	
CPU	Pentium	Socket 7
Speeds (MHz)	550	
Chipset	VIA MVP3	
BIOS		
Bus	4 PCI/3 ISA	1 shared. 100 MHz bus speed
Memory (Mb)	384	3 DIMM sockets
Cache (K)	512	
I/O	2 EIDE, floppy, USB	
Video		AGP
Performance		About average

CT-6ATA2

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		
Chipset	VIA Apollo Pro Plus	
BIOS		
Bus	4 PCI/2 ISA	1 shared UDMA/66
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video		AGP
Performance		
Problems		
Comments		

CT-6ATA4

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III	Slot 1
Speeds (MHz)		
Chipset	Via Apollo	
BIOS		
Bus	5 PCI/1 ISA/1 AMR	1 shared UDMA/66
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video		AGP
Performance		
Problems		
Comments		

CT-6BDU

Essentially jumperless except for clock frequency and keyboard power-on.

Item	Description	Notes
Form Factor	ATX	
CPU	Dual Pentium II	Slot 1
Speeds (MHz)	450	
Chipset	440BX	
BIOS		
Bus	4 PCI/3 ISA	112 MHz bus speed
Memory (Mb)		4 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	Ultra 2 SCSI with RAIDport III on board
Video		AGP
Performance		

CT-6BTA3

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		
Chipset	440BX	
BIOS		
Bus	4 PCI/2 ISA	1 shared
Memory (Mb)	1 Gb	4 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video		AGP
Performance		
Problems		
Comments		CT 6ATA2 is cheaper with faster EIDE

CT-6BTM

Essentially jumperless except for clock frequency and keyboard power-on.

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III/Celeron	Slot 1
Speeds (MHz)	800/533	
Chipset	440BX	
BIOS	Award 4.51PG	
Bus	4 PCI/3 ISA	1 shared. 133 MHz bus speed
Memory (Mb)	1 Gb	4 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video		AGP
Performance		Slow-Good – similar to Soyo SY-6BA+
Problems		
Comments		

CT-6ESA2

Essentially jumperless except for clock frequency and keyboard power-on.

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Speeds (MHz)	333	
Chipset	440EX	
BIOS		
Bus	2 PCI/2 ISA	1 shared. 83 MHz bus speed
Memory (Mb)	256	2 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video		AGP
Audio	Stereo audio	

CT-6ESV

Essentially jumperless except for clock frequency and keyboard power-on.

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Speeds (MHz)	333	
Chipset	440EX	
BIOS		
Bus	2 PCI/2 ISA	1 shared. 83 MHz bus speed
Memory (Mb)	256	2 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video	Rage II-C 4 Mb	AGP
Audio	Stereo audio	
Performance		

CT-6LTM

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	375 MHz	
Chipset	440 LX	
BIOS		
Bus	4 PCI/3 ISA	1 each shared
Memory (Mb)	384 Mb SDRAM 768 Mb EDO	3 DIMM sockets
I/O	2 EIDE, floppy	
Video		AGP
Performance		Fast
Comments		Almost identical to QDI Legend. Jumperless.

CT-6WIV

Item	Description	Notes
Form Factor	Micro-ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		
Chipset	Intel 810	
BIOS		
Bus	3 PCI	UDMA/66
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	2 EIDE, floppy	
Video		
Performance		
Comments		

CT-6WSV2

Item	Description	Notes
Form Factor	Micro-ATX	
CPU	Celeron/PII	Slot1
Speeds (MHz)		
Chipset	Intel 810E	
BIOS		
Bus	3 PCI	UDMA/66
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	2 EIDE, floppy, USB	
Video		Embedded 3D AGP
Performance		
Comments		

Chaplet

(408)732 6159

Chicony

(714) 380 0928

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1	CH 471B	H-00	CH 880C
1-08	C471	H-02	CH 890A
4-01	CH 881A	HC	CH 880C

CH-471A

Jumper	*Position*							*Function*
JP7	1-2							Normal
	2-3							Clear CMOS
JP8,12,13	**JP8**	**JP12**	**JP13**					**CPU Speed**
	Out	Out	Out					20 MHz
	Out	Out	In					25 MHz
	In	In	In					33 MHz
	Out	In	In					40 MHz
	In	Out	Out					50 MHz
JP1,JP2-5	**JP1**	**JP2**	**JP3**	**JP4**	**JP5**	**JP14**	**JP16**	**Cache Size**
14,16	1-2,3-4	2-3	1-2	1-2	1-2	1-2	1-2	32K
	2-3,4-5	1-2	1-2	2-3	1-2	1-2	1-2	64K
	1-2,3-4	2-3	2-3	2-3	1-2	1-2	2-3	128K
	2-3,4-5	1-2	2-3	2-3	2-3	1-2	2-3	256K
	1-2,3-4	2-3	2-3	2-3	2-3	2-3	2-3	512K

Jumper	*Position*							*Function*
	2-3,4-5	1-2	2-3	2-3	2-3	2-3	2-3	1 Mb
JP 32,34, 35	1-2 2-3							5v CPU (P24C/T) 3.3v CPU
JP40	1-2 2-3							Normal Address Strobe Delay
JP44	1-2 2-3							VESA 0 wait VESA 1 wait
JP47	1-2 2-3							VESA <= 33 MHz VESA >33 MHz

JP	20	21	29	31	25	23	26	24	11	10	30	33	36	28	27
SX	2-3	Out	2-3	Out	Out	Out	Out	Out	2-3	1-2	Out	Out	Out	Out	Out
DX	1-2	In	2-3	3-4	Out	Out	Out	Out	2-3	1-2	Out	Out	Out	Out	Out
P24T	1-2	In	1-2	2-3	3-4	Out	2-3	1-2	1-2	1-2	1-2	1-2	1-2	Out	Out
SX-SL	2-3	Out	2-3	Out	3-4	1-2	2-3	4-5	2-3	1-2	Out	Out	1-2	Out	Out
DX"-SL	1-2	In	2-3	3-4	3-4	1-2	2-3	4-5	2-3	1-2	Out	Out	1-2	Out	Out
DX-SL	1-2	In	2-3	3-4	3-4	1-2	2-3	4-5	2-3	1-2	Out	Out	1-2	Out	Out
M6	2-3	Out	2-3	Out	2-3 4-5	Out	1-2 3-4	2-3	1-2	2-3	2-3	2-3	1-2	Out	Out
Cyrix DX/2	1-2	In	2-3	3-4	2-3	Out	1-2 3-4	2-3	1-2	2-3	2-3	2-3	1-2	Out	Out
P24D	1-2	In	1-2	3-4	1-2 3-4	2-3	2-3	4-5	2-3	1-2	Out	Out	1-2	In	In
P24C	1-2	In	2-3	3-4	3-4	1-2	2-3	4-5	2-3	1-2	Out	Out	1-2	Out	Out
AMDX	1-2	In	2-3	1-2	Out	Out	Out	Out	2-3	1-2	3-4	Out	2-3	Out	Out

Clevo

(909)595 5123

Commate

www.tcommate.com.tw

Compaq

www.compaq.com

DeskPro

Jumper	*Position*		*Function*
1	Off		Always Off
2	Off		8 MHz Maths copro installed
3-4	**3**	**4**	**Memory (Kb)**
	On	Off	128
	Off	Off	256
	Off	On	512
	On	On	640

Jumper	Position		Function	
5,6	**5**	**6**	**Video adapter**	
	Off	Off	Mono	
	Off	On	CGA 40 x 25	
	On	Off	CGA 80 x 25	
	On	On	With own BIOS	
7	On		1 floppy	
	Off		2 floppies	
8	On		Always On	

DeskPro v2/8MHz

Jumper	Position		Function	
1	Off		256K X 1 DRAM	
	On		64K X 1 DRAM	
2,3	**2**	**3**	**Memory (Kb)**	
	On	On	Both	
	On	Off	0-256	
	Off	On	0-512	
	Off	Off	All memory	
4,5	**4**	**5**	**Extended Memory**	
	On	On	None	
	On	Off	1.5 Mb	Bank 2-1; 256K DRAM
	Off	On	1-2 Mb	Bank 2/3; 256K DRAM
	Off	Off	64K DRAMs	
6	On		6 MHz only	
	Off		6 or 8 MHz	
7	Off		Always Off	
8	On		Compaq or EGA monitor	
	Off		Non-Compaq monitor	

DeskPro 286 Version 1

Switch	Position		Function
1	Off		Always Off
2	On		8 MHz 8087-2 not installed
	Off*		Coprocessor installed
3,4	**3**	**4**	**Memory (Kb)**
	On	Off	128
	Off	Off	256
	Off	On	512
	On	On	640
5,6	**5**	**6**	**Display**
	On	On	80 x 25 EGA, or RGBI
	Off	On	40 x 25 COMPAQ VDU*
	On	Off	80 x 25 COMPAQ VDU
	Off	Off	720 x 350 Monochrome
7	On		1 floppy
	Off		2 floppies
8			Always On

*Rev F or later ROM

System Memory Board

Jumpers are etched on the solder side (bottom) of the board. Cut the conductor to disconnect any unwanted jumpers, then solder the wire(s) to jumpers as desired. Modifying these jumpers invalidates the warranty.

ROM Set 1

Jumper	*Function*
E7-E8 E10-E11 E13-E14	8K x 8, Static ROM, 250 ns
E8-E9 E10-E11 E13-E14	16K x 8, Static ROM, 250 ns*
E7-E8 E11-E12 E13-E14	Invalid
E8-E9 E11-E12 E13-E14	32K x 8, Static ROM, 250 ns
E7-E8 E10-E11 E14-E15	8K x 8, Dynamic ROM, 150 ns
E8-E9 E10-E11 E14-E15	16K x 8, Dynamic ROM, 150 ns
E7-E8 E11-E12 E14-E15	Invalid
E8-E9 E11-E12 E14-E15	32K x 8, Dynamic ROM, 150 ns

ROM Set 2

Jumper	*Function*
E16-E17 E19-E20 E22-E23	8K x 8, Static ROM, 250 ns
E17-E18 E19-E20 E22-E23	16K x 8, Static ROM, 250 ns
E16-E17 E20-E21 E22-E23	Invalid
E17-E18 E20-E21 E22-E23	32K x 8, Static ROM, 250 ns
E16-E17 E19-E20 E23-E24	8K x 8, Dynamic ROM, 150 ns
E17-E18 E19-E20 E23-E24	16K x 8, Dynamic ROM, 150 ns
E16-E17 E20-E21 E23-E24	Invalid
E17-E18 E20-E21 E23-E24	32K x 8, Dynamic ROM, 150 ns*

Switch	*Position*	*Function*
ED	1-2	Mono display
	2-3*	Compaq display, third party extended graphics, third party RGB adapters. If both Mono and Compaq video boards are installed, the Mono display is active during power on if pin is set on 1-2.
ES	1-2*	I/O Speed/RAM 6 MHz/8 MHz (fast)
	2-3	6 MHz/6 MHz (common). For system ROM E and F, between COMMON and FAST. Rev G system ROM selects between COMMON and HIGH. Rev H system ROM selects between FAST and HIGH for other 80286-based products. If the speed select jumper is changed to 6 MHz (2-3), the system does not respOnd to speed change requests from the keyboard.
7		Reserved
J108,9,10,11,12,13		Reserved

DeskPro 286 Version 2

Assy 000361

Switch	*Position*	*Function*
1	On	64K x 1 DRAM
	Off	256K x 1 DRAM

Switch	Position		Function
2,3	**2**	**3**	**Base Memory**
	On	On	Disable RAM and ROM
	On	Off	256K
	Off	On	512K
	Off	Off	Enable all base Memory
4,5	**4**	**5**	**Memory**
	Off	Off	64K x 1 DRAM
	On	On	256K x 1 DRAM. No extended
	On	Off	Enable bank 2 for 1-1½ Mb
	Off	On	Enable bank 2 & 3 for 1-2 Mb
	Off	Off	Enable all banks for 1-2½ Mb
6	Off*		8/6 MHz
	On		6 MHz
7			Reserved
8	On		COMPAQ VDU, ECG, EGA or RGBI
	Off		Mono
J108,9,10,11,12,13,17			Reserved

DeskPro 286 12 MHz

Assy 000555 &.000700

Switch	Position		Function
1	On		64K x 1 DRAM
	Off		256K x 1 DRAM
2,3	**2**	**3**	**Base Memory**
	On	On	Disable RAM and ROM
	On	Off	256K
	Off	On	512K
	Off	Off	Enable all base Memory
4,5	**4**	**5**	**Memory**
	Off	Off	64K x 1 DRAM
	On	On	256K x 1 DRAM. No extended
	On	Off	Enable bank 2 for 1-1½ Mb
	Off	On	Enable bank 2 & 3 for 1-2 Mb
	Off	Off	Enable all banks for 1-2½ Mb
6	Off*		12/8 MHz software select
	On		8 MHz
7			Reserved
8	On		COMPAQ VDU, ECG, EGA or RGBI
	Off		Mono
E5	1-2		Disable processor slowdown with diskette access
	2-3		Enable processor slowdown with diskette access (allows time dependent copy protection schemes to work properly)
J108,9,10,11,12,13,17			Reserved

System Memory Board

Version 2 and 3

Jumpers are etched on the solder side (bottom) of the board. Cut the conductor to disconnect any unwanted jumpers, then solder the wire(s) to jumpers as desired. Modifying these jumpers invalidates the warranty.

ROM Set 1

E2

Jumper	Function
1-2 4-5 7-8	8K x 8, Static ROM, 250 ns
2-3 4-5 7-8	16K x 8, Static ROM, 250 ns*
1-2 5-6 7-8	Invalid
2-3 5-6 7-8	32K x 8, Static ROM, 250 ns
1-2 4-5 8-9	8K x 8, Dynamic ROM, 150 ns
2-3 4-5 8-9	16K x 8, Dynamic ROM, 150 ns
1-2 5-6 8-9	Invalid
2-3 5-6 8-9	32K x 8, Dynamic ROM, 150 ns

ROM Set 2

E3

Jumper	Function
1-2 4-5 7-8	8K x 8, Static ROM, 250 ns
2-3 4-5 7-8	16K x 8, Static ROM, 250 ns*
1-2 5-6 7-8	Invalid
2-3 5-6 7-8	32K x 8, Static ROM, 250 ns
1-2 4-5 8-9	8K x 8, Dynamic ROM, 150 ns
2-3 4-5 8-9	16K x 8, Dynamic ROM, 150 ns
1-2 5-6 8-9	Invalid
2-3 5-6 8-9	32K x 8, Dynamic ROM, 150 ns*

DeskPro 286e

Switchbank 1

Switch	*Position*		*Function*
1,2	**1**	**2**	**Base Memory**
	On	On	640K
	On	Off	512K
	Off	On	Reserved
	Off	Off	256K
3	Off*		Option ROM disable
	On		Option ROM enable
4	On*		Auto power on speed
	Off		High power on speed
5			Reserved
6	On		All display adapters except Mono
	Off		Mono

Switchbank 2

Switch	*Position*	*Function*
1	On	Secondary address (37X, 17X) FD/HD
	Off*	Primary address (3FX, 1FX) FD/HD
2	On	Disable power on password
	Off*	Enable power on password

Switch	Position		Function
3	On		Disable HD controller
	Off*		Enable HD controller
4,5	**4**	**5**	**Serial Port**
	Off*		COM1 primary address 3FX, IRQ4
		Off	COM2 secondary address 2FX, IRQ3
	*		Reserved
	On	Off	Disable
	Off	On	
	On	On	
6,7	**6**	**7**	**Parallel Port**
	On*		LPT1 primary address 3BX
		Off	LPT1/2 secondary address 37X
	*		Reserved
	Off	On	Disable
	Off	Off	
	On	On	
8	Off*		Enable video
E4	1-2		Enable IRQ12
	2-3		Disable IRQ12 (e.g. allows mouse to be used)
E11	1-2		8 MHz coprocessor
	2-3*		12 MHz coprocessor

Memory Jumpers

Each jumper represents one bank - a maximum of four can be expanded Memory. With modules in locations A and B, the memory expansion board must be configured as extended Memory.

Board	Module A	Module B	E1-E3	E4-E6	E7-E9	Ext	Exp	Total
1 Mb			1-2 Ext	2-3*	2-3*	1 Mb		2 Mb
			2-3 Exp	2-3*	2-3*	1 Mb	1 Mb	2 Mb
1 Mb	1 Mb		1-2 Ext	1-2 Ext	2-3*	2 Mb		3 Mb
			1-2 Ext	2-3 Exp	2-3*	1 Mb	1 Mb	3 Mb
			2-3 Exp	2-3 Exp	2-3*	2 Mb	2 Mb	3 Mb
1 Mb	1 Mb	1 Mb	1-2 Ext	1-2 Ext	1-2 Ext	3 Mb		4 Mb
			1-2 Ext	1-2 Ext	2-3 Exp	2 Mb	1 Mb	4 Mb
			1-2 Ext	2-3 Exp	2-3 Exp	1 Mb	2 Mb	4 Mb
1 Mb	4 Mb		1-2 Ext	1-2 Ext	2-3*	5 Mb		6 Mb
			1-2 Ext	2-3 Exp	2-3*	1 Mb	4 Mb	6 Mb
			2-3 Exp	2-3 Exp	2-3*	1 Mb	6 Mb	6 Mb
1 Mb	1 Mb	4 Mb	1-2 Ext	1-2 Ext	1-2 Ext	6 Mb		7 Mb
			1-2 Ext	1-2 Ext	2-3 Exp	2 Mb	4 Mb	7 Mb
			1-2 Ext	2-3 Exp	2-3 Exp	1 Mb	5 Mb	7 Mb
1 Mb	4 Mb	1 Mb	1-2 Ext	1-2 Ext	1-2 Ext	6 Mb		7 Mb
			1-2 Ext	1-2 Ext	2-3 Exp	5 Mb	1 Mb	7 Mb
			1-2 Ext	2-3 Exp	2-3 Exp	1 Mb	5 Mb	7 Mb
1 Mb	4 Mb	4 Mb	1-2 Ext	1-2 Ext	1-2 Ext	9 Mb		10 Mb
			1-2 Ext	1-2 Ext	2-3 Exp	5 Mb	4 Mb	10 Mb
			1-2 Ext	2-3 Exp	2-3 Exp	1 Mb	8 Mb	10 Mb
4 Mb			1-2 Ext	2-3*	2-3*	4 Mb		5 Mb
			2-3 Exp	2-3*	2-3*		4 Mb	5 Mb
4 Mb	1 Mb		1-2 Ext	1-2 Ext	2-3*	5 Mb		6 Mb
			1-2 Ext	2-3 Exp	2-3*	4 Mb	1 Mb	6 Mb

Board	Module A	Module B	E1-E3	E4-E6	E7-E9	Ext	Exp	Total
			2-3 Exp	2-3 Exp	2-3*		5 Mb	6 Mb
4 Mb	1 Mb	1 Mb	1-2 Ext	1-2 Ext	1-2 Ext	6 Mb		7 Mb
			1-2 Ext	1-2 Ext	2-3 Exp	5 Mb	1 Mb	7 Mb
			1-2 Ext	2-3 Exp	2-3 Exp	4 Mb	2 Mb	7 Mb
4 Mb	4 Mb		1-2 Ext	1-2 Ext	2-3*	8 Mb		9 Mb
			1-2 Ext	2-3 Exp	2-3*	4 Mb	4 Mb	9 Mb
			2-3 Exp	2-3 Exp	2-3*		8 Mb	9 Mb
4 Mb	1 Mb	4 Mb	1-2 Ext	1-2 Ext	1-2 Ext	9 Mb		10 Mb
			1-2 Ext	1-2 Ext	2-3 Exp	5 Mb	4 Mb	10 Mb
			1-2 Ext	2-3 Exp	2-3 Exp	4 Mb	5 Mb	10 Mb
4 Mb	4 Mb	1 Mb	1-2 Ext	1-2 Ext	1-2 Ext	9 Mb		10 Mb
			1-2 Ext	1-2 Ext	2-3 Exp	8 Mb	1 Mb	10 Mb
			1-2 Ext	2-3 Exp	2-3 Exp	4 Mb	5 Mb	10 Mb
4 Mb	4 Mb	4 Mb	1-2 Ext	1-2 Ext	1-2 Ext	12 Mb		13 Mb
			1-2 Ext	1-2 Ext	2-3 Exp	8 Mb	4 Mb	13 Mb
			1-2 Ext	2-3 Exp	2-3 Exp	4 Mb	8 Mb	13 Mb

DeskPro 286N

Any jumpers are for factory testing purposes only

Jumper	*Position*	*Function*
1	On*	Enable video
2	On*	Enable ROM-resident setup
3	On*	Enable external boot
4	On*	Enable power-On password
5	On*	8 MHz coprocessor (or not installed)
	Off	12 MHz coprocessor
		Reserved in 386sx systems
6	On*	Enable diskette write
E1	1-2	Full fan speed
On backplane	2-3	Automatic (slower, quieter speed until temp reaches 85° F)

DeskPro 386

Version 1

Assy 000401

Jumper	*Position*	*Function*
1	On*	Reserved
2	On	Coprocessor installed
	Off*	Not installed
3	On	4 MHz coprocessor
	Off*	8 MHz coprocessor
4	On*	CPU boot 16 MHz except when accessing floppy, then 8 MHz
	Off	CPU boot 16 MHz always
5	Off*	Reserved
6	On	Compaq VDU, ECG, compatible EGA, RGBI, or VGC
	Off	Third party Monochrome

Version 2

Assy 000558

Jumper	Position	Function
1	On*	Reserved
2	Off*	Coprocessor not installed
3	On Off*	80287-3/6 4MHz coprocessor 80287-8 8MHz coprocessor
4	On* Off	CPU boot 16 MHz except when accessing floppy, then 8 MHz CPU boot 16 MHz always
5	Off*	Reserved
6	On Off	Compaq VDU, ECG, compatible EGA, RGBI, or VGC Third party Monochrome
7	On* Off	80287-3/6/8 coprocessor or none installed 80387-16 coprocessor
8	On	Reserved

DeskPro 386N

As for DeskPro 286N

DeskPro 386/20

SW1

Assy 000749
On the right of the system board near the front.

Jumper	Position		Function
1	On*		Reserved – always On
2	Off*		Coprocessor not installed
3	Off*		Reserved – always Off
4	On* Off		Auto power on speed High power on speed
5	Off*		Reserved – always Off
6	On Off		COMPAQ Colour or Dual Mode monitor or CGA installed Third party Monochrome
7,8	**7**	**8**	**Base Memory**
	On	On	640K*
	Off	On	512K
	Off	Off	256K

DeskPro 386/25

SW1

Assy 000944 or 001069
Near centre of system board.

Jumper	Position	Function
1	On*	Reserved – always On

Jumper	Position		Function
2	Off*		Coprocessor not installed
3	On		0-12 Mb cacheable memory
	Off*		0-16 Mb cacheable memory
4	On*		Auto power on speed
	Off		High power on speed
5	Off*		Reserved – always Off
6	On		COMPAQ Colour or Dual Mode monitor or CGA installed
	Off		Third party Monochrome
7,8	**7**	**8**	**Base Memory**
	On	On	640K*
	Off	On	512K
	Off	Off	256K

If the jumper at E14 near the system memory board is moved from its default position (closest to the system PCB) toward the center of the board, the system clock rate is changed from 25 MHz to 24, for expansion boards that encounter difficulties running at the higher clock rate.

DeskPro 386/20e

Switchbank 1

Assy 001625

Switch	Position	Function
1	On*	Enable VGA
2	On	Disable power on password
	Off*	Enable power on password
E4	1-2	Disable IRQ12 (e.g. allows mouse to be used)
	2-3	Enable IRQ12
E10	1-2	8-bit VGA
	2-3	16-bit VGA

Assy 000935, 001196, and 001316

Jumper	Position		Function
1	On*		Enable fail safe timer
2	On		80387 installed
	Off*		80387 not installed, or Weitek installed
3	On		12-16 Mb area not cached
	Off*		12-16 Mb area cached
4	On*		Auto power on speed (20 MHz, 8 MHz accessing floppy)
	Off		High power on speed (20 MHz)
5	Off*		Reserved – always Off
6	On		Compaq Colour or Dual Mode monitor or CGA
	Off		Third party Monochrome
7,8	**7**	**8**	**Base Memory**
	Off	Off	256K
	Off	On	Reserved
	On	Off	512
	On	On	640*

Switchbank 2

Switch	Position		Function
1	On		Secondary address (37X, 17X) FD/HD
	Off*		Primary address (3FX, 1FX) FD/HD
2	On		Disable power on password
	Off*		Enable power on password
3	On		Disable HD controller
	Off*		Enable HD controller
4,5	**4**	**5**	**Serial Port**
	Off*		COM1 primary address 3FX, IRQ4
		Off	COM2 secondary address 2FX, IRQ3
	*		Reserved
	On	Off	Disable
	Off	On	
	On	On	
6,7	**6**	**7**	**Parallel Port**
	On*		LPT1 primary address 3BX
		Off	LPT1/2 secondary address 37X
	*		Reserved
	Off	On	Disable
	Off	Off	
	On	On	
8	Off*		Enable video

386/25e

Switch	Position	Function
1	On*	Enable VGA
2	On	Disable power on password
	Off*	Enable power on password

DeskPro 386s/20

Assy 002040

Jumper	Position	Function
1	On*	Enable video
2	On*	Enable ROM-resident setup
3	On*	Enable external boot
4	On*	Enable power-On password
5		Reserved
6	On*	Enable diskette write
E1	1-2	Full fan speed
Backplane	2-3	Automatic (slower, quieter speed until temp reaches 85° F)

Assy 001421

Switch	Position	Function
1	On*	Enable VGA
2	On	Disable power on password
	Off*	Enable power on password

DeskPro 386s

SW1

Assy 002116

Jumper	*Position*	*Function*
1	On*	Enable video
2	On*	Enable ROM-resident setup
3	On*	Enable external boot
4	On*	Enable power-On password
5		Reserved
6	On*	Enable diskette write
E1	1-2	Full fan speed
On backplane	2-3	Automatic (slower, quieter speed until temp reaches 85º F)

Assy 000954, 001145, 001148, 001157, and 001644

Jumper	*Position*	*Function*
1	On*	Enable fail safe timer
2	On	80387SX installed
	Off*	80387 not installed, or Weitek installed
3		Reserved
4	On	Auto power on speed (16 MHz, 8 MHz accessing floppy)
	Off*	High power on speed (16 MHz)
5	Off*	Reserved – always Off
6	On	COMPAQ Colour or Dual Mode monitor or CGA
	Off	Third party Monochrome

SW2

Assy 000954, 001145, 001148, 001157, and 001644

Switch	*Position*		*Function*
1	On		Secondary address (37X, 17X) FD/HD
	Off*		Primary address (3FX, 1FX) FD/HD
2	On		Disable power on password
	Off*		Enable power on password
3	On		Disable HD controller
	Off*		Enable HD controller
4,5	**4**	**5**	**Serial Port**
	Off*		COM1 primary address 3FX, IRQ4
		Off	COM2 secondary address 2FX, IRQ3
	*		Reserved
	On	Off	Disable
	Off	On	
	On	On	
6,7	**6**	**7**	**Parallel Port**
	On*		LPT1 primary address 3BX
		Off	LPT1/2 secondary address 37X
	*		Reserved
	Off	On	Disable
	Off	Off	
	On	On	

Switch	*Position*	*Function*
8	Off*	Enable video

SW3

Assy 000954, 001145, 001148, 001157, and 001644

Switch	*Position*				*Function*			
1,2	**1**	**2**			**Base Memory**			
	Off	Off			256K			
	Off	On			Reserved			
	On	Off			512			
	On	On			640*			
3,4,5,6	**3**	**4**	**5**	**6**	**Mem**	**Mod A**	**Mod B**	**Total**
	On	On	On	On				1Mb*
	On	On	On	Off	1 Mb			2 Mb
	On	On	Off	On	1 Mb	1Mb		3 Mb
	On	On	Off	Off	1 Mb	1 Mb	1Mb	4 Mb
	Off	On	On	Off	4 Mb			5 Mb
	On	Off	Off	On	1 Mb	4 Mb		6 Mb
	On	Off	On	On	1 Mb	1 Mb	4 Mb	7 Mb
	Off	On	Off	On	4 Mb	4 Mb		9 Mb
	On	Off	Off	Off	1 Mb	4 Mb	4 Mb	10 Mb
	Off	On	Off	Off	4 Mb	4 Mb	4 Mb	13 Mb

Jumper Settings

Assy Nos. 000954, 001145, 001148, 001157, and 001644

Switch	*Position*	*Function*
E2	On	Reserved
E3	On	Reserved
E4	1-2	Disable IRQ12 (e.g. allows mouse to be used)
	2-3	Enable IRQ12

DeskPro 386/25e

Switch	*Position*	*Function*
1	On*	Enable VGA
2	On	Disable power on password
	Off*	Enable power on password

DeskPro 386/33(L)

Switch	*Position*	*Function*
1	On*	Enable VGA
2	On	Disable power on password
	Off*	Enable power on password

Assy 001987

Switch	*Position*	*Function*
1		Reserved
2	Off*	Disable lock EISA configuration

Switch	Position	Function
3	On	Read only diskette write
	Off*	Read/write diskette write
4	On	Enable boot from diskette
	Off*	Disable boot from diskette (override EISA configuration)
5	On	Enable erase power on password
	Off*	Disable erase power on password
6	On	Enable erase EISA configuration
	Off*	Disable erase EISA configuration

Jumpers

Jumper	Position	Function
E1	1-2	Enable maintenance mode
E1(L)	1-2	Erase configuration
	2-3	Standard
E2	1-2	Disable power on password
	2-3*	Enable power on password
E3	2-3*	Enable VGA

DeskPro 486/25

Jumper	Position	Function
E1	1-2	Enable maintenance mode
	2-3*	Standard mode
E2	1-2	Disable power on password
	2-3*	Enable power on password
E3	2-3*	Enable VGA

DeskPro 486/33L

Jumper	Position	Function
E1	1-2	Erase standard configuration
	2-3*	Standard configuration
E2	1-2	Disable power on password
	2-3*	Enable power on password
E3	2-3*	Enable VGA

DeskPro 486/50L

Switch	Position	Function
1		Reserved
2	Off*	Disable lock EISA configuration
3	Off*	Diskette write enabled
4	On*	Enable boot from diskette
5	Off*	Disable power on password
6	Off*	Disable override EISA configuration

DeskPro 486/33M

Assy 002319/002297

Switch	Position	Function
1	On*	Reserved – always On
2	Off*	Reserved – always Off
6	On*	Reserved – always On

DeskPro 486s/16M

Switch	Position	Function
1	On*	Reserved – always On
2	Off*	Reserved – always Off
6	On*	Reserved – always On

DeskPro 486s/25M

Switch	Position	Function
1	On*	Reserved – always On
2	Off*	Reserved – always Off
6	On*	Reserved – always On

Deskpro 486s/25

Assy 002316/002302)
486s/16 Processor Board
Assy 002313/002300

Switch	Position	Function
1	Off*	Reserved – always Off
2	Off*	487 upgrade not installed**
6	Off*	487 upgrade not installed**

** or 486 or 486/DX2

DeskPro 486/66

Assy 002431

Switch	Position	Function
1	On*	Reserved
2	Off*	Reserved
6	On*	Reserved

DeskPro/I

SW500

Switch	Position				Function
1,2,3,4	1	2	3	4	Processor
	Off	On	Off	On	386-25

Switch	Position				Function
	Off	On	Off	Off	386-33
	Off	Off	Off	On	486SX
	Off	On	On	On	487SX
	On	Off	On	On	486DX-25
	On	Off	On	Off	486DX-33
	On	Off	On	On	486DX2/50
	On	Off	On	Off	486DX2/66*
	Off	On	On	On	50 MHz overdrive
	Off	On	On	Off	66 MHz overdrive

SW501

Omitted on later models.

Switch	Position						Function
1,2,3,4,5,6	1	2	3	4	5	6	Processor
	Off	Off	Off	On	On	On	386
	On	On	On	Off	Off	Off	486SX
	On	On	On	Off	Off	Off	487SX
	On	On	On	Off	Off	Off	486DX
	On	On	On	Off	Off	Off	486DX2
	On	On	On	Off	Off	Off	50 MHz overdrive
	On	On	On	Off	Off	Off	66 MHz overdrive*

SW502

System Maintenance

Switch	Position	Function
1	Off*	Enable video
2	Off*	Disable lock setup (allows changes)
3	Off*	Diskette write enabled (e.g. read/write)
4	Off*	Reserved – always Off
5	On	Clear power-On and administrator password
	Off*	Allow power on and administrator password
6	Off*	Reserved – always Off

Audio

Switch	Position	Function	
E1	1-2	IRQ 11	
E3	1-2	IRQ 7	
E6	1-2	IRQ 10	
E4	1-2	Capture	DMA channel 0
	2-3	Playback	
E7	1-2	Capture	DMA channel 1
	2-3	Playback	
E9	1-2	Capture	DMA channel 3
	2-3	Playback	
E8	1-2	608h-60bh	
	2-3	534h-537h*	
6	1-2	Audio system enabled	

Switch	*Position*	*Function*
	2-3	

DeskPro/M

Switch	*Position*	*Function*
1		Reserved
2	Off*	Disable lock EISA configuration
3	Off*	Diskette write enabled
4	On	Override EISA Configuration Diskette Boot
	Off*	Don't override
5	On	Clear power on password
	Off*	Don't clear
6	On	Erase EISA configuration
	Off*	Don't erase

Processor

Switch	*Position*					*Function*
P2-7	**P2**	**P3**	**P4**	**P6**	**P7**	**Processor**
	1-2	1-2	3-4	1-2	1-2	486SX-25
	1-2	1-2	3-4	1-2	2-3	486SX-33
	1-2	1-2	3-4	1-2	1-2	487SX-25
	2-3	2-3	1-2	1-2	1-2	486DX-25
	2-3	2-3	1-2	1-2	2-3	486DX-33
	2-3	2-3	1-2	1-2	1-2	486DX2/50
	2-3	2-3	1-2	1-2	2-3	486DX2/66*
	2-3	2-3	2-3	1-2		ODP
	2-3	2-3	1-2	1-2		ODPR
	2-3	2-3	2-3	2-3		Pentium ODP

Switch	*Position*	*Function*
P7	2-3	33/66 MHz
	1-2	25/50 MHz
P1	2-3*	Pentium ODP in Write Back mode
	1-2	Pentium ODP in Write Through mode
P5	2-3*	Enable Onboard Video
P8	1-2*	Printer on IRQ 7
	2-3	Printer on IRQ 5
P9	Off	Clear password

DeskPro XE

SW500

Processor

Switch	*Position*				*Function*
S1-4	**S1**	**S2**	**S3**	**S4**	**Processor**
	Off	Off	Off	Off	486SX-33

Switch	Position				Function
	On	Off	On	On	486DX2/50
	On	Off	On	Off	486DX2/66
	On	Off	On	Off	486DX4/100
	Off	On	On	On	487SX/25
	On	Off	On	Off	486DX-33
	On	Off	On	On	486DX2/50
	On	Off	On	Off	486DX2/66*
	Off	On	On	Off	33/66/100 MHz overdrive
	Off	On	On	On	25/50/75 MHz overdrive (5v)

SW502

System Maintenance

Switch	Position	Function
S1	Off*	Enable video
S2	Off*	Disable lock setup (allows changes)
S3	Off*	Diskette write disabled (e.g. read only)
S4	Off*	Reserved – always Off
S5	On	Clear power-On and administrator password
	Off*	Allow power on and administrator password
S6	On	Flash ROM can be updated
	Off*	Prevents Flash ROM updates

Deskpro/XL

SW1

Pentium Based Systems

Switch	Position		Function
S1-2	**S1**	**S2**	**Processor**
	On	Off	Pentium/75 MHz, 50 MHz external, 75 internal
	Off	Off	Pentium/90 MHz, 60 MHz external, 90 internal
	On	On	Pentium/100 MHz, 50 MHz external, 100 internal
	Off	On	Reserved

486 Based Systems

Switch	Position				Function
S1-2	**S1**	**S2**	**S3**	**S4**	**Processor**
	On	On	Off	Off	486DX2/50
	On	Off	Off	Off	486DX2/66
	On	Off	Off	Off	486DX4/100
	Off	Off	On	Off	Reserved

Jumpers

Jumper	Position	Function
E6	1-2	Password Enable
E5	1-2	Internal battery
	2-3	External battery

Switches

Switch	Position	Function
S1	On	Flash ROM can be updated
	Off*	Prevents Flash ROM updates
S2	On	Locks EISA Configuration
	Off*	Allows changes to EISA
S3	Off*	Diskette write enabled (e.g. read/write)
S4	On	Override EISA config.diskette boot control
	Off*	Maintains EISA config.diskette boot control
S5	On	Clear power-On and administrator password
	Off*	Allow power on and administrator password
S6	On	Erases current EISA configuration
	Off*	Maintains current EISA configuration

Portable 286

Jumper	Position	Function
ED	1-2	Mono
	2-3*	COMPAQ Colour, Dual Mode monitor or CGA
ES	1-2*	CPU boot 8 MHz
	2-3	CPU boot 6 MHz
		If changed to 6 MHz, the system will not respond to speed change requests from the keyboard.
EM		Reserved
E1-3	1-2	128K, 256 K or 512K**
	2-3	640 Kbytes
		** For 512 K, PAL (PN 105045-001) must be in U2 if not already present.

Diskette/Tape Controller Board

There are 2 versions. Version 1 contains jumpers J1, J2, J3, and J4.

Version 2 contains Switch SW1 and shunt jumpers J1 and J2, which replace jumpers J1-J4.

Jumper	Position	Function
J1	1-2	Secondary address 370h
	2-3*	Primary address 3F0h
J2	1-2*	Serial port as COM1
	2-3	Serial port as COM2
		See also J4
J3	2-3*	Parallel port enabled
J4	1-2	Serial port IRQ4
	2-3	Serial port IRQ3
		See also J2

Portable 386

Jumper	*Position*				*Function*
E1,2	**E1**	**E2**			**Parallel interface**
	2-3*	1-2*			LPT1
	2-3				LPT2
	1-2				LPT3
	2-3	2-3			Disable
E3,4,8,9	**E3**	**E4**	**E8**	**E9**	Serial as COM1 (3FX, IRQ4), with modem or 2nd as COM2 (2FX,IRQ3)
	2-3*	1-2*	1-2*	1-3*	
			3-4*	2-4*	
E3,4,8,9	**E3**	**E4**	**E8**	**E9**	Serial as COM2 (2FX, IRQ3), with modem or 1st as COM1 (3FX,IRQ4)
	2-3	1-2	1-3	1-2	
			2-4	3-4	
E3,4,8,9	**E3**	**E4**	**E8**	**E9**	Serial as COM1 (3FX, IRQ4), with modem or 2nd disabled.
	2-3	2-3	1-2	1-3	
			3-4	2-4	
E3,4,8,9	**E3**	**E4**	**E8**	**E9**	Serial as COM2 (2FX, IRQ3), with modem or 1st disabled.
	1-2	2-3	1-2	1-2	
			3-4	3-4	
E3,4,8,9	**E3**	**E4**	**E8**	**E9**	Modem or 2nd serial as COM1 (3FX,IRQ4), COM2 disabled
	2-3	2-3	1-3	1-2	
			2-4	3-4	
E3,4,8,9	**E3**	**E4**	**E8**	**E9**	Modem or 2nd as COM2 (2FX,IRQ3), COM1 disabled
	1-2	2-3	1-3	1-3	
			2-4	2-4	
E3,4,8,9	**E3**	**E4**	**E8**	**E9**	Both serial disabled
	1-2	1-2	1-2	1-3	
			2-4	2-4	
E5	1-2*				Floppy enabled
E6	1-2				Floppy secondary address
	2-3*				Floppy primary address
E7	1-2				Primary IRQ 7
	2-3				Alternative IRQ5
E12	1-2				Reserved
E13,14	**E13**	**E14**			**Base Memory**
	1-2*	1-2*			640K
	2-3				512K
	2-3	2-3			256K
E15-17	**E15**	**E16**	**E17**		**Total 32-bit memory**
	1-2*	1-2*	1-2*		1 Mb
	2-3	1-2	1-2		2 Mb
	1-2	2-3	1-2		3 Mb
	2-3	2-3	1-2		4 Mb
	1-2	2-3	2-3		6 Mb
	2-3	2-3	2-3		10 Mb
E18	2-3				Reserved
E19	1-2				Reserved
E20	2-3*				387 not installed or 3167
	1-2				387 installed
E21	1-2*				CPU boot speed 20 MHz, 8 accessing floppy
	2-3				CPU boot speed always 20 MHz
E22	2-3				Reserved

Jumper	*Position*	*Function*
E23	1-2*	Plasma display in CGA mode
	2-3	Plasma display in Mono mode
E24	1-2	Reserved
E25	1-2	Reserved

Portable 486c

Switches

Switch	*Position*	*Function*
SW1	Off*	Enable video
SW2	On	Locks EISA Configuration
	Off*	Allows changes to EISA
SW3	Off*	Diskette write enabled (e.g. read/write)
SW4	On	Override EISA config.diskette boot control
	Off*	Maintains EISA config.diskette boot control
SW5	On	Clear power-On and administrator password
	Off*	Allow power on and administrator password
S6	On	Erases CMOS
	Off*	Normal ops

Jumpers

Jumper	*Position*		*Function*
ED	1-2		3rd party Mono
	2-3*		COMPAQ Colour, Dual Mode monitor or CGA
ES	1-2*		CPU boot 8 MHz
	2-3		CPU boot 6 MHz
			If changed to 6 MHz, the system will not respOnd to speed change requests from the keyboard.
EM			Reserved
MS1,2	MS1	MS2	System board memory
	G	G	Disable
	V	G	256K
	G	V	512K
	V	V	640K
MS3	V		1 Mb memory
	G*		1.5 Mb memory

Portable III

Jumpers

Jumper	*Position*		*Function*
E1	1-2		CPU speed 12 MHz during floppy access
	2-3*		CPU speed 8 MHz during floppy access
E2			Reserved
E3,4	**E3**	**E4**	**Serial Port**
	1-2*		Enable COM1

Jumper	*Position*		*Function*
		1-2*	Enable modem COM2
	1-1		Enable modem COM1
	2-2	2-2	Enable COM2
E5	1-2		Serial IRQ3 Select COM2
E16	1-2		Modem IRQ4 Select COM1
E5,16	1-1*		Modem IRQ3 Select COM2
E5,16	2-2*		Serial IRQ4 Select COM1
E7	2-3*		Enable printer
E8	1-2,4-5*		FD primary address
	2-3,5-6		FD secondary address
E10	1-2*		16K ROM
	2-3		32K ROM
E12	2-3*		Disable ROM set 2
E17	2-3,4-5*		No expansion RAM
	2-3,5-6		Address Bank 1 (J201 and J202)
	1-2,4-5		Address Banks 1-2 (J201 - J204)
	1-2,5-6		Address Banks 1, 2 & 3 (J201 - J206)

Switches

Switch	*Position*		*Function*
1,2	**1**	**2**	**Base Memory**
	On	On	None (and no ROM)
	On	Off	0-256K
	Off	On	0-512K
	Off*	Off*	0-640K
S3,4	**3**	**4**	**Extended Memory**
	On	On	Reserved
	On*	Off*	640K plus 256 K modules
	Off	On	640K plus 1 Mb modules
	Off	Off	Reserved
S5	On*		Enable HD
S6	On		8 MHz CPU boot speed
	Off*		12 MHz CPU boot speed
S7	On*		Plasma display in colour mode
	Off		Plasma display in Mono mode
S8	Off*		Reserved

Plasma Display Controller Board

Jumper	*Position*	*Function*
	1-2	Primary address
	2-3	Secondary address

Portable and Plus

Version 1

Bank 1

Switch	Position		Function
1	Off*		Reserved - always Off
2	On*		Copro – always On
3,4	Off*		Memory - always Off
5,6	**5**	**6**	**Video adapter**
	Off	Off	Mono
	On	Off	Compaq video*
7,8	**7**	**8**	**Floppies**
	On	On	1 floppy
	Off	On	2 floppies
	On	Off	3 floppies
	Off	Off	4 floppies

Bank 2

Switch	Position	Function							
S1-8	**Memory**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	128	On	Off	On	On	Off	Off	Off	Off
	192	On	On	Off	On	Off	Off	Off	Off
	256	On	Off	Off	On	Off	Off	Off	Off
	320	On	On	On	Off	Off	Off	Off	Off
	384	On	Off	On	Off	Off	Off	Off	Off
	448	On	On	Off	Off	Off	Off	Off	Off
	512	On	Off	Off	Off	Off	Off	Off	Off
	544	Off	Off	Off	Off	Off	Off	Off	Off

If ROMs in U40 (and U47) are Rev C or above, SW2 is ignored. It has been removed on Revision J or above. If Revision C ROMs or above are installed, 256K x 1 RAM chips may be used instead of 64K x 1 bit RAM chips in banks 2 and 3 of the system board, but a new decoder PROM must be in socket U35.

Version 2

Because all Version 2 boards contain Revision C or higher ROMs, only one switch, SW1, is installed.

Bank 1

Switch	Position		Function
1	Off*		Reserved – always Off
2	Off		8 MHz Maths copro installed
3,4	On*		Reserved – always On
5,6	**5**	**6**	**Video adapter**
	Off	Off	Mono
	Off	On	CGA 40 x 25
	On	Off	CGA 80 x 25
	On	On	With own BIOS

Switch	Position	Function
7	On	1 floppy
	Off	2 floppies
8	On*	Reserved – always On

Bank 2

Switch	Position	Function							
S1-8	**Memory**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	64	1	1	1	1	0	0	0	0
	128	1	0	1	1	0	0	0	0
	192	1	1	0	1	0	0	0	0
	256	1	0	0	1	0	0	0	0
	320	1	1	1	0	0	0	0	0
	384	1	0	1	0	0	0	0	0
	448	1	1	0	0	0	0	0	0
	512	1	0	0	0	0	0	0	0
	544-640	0	0	0	0	0	0	0	0

Version 2 contains a shunt jumper that is used for selecting either Banks 2 and 3 or Alternate Banks 2 and 3. To enable Banks 2 and 3, insert the shunt jumper so that pins 5-12, 6-11, 7-10, and 8-9 are connected. To enable Alternate Banks 2 and 3, try 1-16, 2-15, 3-14, and 4-13.

Asynchronous Board

Jumper	Position	Function
J702	1-2	COM2 Address
	2-3	COM1 Address
J703	1-2	IRQ3
	2-3*	IRQ4
U13	5-12,6-11,7-10,8-9	RS-232-C
	1-16,2-15,3-14,4-13	20 mA current loop

Presario 400

Jumper	Position			Function
P1	1-2			25 MHz (50)
	2-3*			33 MHz (66)
P2	1-2			PQFP (Socket Not Used)
	2-3			PGA (Socket Used)
P3-5	**P3**	**P4**	**P5**	**Processor select**
	1-2	1-2	1-2	486SX (PQFP), 486DX, 486DX2
	1-2	1-2	2-3	487SX (Overdrive)
	2-3	2-3	3-4	486SX (PGA)
P6				Password erase (remove & replace)
P7	1-2			Internal modem ROM
	2-3			External modem ROM

Presario 500

Jumper	Position		Function
P1,2	**P1**	**P2**	**Processor**

Jumper	Position		Function
	2-3		486DX33
	1-3		486SX2/50
	1-3		Overdrive 50
	2-3		486DX2/50
	1-3		486SX2/66
	2-3		486DX2/66
	2-3	2-3	Overdrive 66
P5			CMOS and password protect (remove to clear, replace)

Presario 5500

Jumper	Position		Function
P1	1-2*		Secure CMOS
	Open		Clear CMOS
P2	A1	A2	CPU 1.5 x bus speed
	B1	B2	
	A2	A3	CPU 2 x bus speed
	B1	B2	
	A2	A3	CPU 2.5 x bus speed
	B2	B3	
	A1	A2	CPU 3 x bus speed
	B2	B3	
P3	2		50 MHz bus speed
	3		40 MHz bus speed
	4		60 MHz bus speed
	4	5	66 MHz bus speed

Presario 600

Jumper	Position	Function
P5,6	1-2 both	Enable Onboard video
P7	1-2	Nonsocketed enable
	2-3	Nonsocketed disable
	None	Socketed
P8	1-2	33 MHz CPU bus
	2-3	25 MHz CPU bus
P9	1-2	486DX2, 486SX (nonsocketed), 487SX/OD
	2-3	486SX (socketed)
P10	1-2	486SX
	2-3	486DX2, 487SX/OD
P11	1-2	486DX/DX2
	2-3	487SX/OD
	3-4	486SX
P13	1-2	Config registers super/IO chip 26Eh/26Fh
	None	Config registers super/IO chip 398h/399h
P14		Clear CMOS

Presario 800

CPU	P1	P3	P4	P6	P7
486SX/25	1-2	1-2	3-4	1-2	1-2

CPU	P1	P3	P4	P6	P7
486SX/33	1-2	1-2	3-4	1-2	2-3
487SX/25	1-2	1-2	3-4	1-2	1-2
486DX/25	2-3	2-3	1-2	1-2	1-2
486DX/33	2-3	2-3	1-2	1-2	2-3
486DX2/50	2-3	2-3	1-2	1-2	1-2
486DX2/66	2-3	2-3	1-2	1-2	2-3
ODP	2-3	2-3	2-3	1-2	*
ODPR	2-3	2-3	1-2	1-2	*
Pentium ODP	2-3	2-3	2-3	2-3	*

Jumper	*Position*	*Function*
P1	2-3*	CPU in writeback mode
	1-2	CPU in writethrough mode
P8	1-2*	Printer on IRQ7
	2-3	Printer on IRQ5
P5	1-2	Disable video
	2-3*	Enable video
P9		Clear CMOS

Presario 700

486 based

CPU	P1	P3	P4
486DX-33	2-3	1-2	3-4
486SX2/50	1-2	1-2	3-4
Overdrive 50	1-2	1-2	3-4
486DX2/50	1-2	1-2	3-4
486SX2/66	2-3	1-2	3-4
486DX2/66	2-3	1-2	3-4
Overdrive 66	2-3	1-2	3-4
DX4/100	2-3	1-2	3-4

Jumper	*Position*	*Function*
P1	1-2	CPU 25 MHz (50)
	2-3*	CPU 33 MHz (66)
P3	1-2*	Writethrough L1 cache (All486/7)
	2-3	Writeback L1 cache (Overdrive)
P4	1-2	DX4 2.5 x clock speed
	2-3	DX4 2 x clock speed
	3-4*	DX4 3 x clock speed
P5		Clear CMOS

Pentium Based

Jumper	*Position*	*Function*
P3	1-2	Enable password
	2-3	Disable password
P5	1-2	60 MHz
	2-3	50 MHz

Jumper	*Position*	*Function*
P11	1-2	CPU core 1.5 x bus speed
	2-3	CPU core 2 x bus speed

Presario 7100

486 Based

Jumper	AMD DX2/80	AMD DX2/80+	AMD DX4/100	AMD DX4/100+	Cyrix DX2-V80	Pent Odrive
JC1	Open	2-3	Open	2-3	1-2	Open
JC2	Open	2-3	Open	2-3	1-2	2-3
JC3	Open	2-3	Open	2-3	1-2	Open
JC4	Open	2-3	Open	2-3	1-2	2-3
JC5	Open	2-3	Open	2-3	1-2	Open
JC6	Open	2-3	Open	2-3	1-2	Open
JC7	Open	2-3	Open	2-3	1-2	2-3
JC8	Open	2-3	Open	Open	Open	Open
JC9	2-3	1-2	2-3	1-2	1-2	1-2
JC10	1-2	2-3	Open	2-3	Open	Open
JC11	2-3	2-3	2-3	2-3	2-3	1-2
JP16	3-4	3-4	3-4	3-4	1-2	5-6,7-8,9-10
JP26	Open	Open	1-2	1-2	Open	1-2

PentiumBased

Jumper	*Position*	*Function*
JP4	Open*	Enable ES1688 (sound)
	Close	Disable
JP7	1-2	CPU Core/Bus 75/50 MHz
	3-4	CPU Core/Bus 90/60 MHz
	1-2,5-6	CPU Core/Bus 100/66.6 MHz
JP201	1-2	Discharge CMOS
	2-3*	Normal ops

Presario 900

486 based

As for Presario 700

Pentium based

As for Presario 700

Presario 9500

Jumper	*Position*	*Function*
P1	Open	Discharge CMOS
P2	A1-A2 B1-B2	CPU 1.5 x
	A2-A3 B1-B2	CPU 2 x
	A2-A3 B2-B3	CPU 2.5 x
	A1-A2 B2-B3	CPU 3 x
P3	1-2	CPU External Bus 50 MHz
	2-3	CPU External Bus 40 MHz
	2-4	CPU External Bus 60 MHz
	4-5	CPU External Bus 66 MHz

ProLiant 1000

CPU	S1	S2	S3
486DX2/66	On	Off	On
Overdrive	Off	On	On

SW2

System Maintenance

Switch	*Position*	*Function*
S1	Off*	Enable Onboard video
S2	Off*	Enable changes in NVM
S3	Off*	Reserved – always Off
S4	On	Enable boot from floppy regardless of setup
	Off*	Floppy boot controlled by setup
S5	On	Enable password set in configuration
	Off*	Disable
S6	On	Clear CMOS

ProLiant 1500

SW1

System Maintenance

Switch	*Position*	*Function*
1	Off*	Enable Onboard video
2	Off*	Enable configuration in NVM
3	On	Rack mounted chassis
	Off*	Tower chassis
4	On	Enable boot from floppy regardless of setup
	Off*	Floppy boot controlled by setup
5	On	Clear passwords
	Off*	Boot is password protected if one is set
6		Clear CMOS

ProLiant 2000/4000

Switch	*Position*	*Function*
S1	Off*	Enable Onboard video
S2	On Off	Extra 3rd and 4th processor, enable 2nd fan sensing. Up to 2 processors
S3	Off*	Reserved – always Off
S4	On Off*	Enable boot from floppy regardless of setup Floppy boot controlled by setup
S5	On Off*	Enable password set in configuration Disable
S6	On	Clear CMOS

ProLiant 4500 Servers

As for Proliant 1500

ProLinea

486 Based

Jumper	*Position*	*Function*
E6	1-2	Enable password
E5	1-2 2-3	Internal battery External battery at P3

CPU	S1	S2	S3	S4
486DX2/50	On	On	Off	Off
486DX2/66	On	Off	Off	Off
486DX4/100	On	Off	Off	Off
Reserved	Off	Off	On	Off

586 Based

Jumper	*Position*	*Function*
E6	1-2	Enable password
E5	1-2 2-3	Internal battery External battery at P3

CPU	S1	S2
586/75 (50)	On	Off
586/90 (60)	Off	Off
586/100 (50)	On	On

Pentium Based

Jumper	*Position*	*Function*
E6	1-2	Enable password
E5	1-2 2-3	Internal battery External battery at P3

CPU	S1	S2
Pentium/75 (50)	On	Off
Pentium/90 (60)	Off	Off
Pentium/100 (50)	On	On
Reserved	Off	On

Prosignia

SW1

CPU	S1	S2	S3
486-33 or DX2/66	On	Off	On
Overdrive	Off	On	On

SW2

System Maintenance

Switch	*Position*	*Function*
S1	Off*	Enable Onboard video
S2	Off*	Enable changes in NVM
S3	Off*	Reserved – always Off
S4	On Off*	Enable boot from floppy regardless of setup Floppy boot controlled by setup
S5	On Off*	Enable password set in configuration Disable
S6	On	Clear CMOS

ProSignia 300 Servers

Switch	*Position*	*Function*
1	Off*	Enable Onboard video
2	Off*	Enable configuration in NVM
3	On Off*	Rack mounted chassis Tower chassis
4	On Off*	Enable boot from floppy regardless of setup Floppy boot controlled by setup
5	On Off*	Clear passwords Boot is password protected if one is set
6		Clear CMOS

ProSignia VS Server

SW1

CPU	S1	S2	S3
486SX/33	On	Off	On
486DX/33 or DX2/66	On	Off	On

CPU	S1	S2	S3
Overdrive	Off	On	On

SW2

System Maintenance

Switch	*Position*	*Function*
S1	Off*	Enable Onboard video
S2	Off*	Enable changes in NVM
S3	Off*	Reserved – always Off
S4	On	Enable boot from floppy regardless of setup
	Off*	Floppy boot controlled by setup
S5	On	Enable password set in configuration
	Off*	Disable
S6	On	Clear CMOS

004506001, 004509001

Switch	*Position*	*Function*
1	Off*	Enable Onboard video
2	Off*	Enable configuration in NVM
3	On	Rack mounted chassis
	Off*	Tower chassis
4	On	Enable boot from floppy regardless of setup
	Off*	Floppy boot controlled by setup
5	On	Clear passwords
	Off*	Boot is password protected if one is set
6		Clear CMOS

486 based

Assy 003904001, 003907001

SW1

Assy 003910001, 003922001

CPU	S1	S2	S3	S4
486DX2/50	On	On	Off	Off
486DX2/66	On	Off	Off	Off
486DX4/100	On	Off	Off	Off
Reserved	Off	Off	On	Off

Jumper	*Position*	*Function*
E6	1-2	Enable password
E5	1-2	Internal battery
	2-3	External battery at P3

586 Based

With or without integrated graphics.
Assy 003768001, 003771001, 003774001

Jumper	Position	Function
E6	1-2	Enable password
E5	1-2	Internal battery
	2-3	External battery at P3

CPU	S1	S2
586/75 (50)	On	Off
586/90 (60)	Off	Off
586/100 (50)	On	On

SLT 286

Jumper	Position	Function
J1	1-2	8 MHz 80287
	2-3*	12 MHz 80c287

Jumpers E2, E3, and E4 are reserved. They must be installed for proper operation.

SLT 386s/20

Jumper	Position	Function
SW1-1	On*	Enable fail safe timer
SW1-2	On	Enable clear password
	Off*	Disable clear password

Sytempro

Switch	Position	Function
E1	2-3*	Enable power on password
E2		Reserved
E3	1-2	Bypass extended NVM on power up (maintenance)
	2-3*	Read extended NVM on power up (standard)
E4	2-3*	Enable Onboard video

Compower

See Procomp

Computer Technology System

www.acttcs.com.tw

Computrend

See Premio

Concord OA

Now AVT Industrial
www.concord.com.hk

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1C	COA 530	4C	COA 507

COA 507

Fugutech M 507 in disguise

COA 530

Fugutech M 530 in disguise

Core International

Atomizer 386/33

Switch	*Position*	*Function*
S1	On*	Reserved
S2	Off*	80387 not installed
S3	Off*	Reserved
S4	Off*	EGA BIOS relocation disabled
S5	Off*	Reserved
S6	On*	Colour video
	Off	Mono video
S7	On*	Cache activated
S8	On	Bus speed 11 MHz
	Off*	Bus speed 8.25 MHz
W3	1-2	Reserved
W4,5,6	Out*	Reserved
W7	1-2	80387 in asynchronous mode
	2-3	80387 in synchronous mode
W8	1-2	80387 in asynchronous mode
	Out	80387 in synchronous mode
W10	Out	Reserved
W11	1-2	Cache enabled
W12	1-2	Direct mapped cache (see also W13)
	Out	2-way set associative cache
W13	1-2	Direct mapped cache (see also W12)
	2-3*	2-way set associative cache

Switch	*Position*	*Function*
W15		Turbo switch connector. Either connect turbo switch to W11, then turbo light to W25, to slow system board to non-cache speed, or connect turbo switch to On/Off jumper and light to W9.
W22	In Out*	Cache video BIOS if not relocated Don't cache
W23	In Out*	Cache video BIOS if not relocated Don't cache
W25		Cache turbo light

Crusader

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C-00	C586 IPC	AC	C586 HX
9C	586VX Rev B+	FC-00	C586 VX Rev C+
AC	C688 LX	HC	C586HX rev D+

C586HX

Same as DFI G586IPC rev D+ or Global Impact C586HX

C586VX

Same as DFI G586IPV

CyberMax

Rebadges Biostar motherboards.

Cycle Computer Corp

www.cyclecc.com

Notes

D

Daewoo

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
H-00	CPC 4600		

486 (CPC 2700U?)

VL Bus, with UMC 82C491F chipset. 8 30-pin SIMM sockets & 2 PS/2 connectors. P/N 9916522801

Jumper	*Position*					*Function*
JP1	1-2					CMOS clear
	2-3					Normal
	Off					External battery
JP2	On					Colour display
	Off					Mono display
JP4-8	**JP5**	**JP5**	**JP6**	**JP7**	**JP8**	**Cache Size**
	Off	1-2	Off	Off	On	64K
	2-3	2-3	Off	On	On	128K
	1-2	1-2	On	On	On	256K
JP9,11	**JP9**	**JP11**				**CPU**
	1-2,3-4	1-2				486DX

Jumper	Position		Function
	2-3	Off	486SX
	1-2,3-4	2-3	487SX
JP10	On		CPU > 33 MHz
	Off		CPU <= 33 MHz
JP12	5-6		25 MHz
	1-2,5-6		33 MHz
	1-2,3-4		40 MHz
	3-4		50 MHz

Darter

DataExpert

(408) 737 8880
www.dataexpert.com.tw

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1	EXP 4044	BC	ExpertColor MLX 8440
1-00	EXP 4049	CC	EXP 8661
9C	EXP 8561	EC-00	ExpertColor TX430II
AC	MLX 8440-0A/0B		

ExpertColor TX 430II

Same as Global Circuit GCT 8ITB

Datatech

www.dtk.com
See also Gemlight

Dell

286-8/12

Switch	Position	Function
SW1	On	Colour monitor primary
	Off*	Mono monitor primary

Switch	*Position*	*Function*		
SW2	On	LED shows fast speed		
	Off*	LED shows power		
SW3	On*	256K ROM		
	Off	128K ROM		
SW4	On	Maintenance Mode		
	Off*	Operation mode		
SW5		Reserved		
SW6,7,8	**Base Memory**	**SW6**	**SW7**	**SW8**
	256K		On	On
	512K		On	Off
	640K		Off	On
	512K+512 ext	Off	Off	Off
	640K+384 ext	On*	Off	Off

200

Jumper	*Position*	*Function*	
J5	Out	Normal operations	
	In	Maintenance mode	
J13,14	**Maths Copro**	**J13**	**J14**
	80287/82C287	1-2	
	Debugger in slot	2-3	2-3
J15		Reserved	
J16			

210

Jumper	*Position*	*Function*
W1	1-2	VGA via feature connector
	2-3	On board VGA
W4	2-3	Enable floppy
W5	1-2	IDE drives that tristate IRQ14
	2-3	IDE drives that do not tristate IRQ14
W10	2-3	Enable IDE
W11	2-3	Enable VGA
WX1	1-2	Mono adapter
	2-3	Colour adapter
WX2	1-2	On board video drives IRQ9
	Off	Doesn't

212N

Jumper	*Position*	*Function*
J41	Out*	Normal use
	1-2	Maintenance – cycles POST
	2-3	EPROM programming
J44	In*	Enable password

220

Jumper	Position	Function		
W1	1-2 In	Colour video		
	1-2 Out	Mono		
W2	Out	Disable gate to read status bits on parallel port		
W3	1-2	Enable external oscillator input		
W4	1-2*	Enable COM1 IRQ4		
	3-4	Enable COM2 IRQ3		
	5-6	Enable LPT2 IRQ5		
	7-8	Enable LPT2 IRQ7		
W5	1-2*	Enable HD		
W6	1-2*	Enable floppy		
W7	2-3	HD INT selected		
W8	In*	IDE HD diagrams enabled		
W9		Reset		
W10,12,13	**Base Memory**	**W10**	**W12**	**W13**
	640K*	2-3		
	256K	1-2	2-3	1-2
W11	1-2	Disable VGA		
W15,16	1-2 both	8 MHz coprocessor		
W14	1-2	512K ROM		
	2-3	256K ROM		
W17	Out*	Normal clock for 80287		
	In	Clock divided by 2 for 80287		

300

Jumper	Position	Function
J9		Reset
J10	In*	Colour video
	Out	Mono video
J11	In	Maintenance mode
	Out*	Operational mode

316

Jumper	Position	Function
JMPHD	1-2	Reserved
JMPRDY		For some 3rd party drives that require an extra signal on pins 21 or 27

316sx

Jumper	Position	Function
JM3	1-2 In	On board VGA drives IRQ9
	1-2 Out	On board VGA ignores IRQ9
JM4	1-2	Mono display
	2-3	Colour display
JM5	2-3*	Enable VGA
JM6	1-2	IDE pin 21/IOCHRDY
	2-3	IDE pin 27/IOCHRDY (should be out)

Jumper	*Position*	*Function*
JM7	2-3*	Enable IDE
JM8	1-2	IDE tristate IRQ14
	2-3	IDE does not tristate IRQ14
JM9	2-3*	Enable floppy

320LX

Jumper	*Position*	*Function*
JMPHD	1-2*	ESDI and most IDE drives
	2-3	IDE drives needing SLVACT asserted
JMPRDY	1-2	Pin 21/IOCHRDY
	2-3	Pin 27/IOCHRDY (should be out for Dell IDE drives)

325/333D

Jumper	*Position*	*Function*
RSET	Out*	Reserved
MOCO	Out	VGA Mono on boot
	In*	VGA colour on boot
MNT	Out*	Reserved
EPWD	In*	Enable password
PIDE*1	Out	2 x HD – 2nd is primary
	In*	1 x IDE – always primary
SIDE*1	Out*	Primary IDE on system board
	In	Primary IDE on expansion board
MSYC	Out*	Not using multisync
	In	Using multisync
VIRQ	Out*	Onboard VGA not using IRQ9
	In	Onboard VGA using IRQ9
NIDE*2	Out	Not using new IDE drives
	In*	New IDE drives (>Jan 89)
OIDE*2	Out	Not using old IDE drives
	In*	Old IDE drives (<Jan 89)
EVGA	In*	Enable VGA
AROM	Out*	Reserved
WSP1	Out*	Reserved

325/333P

Jumper	*Position*	*Function*
WSP2	Out*	Reserved
MOCO	Out	Mono on boot
	In*	Colour on boot
MNT	Out*	Reserved for maintenance
	In	Cycle POST on power up
EPWD	In*	Enable password
PIDE	In*	Always jumpered - IDE HD primary
SIDE	Out*	IDE on system board
	In	IDE on expansion board
MSYC	Out*	Not using multisync

Jumper	*Position*	*Function*
	In	Using multisync
VIRQ	Out*	Video not using IRQ9
	In	Video using IRQ9
NIDE	Out	Old IDE drives that do not gate IRQs internally
	In*	Newer IDE drives with internal IRQ gating
		Should be closed for all Dell IDE drives
OIDE	Out*	Opposite of NIDE – open for all Dell IDE drives
EVGA	In*	Enable VGA
AROM	Out*	Reserved
WSP1	Out*	Reserved

386-16

Jumper	*Position*	*Function*
J10	In*	Colour video
	Out	Mono video
J11	In	Maintenance mode
	Out*	Normal ops

425E

Jumper	*Position*	*Function*
JM2	Out	Normal ops
	In	Reserved
JM4	1-2	Mono on boot
	2-3	Colour on boot
J20		Reset
J26A	Out	SIMM bank A=2Mb SIMM
	In	SIMM bank A=1Mb SIMM
J26B	Out	SIMM bank B=2Mb SIMM
	In	SIMM bank B=1Mb SIMM
J26C	Out	SIMM bank C=2Mb SIMM
	In	SIMM bank C=1Mb SIMM
J26D	Out	SIMM bank D=2Mb SIMM
	In	SIMM bank D=1Mb SIMM

DFI

Diamond Flower International
(916) 568 1234
www.dfiusa.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	G586IPV rev B+	BC	G586IPC rev C+

Code	Motherboard	Code	Motherboard
9C-00	G586VPM vB/G586VPS Pro vB1+	FC	G586IPV rev C+
9C-00	586STC	GC	G586IPC rev D+/586IPV C+
AC	G586IPC rev B+/ITBD	HC	G586IPC rev D+
AC-00	G586VPM	LC	G586IP/W

G586IPC

Same as Crusader C586HX rev D+ or Global Impact C586HX

G586IPV B+

Same as Crusader C586VX rev B+

G586IPV C+

Same as Crusader C586IPV rev C+

P2XBL

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Speeds (MHz)		
Chipset	440 BX	
BIOS	Award 4.51PG	
Bus	4 PCI/3 ISA	1 each shared
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video		AGP
Performance		Average

Switch	*Position*				*Function*
SW1	**1**	**2**	**3**	**4**	**Clock Multiplier**
	Off	Off	On	On	3.5x
	On	On	Off	On	4x
	Off	On	Off	On	4.5x
	On	Off	Off	On	5x
	Off	Off	Off	On	5.5x
	On	On	On	Off	6x
	Off	On	On	Off	6.5x
	On	Off	On	Off	7x
	Off	Off	On	Off	7.5x
	On	On	Off	Off	8x
JP1	1-2				Disable wake-on-keyboard/mouse
	2-3				Enable
JP3	1-2				Auto FSB
	2-3				66 MHz

Switch	Position	Function
	Out	100 MHz
JP4	1-2	Normal
	2-3	Clear CMOS

P5BV3+

Item	Description	Notes
Form Factor	AT	
CPU	K6, etc	Socket 7
Speeds (MHz)	550	
Chipset	Via MVP3	
BIOS	Award 4.51PG	
Bus	4 PCI/3 ISA	1 each shared 100 MHz
Memory (Mb)	512 Mb	3 DIMM sockets
Cache (K)	512	
I/O	2 EIDE, floppy, USB	
Video		AGP
Performance		Average

Diamond Flower International

See DFI

Diamond Micronics

www.diamondmm.com

Digicom

www.digicomgroup.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1-00	P5-VP	9C-00	P54HP

Digimate

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
AC	T5DX-VPX1E-1	DC	T5DX-VPX2E

T5DX-VPX1E-1

Same as Eagle VPX 200B and one Vtech.

T5DX-VPX2E

Same as Vtech/PCPartner VIB804DSE

Digital

www.digital.com

Domex

Formerly DTC
www.domexusa.com
www.domex.com.tw

DTC

See Domex

DTK

(847) 593 3080
www.dtk.com.tw
See also Gemlight

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	GMB P55IPS/P57IPS	IC	PAM 0054I
AC	PAM 0055I	JC	PAM 541PS

PAM 0054I-E1

Same as Gemlight GMB P54PSI?

QUIN-35

Item	Description	Notes
CPU		
Speeds (MHz)		
Chipset	Sis 85C501, 85C502, and 85C503	Also Winbond W83769F, W83787F, and W83768F chips
BIOS	Award	
Bus	3 PCI/3 ISA	1 each shared. PCI 2.0-compliant
Memory (Mb)	Up to 128 MB of conventional DRAM	4 72-pin sockets
Cache (K)	Up to 1 MB of standard Cache (K)	
I/O	2 16550 serial, 1 EPP/ECP parallel, 1 game port, floppy, 2 EIDE	

E

Eagle

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
AC	VPX 200B		

VPX 200B

Same as Digimate T5DX-VPX1E-1 or a Vtech.

ECS

Elite Group
www.ecs.com.tw
www.ecsusa.com
(510) 226 7333

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1-00	UM 8810P	AC	SI54P-AIO rev 1.0
1C-00	SI54P-AIO rev 1.0	AC-00	SI54P AIO
2C-00	SI54P-AIO	DC	SI55P AIO
9C	SI55P AIO	HC	TS54P-AIO
A	SI56P AVIO	NC	TR5510-AIO

AL 486(-I)

Jumper	*Position*				*Function*
JP2	Open				Normal EPROM
	1-2				12v Flash ROM
	2-3				5v Flash ROM
JP11,12	**JP11**	**JP12**	**JP20**	**JP21**	**CPU Speed**
20,21	3-4,5-6	1-2	1-2	1-2	25 MHz
	1-2,3-4	1-2	1-2	1-2	33 MHz
	1-2,5-6	2-3	2-3	2-3	40 MHz
	3-4,5-6	2-3	2-3	2-3	50 MHz
JP13-15	JP13	JP14	JP15		CPU type for system controller
	Short	Open	Short		Cx486s (M6)
	Open	Open	Open		Intel 80486 & Am486
	Short	Open	Open		Cx486DX/DX2 (M7)
JP22	1-2				<=33 MHz VESA clock speed
	2-3				> 33 MHz
JP23	1-2				0 VESA wait state
	2-3				1 VESA wait state
JP39	1-2				Local ready select <=33 MHz
	2-3				Local ready select >33 MHz
JP46,62	**JP46**	**JP62**			**CPU voltage**
	1-2	Open			5v (from power supply)
	2-3	1-2 3.45v, 2-3 3.3v			3.45/3.3v onboard
	Open	Open			3.3v from special power supply

Cache Size	JP16	JP33	JP34	JP40	JP41
64K	Open	Open	Open	1-2	Open
128K	Short	Open	Short	2-3	Open
256K	Short	Open	Short	1-2	Short
512K	Short	Short	Short	1-2 (64Kx8) 2-3(128Kx8)	Short

CPU Type	JP25	JP31	JP32	JP35	JP36	JP37	JP38	JP45	JP48	JP49	JP52	JP 60
486SX/SX2	Open	Open	Open	Open	-	Open	1-2	2-3	-	Open	2-3	2-3
486DX/DX2	Short*	Open	Open	Open	-	2-3	1-2	2-3	-	Open	1-2,3-4	2-3
487SX	Open	Open	Open	Open	-	1-2	1-2	2-3	-	Open	1-2,3-4	2-3
486DX/DX2 (SL)	Short	Open	1-2	1-2	-	2-3	1-2	2-3	-	Open	1-2,3-4	1-2
486SX/SX2(SL)	Short	Open	1-2	1-2	-	Open	1-2	2-3	-	Open	2-3	1-2

CPU Type	JP25	JP31	JP32	JP35	JP36	JP37	JP38	JP45	JP48	JP49	JP52	JP 60
486DX4(SL)	Short	Open	1-2	1-2	-	2-3	1-2	1-2	Opn**	Open	1-2,3-4	1-2
Am486DXL/DXL2	Open	Open	5-6	5-6	-	2-3	1-2	2-3	-	1-2	1-2,3-4	2-3
Cx486S(M6)	Open	2-3	3-4	3-4	Open	Open	1-2	2-3	-	2-3	2-3	1-2
Cx486DX/DX2 M7	Open	2-3	3-4	3-4	Op***	2-3	1-2	2-3	-	2-3	1-2,3-4	1-2

*DX50 only **3x CPU clock – Short for 2x clock ***1x CPU clock – short for 2x

FA 386

Jumper	*Position*				*Function*
JP1,3	**JP1**	**JP3**			**Coprocessor**
	Open	Open			No 80387
	Closed	Closed			80387 installed
JP2	1-2				Mono display
	2-3				Colour
JP4-7	**JP4**	**JP5**	**JP6**	**JP7**	**Cache setting**
	1-2	1-2	Open	Open	64K
	2-3	2-3	Closed	Closed	128K

FA 486

Jumper	*Position*				*Function*
JP2	1-2				Mono display
	2-3				Colour
JP3-4	**JP3**	**JP4**			**CPU Type**
	1-2	1-2,3-4			80486DX (DX2)
	Open	2-3			80486SX
	2-3	1-2,3-4			80487SX (Overdrive)
JP5-8	**JP5**	**JP6**	**JP7**	**JP8**	**Cache setting**
	Open	2-3	1-2	Open	64K
	Open	1-2	2-3	Closed	128K
	Closed	2-3	2-3	Closed	256K

FE 386

Jumper	*Position*	*Function*							
J3	1-2	Colour display							
	2-3	Mono							
JP2	Closed	80387 installed							
	Open	No 80387							
W2-9	**Cache size**	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**W8**	**W9**
	64K	Open	Open	Open	Open	1-2	Open	1-2	1-2
	128K	Open	Open	Close	Close	2-3	1-2	2-3	1-2
	256K	Close	Close	Close	Close	1-2	2-3	2-3	2-3

MX 386

Jumper	*Position*	*Function*
JP1	1-2	Mono display
	2-3	Colour display

Jumper	*Position*	*Function*
JP2	1-2	Coprocessor installed
	2-3	Not installed
JP3	1-2	A20MASK selector from keyboard (Cyrix)
	2-3	A20MASK selector from chipset (Cyrix)
JP4	1-2	KEN selector current version (Cyrix – v1.0)
	2-3	KEN selector next reversion ox MXC305 (Cyrix - v1.0)

P5HX-A v1.0

Jumper	*Position*		*Function*
JP1	1-2		3.3v (STD) I/O voltage
	3-4		3.52v (VRE) I/O voltage
JP2-5	1-2		P54C, 6x86
	2-3		P55C
JP7,8	**JP7**	**JP8**	**Clock Multiplier**
	1-2	1-2	1.5x
	1-2	2-3	2x
	2-3	2-3	2.5x
	2-3	1-2	3x
	Open	2-3	Cyrix 2x
	Open	1-2	Cyrix 3x
JP9	1-2,3-4		50 MHz Host Clock
	open		55 MHz Host Clock
	3-4		60 MHz Host Clock
	1-2		66 MHz Host Clock
JP10	2-3		Flash ROM PnP (12v)
	1-2		Flash ROM non-PnP (5v)
JP11	1-2		Clear CMOS
	2-3		Normal operation
JP12	2-3		Flash ROM normal
	1-2		BIOS recover
JP15-16	**JP15**		**Cache size**
	Short		256K
	Open		512K (onboard)

Case Connections – J12

SMI switch	4-5
Reset switch	9-10
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

P5HX-A v1.1

Jumper	*Position*		*Function*	
JP1	1-2		3.3v (STD) I/O voltage	
	3-4		3.52v (VRE) I/O voltage	
JP2-5	All 1-2		Single voltage CPU	
	All 2-3		Dual voltage CPU	
JP7,8	**JP7**	**JP8**	**Clock Multiplier**	JP7 open for Cyrix 6x86
	1-2	1-2	1.5x	

Jumper	*Position*		*Function*
	1-2	2-3	2x
	2-3	2-3	2.5x
	2-3	1-2	3x
JP9	1-2,3-4		50 MHz Host Clock
	open		55 MHz Host Clock
	3-4		60 MHz Host Clock
	1-2		66 MHz Host Clock
JP11	1-2		Clear CMOS
	2-3		Normal operation
JP15-16	JP15		Cache size
	Open		256K (module)
	Short		256K (onboard)
	Open		512K (modue)
	Short		512K (256K onboard + 256K module)
	Open		512K (onboard)
JP17	1-2		2.5v CPU core voltage
	3-4		2.7v CPU core voltage
	5-6		2.8v CPU core voltage
	7-8		2.9v CPU core voltage
JP18	1-2		Password check disabled
	2-3		Enabled

P5HX-B

Item	Description	Notes
Form Factor		
CPU	Pentium	Socket 7
Speeds (MHz)	166	
Chipset	Intel 430HX	
BIOS	Award Flash	
Bus	4 PCI/4 ISA	
Memory (Mb)	8-256	4 72-pin sockets – EDO/FPM
Cache (K)	512	
I/O	2S, 1P, floppy, IDE, USB, IR	

Jumper	*Position*		*Function*
JP2,3	**JP2**	**JP3**	**Clock Multiplier**
	1-2	1-2	1.5x
	1-2	2-3	2x
	2-3	2-3	2.5x
	2-3	1-2	3x
			JP2 open for Cyrix 6x86
JP4	1-2,3-4		50 MHz Host Clock
	open		55 MHz Host Clock
	3-4		60 MHz Host Clock
	1-2		66 MHz Host Clock
JP5	1-2		Clear CMOS
	2-3		Normal operation
JP10	1-2		3.3v (STD) I/O voltage
	3-4		3.52v (VRE) I/O voltage
JP11-14	All 1-2		Single voltage CPU

Jumper	*Position*		*Function*
	All 2-3		Dual voltage CPU
JP15-16	**JP15**	**JP16**	**Cache size**
	In	1-2	256K (onboard)
	Out	1-2	256K (module)
	In	3-4	512K (256K onboard + 256K (module)
	In	3-4	512K (onboard)
	Out	Out	Nil
JP17	1-2		2.51v CPU core voltage
	3-4		2.73v CPU core voltage
	5-6		2.91v CPU core voltage

Case Connections – J12

Turbo LED	2-3
SMI switch	4-5
Turbo Switch	6-7
Reset switch	9-10
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

P5SD-B

Item	Description	Notes
Form Factor	Baby AT	
CPU	Pentium	Socket 7
Speeds (MHz)	75-500 MHz	
Chipset	SiS 5591/5595	
BIOS		
Bus	4 PCI/3 ISA	
Memory (Mb)	384 Mb SDRAM	2 DIMM sockets
Cache (K)		
I/O		
Video		AGP
Audio		
Performance		100 MHz bus speed with 5 x multiplier
Problems		
Comments		Power for AT and ATX.

Jumper	*Position*			*Function*		
JP1,2,3	**JP1**	**JP2**	**JP3**	**Ext clk**	**AGP**	**PCI**
	2-3	2-3	2-3	60	60	30
	1-2	2-3	2-3	66.8	66.8	33.4
	2-3	2-3	1-2	68.5	68.5	34.3
	2-3	1-2	2-3	75	64	32
	1-2	2-3	1-2	75	75	37.5
	1-2	1-2	2-3	83.3	66.6	33.3
	2-3	1-2	1-2	90	60	30
	1-2	1-2	1-2	100	66.6	33.3
JP5	1-2			ATX power supply		

Jumper	*Position*			*Function*
	2-3			AT power supply
JP6	1-2			Normal
	2-3*			Clear CMOS
JP10-12	**JP10**	**JP11**	**JP12**	**CPU clock multiply**
	1-2	1-2		1.1/3.3x
	2-3	1-2		2x
	2-3	2-3		2.5x
	1-2	2-3		3x
	2-3	1-2	2-3	4x
	2-3	2-3	2-3	4.5x
	1-2	2-3	2-3	5x
JP13	1-2			Reserved for 100 MHz
	3-4			CPU I/O voltage VRE 3.5v
	5-6*			CPU I/O voltage STD 3.3v
JP14	1-2,3-4,7-8			1.8v CPU core voltage
	1-2,3-4,5-6,7-8			2v CPU core voltage
	7-8			2.2v CPU core voltage
	5-6,9-10			2.5v CPU core voltage
	3-4			2.8v CPU core voltage
	3-4,9-10			2.9v CPU core voltage
	3-4,7-8,9-10			3.1v CPU core voltage
	3-4,5-6			3.2v CPU core voltage
	3-4,5-6,9-10			3.3v CPU core voltage
	3-4,5-6,7-8,9-10			3.5v CPU core voltage

P5SJ-B

To enable VGA, set JP1-2 at 1-2, JP10 at 2-3. Reverse to disable.

P5SD-B+

Item	Description	Notes
Form Factor	Baby AT	
CPU	Pentium	Socket 7
Speeds (MHz)	66-100	
Chipset	VT82C586B	
BIOS	Award	
Bus	4 PCI/2 ISA	
Memory (Mb)	512	
Cache (K)		
I/O	The usual	
Video	AGP	

P5SJ-B

Item	Description	Notes
Form Factor	Baby AT	
CPU	Pentium	Socket 7
Speeds (MHz)	66-100	

Item	Description	Notes
Chipset	Sis 5598	
BIOS	Award	
Bus	3 PCI/3 ISA	
Memory (Mb)	512	
Cache (K)		
I/O	The usual	

P5SS-Me (Sinbad)

Item	Description	Notes
Form Factor	Micro ATX	
CPU	Pentium	Socket 7
Speeds (MHz)		
Chipset	SiS 530/5595	66-100 MHz
BIOS		
Bus	3 PCI/1 ISA	
Memory (Mb)	1 Gb	3 DIMM sockets
Cache (K)	1 Mb	
I/O		
Video	AGP	
Audio		
Performance		

P5TX-Apro

Defaults to 3.3 volts. For dual voltage, set JP-04 to 3-4.

P5TX-Bpro

Pentium

Jumper	*Position*	*Function*
JP1	11-13,19-21,20-22	50 Mhz External Clock Speed
	11-13,17-19,20-22	55 Mhz External Clock Speed
	9-11,19-21,20-22	60 Mhz External Clock Speed
	11-13,19-21,18-20	66 Mhz External Clock Speed
	9-11,17-19,18-20	68 Mhz External Clock Speed
	9-11,17-19,20-22	75 Mhz External Clock Speed
	11-13,17-19,18-20	83 Mhz External Clock Speed
JP1	1-3,2-4	1.5x & 3.5x clock multiplier
	1-3,4-6	2x clock multiplier
	3-5,4-6	2.5x clock multiplier
	3-5,2-4	3x clock multiplier
JP2	1-2*	Clear CMOS
	2-3	Normal operations
JP3	11-12	2.2v CPU core voltage
	9-10	2.8v CPU core voltage
	7-8	2.9v CPU core voltage
	3-4	3.2v CPU core voltage
	1-2	3.25v CPU core voltage

Case Connections – J22

Power-on LED	2-3
SMI switch	4-5
Reset switch	9-10
Keyboard lock	11-15
Speaker	17-20

P5VP-A+

Item	Description	Notes
Form Factor	ATX	
CPU	K6 etc	Socket 7
Speeds (MHz)	450	
Chipset	Via MVP3	
BIOS	Award 4.51PG	
Bus	4 PCI/2 ISA	1 each shared 124 MHz
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video		AGP
Performance		Average

P5VX-A

Jumper	*Position*		*Function*
JP3	Open		50 MHz CPU
	1-2,3-4		55 MHz CPU
	1-2		60 MHz CPU
	3-4		66 MHz CPU
JP8	1-2		12v Flash ROM
	2-3		5v Flash ROM
JP10	1-2		3.3v (STD) I/O voltage
	3-4		3.52v (VRE) I/O voltage
JP11,12	**JP11**	**JP12**	**Clock multiplier**
	1-2	1-2	1.5x
	1-2	2-3	2x
	2-3	2-3	2.5x
	2-3	1-2	3x
JP13	Open		Normal
	Short		Clear CMOS
JP15	1-2		Enable Super I/O
	2-3		Disable
JP16-18	1-2		P54C
	2-3		P55C (Mount U10)
JP20	1-2		2.5v CPU core voltage
	3-4		2.8v CPU core voltage
JP21	Open		Disable 3D sound
	Short		Enable

Case Connections – J12

Power On	1-2
SMI switch	4-5
Reset switch	9-10
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

P5VX-B

Item	Description	Notes
Form Factor		
CPU	Pentium	Socket 7
Speeds (MHz)	166	
Chipset	Intel 82437VX	
BIOS	Award Flash	
Bus	4 PCI/4 ISA	
Memory (Mb)	4-128	4 72-pin sockets - EDO/FPM. 1 DIMM
Cache (K)	0-512	
I/O	2S, 1P, floppy, IDE	

Jumper	*Position*		*Function*
JP3	Open		50 MHz Host clock
	1-2,3-4		55 MHz Host clock
	1-2		60 MHz Host clock
	3-4		66 MHz Host clock
JP4	1-2		12v Flash ROM programming
	2-3		5v Flash ROM programming
JP8	Short		512K cache (256 onboard + module)
JP10	1-2		3.3v (STD) CPU voltage
	3-4		3.525v (VRE) CPU voltage
JP11,12	**JP11**	**JP12**	**CPU clock multiplier**
	1-2	1-2	1.5x
	1-2	2-3	2x
	2-3	2-3	2.5x
	2-3	1-2	3x
JP13	Open		Normal operations
	Short		Clear CMOS
JP15-16	**JP15**	**JP16**	**CPU Type**
	1-2	1-2	Intel P54C, CT, CTB, Cyrix M1
	2-3	2-3	P55C (needs VR at U30)
JP17	1-2		2.5v P55C core voltage
	3-4		2.8v P55C core voltage

Case Connections – J12

Turbo LED	2-3
SMI switch	4-5
Reset switch	9-10
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

P5VX-Be

Item	Description	Notes
Form Factor		
CPU	Pentium	Socket 7
Speeds (MHz)	200	
Chipset	Intel 430VX	
BIOS	Award Flash	
Bus	4 PCI/3 ISA	
Memory (Mb)	4-128	4 72-pin sockets - EDO/FPM. 1 DIMM
Cache (K)		May hang if set to write-back
I/O	2S, 1P, floppy, IDE, NCR SCSI, USB, IR	SMC 37C665 I/O controller - check for GT at end of model no, to fix crashes using comms programs. SCSI controller may need IRQ 15.

Jumper	*Position*		*Function*
JP1	In		Disable password check
	Out		Normal operation
JP2	1-2,3-4,5-6		50 MHz Host Clock
	1-2,3-4		55 MHz Host Clock
	3-4,5-6		60 MHz Host Clock
	1-2,5-6		66 MHz Host Clock
JP4	In		Clear CMOS
	Out		Normal operation
JP5	1-2		3.3v CPU I/O voltage
	3-4		3.525v CPU I/O voltage
JP6	1-2		Split Rail CPU
	2-3		Single voltage CPU
JP7	1-2		2.5v CPU core voltage
	3-4		2.8v CPU core voltage
	5-6		2.9v CPU core voltage
JP11,12	**JP11**	**JP12**	**Clock Multiplier**
	1-2	1-2	1.5x
	2-3	1-2	2x
	2-3	2-3	2.5x
	1-2	2-3	3x

Case Connections – J20

Turbo LED	2-3
SMI switch	4-5
Reset switch	9-10
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

P6BAT-A+

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/III/Celeron	Socket 370 & Slot 1
Speeds (MHz)		
Chipset	VIA	

Item	Description	Notes
BIOS	Award Flash	
Bus	4 PCI/2 ISA	
Memory (Mb)	768	3 DIMM sockets
I/O	2S, 1P, floppy, IDE, NCR SCSI, USB, IR	
Audio	Yamaha	

Jumper	*Position*	*Function*
JP1	1-2	Normal
	2-3	Clear CMOS
JP2	1-2	Disable Keyboard Power On
	2-3	Enable
JP4	1-2	Normal bus frequency
	2-3	Force 100 MHz
JP7	1-2	Enable Flash BIOS
	2-3	Disable
JP9	1-2	66/100 MHz
	2-3	Force 133 MHz

P6BTM

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Chipset	440 BX	
BIOS	Award 4.51PGMA	
Bus	3 PCI/2 ISA	66-100 MHz
Memory (Mb)	1024 Mb	
I/O	2 EIDE, floppy, USB	
Video	AGP	

P6BX-A+

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Chipset	440 BX	
BIOS	Award 4.51PGMA	
Bus	5 PCI/2 ISA	1 each shared
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2 EIDE, floppy, USB	
Video		AGP
Performance		Relatively poor

P6BX-Me

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Chipset	440 BX	

Item	Description	Notes
BIOS	Award 4.51PGMA	
Bus	2 PCI/2 ISA	66-100 MHz
Memory (Mb)	384 Mb	
I/O	2 EIDE, floppy, USB	
Video		AGP
Performance		

P6BX-MS

Item	Description	Notes
Form Factor	Micro ATX	
CPU	Pentium II/Celeron	Slot 1
Chipset	440 BX	
BIOS	Award 4.51PGMA	
Bus	3 PCI/1 ISA	66-100 MHz
Memory (Mb)	768 Mb	
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video		Yes, + sound
Performance		

P6SBXT (Libra)

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Chipset	440 BX	
BIOS	Award	
Bus	4 PCI/2 ISA	66-100 MHz
Memory (Mb)	768 Mb	
I/O	2 EIDE, floppy, USB	
Video	AGP	
Performance		

P6EX-A+

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Chipset	440 EX	
BIOS	Award 4.51PGMA	
Bus	4 PCI/3 ISA	66-133 MHz
Memory (Mb)	256 Mb	
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video	AGP	
Performance		

P6EXP-Me (Robin)

Item	Description	Notes
Form Factor	ATX	
CPU	Celeron	Socket 370
Chipset	440 EX	
BIOS	Award	
Bus	3 PCI/1 ISA	66-133 MHz
Memory (Mb)	256 Mb	
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video	AGP	
Performance		

P6FX1-A

Jumper	*Position*	*Function*
JP4	1-2	5v Flash BIOS
	2-3	12v Flash BIOS
J13	3-4,5-6	60 MHz Host Clock
	1-2,7-8	66 MHz Host Clock
J13	9-10,11-12,13-14,15-16	Host Clock x2
	11-12,13-14,15-16	Host Clock x2.5
	9-10,13-14,15-16	Host Clock x3
	13-14,15-16	Host Clock x3.5
	9-10,11-12	Host Clock x4

P6FX1-B

Jumper	*Position*	*Function*
JP3	Short	Clear CMOS
JP4	1-2	Clear password
	2-3	Normal
J13	3-4,5-6	60 MHz Host Clock
	1-2,7-8	66 MHz Host Clock
J13	9-10,11-12,13-14,15-16	Host Clock x2
	11-12,13-14,15-16	Host Clock x2.5
	9-10,13-14,15-16	Host Clock x3
	13-14,15-16	Host Clock x3.5
	9-10,11-12,15-16	Host Clock x4
J13	17-18, 19-20, 21-22,23-24	Open for CPU with VID enabled. Otherwise see table

J13	VID O 17-18	VID 1 19-20	VID 2 21-22	VDI 3 23-24
VID Enable	open	open	open	open
2.1	short	open	open	open
2.2	open	short	open	open
2.3	short	short	open	open
2.4	open	open	short	open
2.5	short	open	short	open
2.6	open	short	short	open

J13	VID O 17-18	VID 1 19-20	VID 2 21-22	VDI 3 23-24
2.7	short	short	short	open
2.8	open	open	open	short
2.9	short	open	open	short
3.0	open	short	open	short
3.1	short	short	open	short
3.2	open	open	short	short
3.3	short	open	short	short
3.4	open	short	short	short
3.5	short	short	short	short

Case Connections

SMI switch	4-5
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

P6FX2

Dual Pentium Pro

Jumper	*Position*	*Function*
JP2	1-2	Clear CMOS
JP4	1-2,3-4	50 MHz host frequency
	1-2	66 MHz host frequency
	2-3	60 MHz host frequency
	None	55 MHz host frequency
JP8	1-2,3-4,5-6,7-8	2x CPU
	3-4,5-6,7-8	2.5x CPU
	1-2,5-6,7-8	3x CPU
	5-6,7-8	3.5x CPU
	1-2,3-4,7-8	4x CPU
J13	1-2	Clear password

Case Connections – J8

Power LED	2-3
SMI switch	4-5
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

P6LX-A+

Keyboard on-now feature turned off by disabling JP1.

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Chipset	440 LX	
BIOS	Award 4.51PGMA	

Item	Description	Notes
Bus	4 PCI/3 ISA	66-100 MHz
Memory (Mb)	1024 Mb	
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video	AGP	
Performance		

P6SBU

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Chipset	440 BX	
BIOS	AMI	
Bus	3 PCI/2 ISA	66-100 MHz
Memory (Mb)	1024 Mb	
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video	AGP	

P6SEP-Me (Eagle)

Item	Description	Notes
Form Factor	Micro ATX	
CPU		Socket 370
Chipset	SiS 620/5595	
BIOS	Award	
Bus	3 PCI/1 ISA	66-133 MHz
Memory (Mb)	3844 Mb	
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video	AGP	
Performance		

SA486P AIO-U

Item	Description	Notes
Form Factor		
CPU		
Speeds (MHz)		
Chipset	Saturn	
BIOS		
Bus		
Memory (Mb)		
Cache (K)		May hang if set to write-back
I/O	IDE, NCR SCSI	SMC 37C665 I/O controller - check for GT at end of model no, to fix crashes using comms programs. SCSI controller may need IRQ 15.

SC58P VIO/S

Jumper	*Position*	*Function*
J9	1-2	Normal
	2-3	Clear CMOS
JP3	Short	Enable
	Open	Disable
JP11	1-2	BIOS program 12v
	2-3	BIOS Not Program Mode (5v)
JP13	1-2	256K cache
	2-3	512K cache
JP14	1-2	50 MHz host clock
	3-4	60 MHz host clock
	1-2,3-4	66 MHz host clock
JP17	Open	CPU 1.5x
	1-2	CPU 2x
	1-2,3-4	CPU 2.5x
	3-4	CPU 3x
JP19	1-2	3.3v CPU
	3-4	3.525v CPU (VRE)
JP21	1-2	Normal floppy
	2-3	Write protect
JP22	1-2	CPU non-linear mode (Intel)
	2-3	CPU linear mode (Cyrix)

SI54P AIO

Pentium.

Jumper	*Position*		*Function*
JP1-2	**JP1**	**JP2**	**ECP Mode**
	1-2	2-3	Parallel Port DRQ1 DACK1
	2-3	1-2	Parallel Port DRQ3 DACK3
JP3	1-2		Enable onboard I/O
	2-3		Disable
JP4	Open		Enable onboard PCI IDE
	Short		Disable
JP5	1-2,3-4		Double density memory (or 1&2 single)
	2-3		All single density memory
JP7	2-3,5-6,7-8		50 MHz host clock speed (1.5x CPU)
	2-3,4-5,8-9		60 MHz host clock speed (1.5x CPU)
	1-2,5-6,7-8		66 MHz host clock speed (1.5x CPU)
JP8	Open		System ROM is EPROM or Normal use
	1-2		System ROM is 5v Flash ROM
	2-3		System ROM is 12v Flash ROM
JP9	Short		Enable DRAM parity check
	Open		Disable
JP10,11	**JP10**	**JP11**	**L2 cache**
	Open	Open	256K (32Kx8)
	Open	Short	512K (64Kx8)
	Short	Short	1 Mb (128Kx8)
JP12	1-2		L1 cache write-back
	2-3		L1 cache write-through
JP14	1-2		CPU Signal Select always invalidated

Jumper	*Position*	*Function*
	2-3	CPU Signal Select write to invalidated

Case Connections – J13

Turbo LED	2-3
SMI switch	4-5
Turbo switch	6-7
Reset switch	9-10
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

SI5PI AIO

Pentium. Rev 1.0 has parity checking always enabled. Rev 1.0a has parity checking always disabled, so can use parity or non-parity DRAM. Rev 1.1 uses JP22 to set parity checking.

Jumper	*Position*				*Function*
JP1	1-2				Enable onboard multi I/O
	2-3				Disable
JP2	Open				Enable IDE
	Short				Disable IDE
JP4	1-2,3-4				Double density memory used
	2-3				Single density memory only
JP5-7	**JP5**	**JP6**	**JP7**		**CPU Clock**
	1-2	2-3	1-2		60 MHz
	2-3	1-2	2-3		66 MHz
JP8	Open				Normal LPT mode
	Short				ECP mode
JP9-10	**JP9**	**JP10**			**Parallel Port ECP PRQ & DACK**
	2-3	1-2			DRQ1, DACK1
	1-2	2-3			DRQ3, DACK3*
JP11	1-2,5-6				12v Flash ROM
	2-3,4-5				EPROM
JP13-16	**JP13**	**JP14**	**JP15**	**JP16**	**L2 cache setting**
	Open	Open	Open	1-2,3-4	256K (32Kx8 in Bank 0)
	Open	Short	Open	2-3,4-5	512K (32Kx8 in Bank 0&1)
	Open	Short	1-2	1-2,3-4	512K (64Kx8 in Bank 0)
	Short	Short	2-3	2-3,4-5	1 Mb (64Kx8 in Bank 0&1)
	Short	Short	1-2,3-4	1-2,3-4	1 Mb (128Kx8 in Bank 0)
JP19	1-2				L1 writeback
	2-3				L1 writethrough
JP20	1-2				CPU Signal Select always invalidated
	2-3				CPU Signal Select write to invalidated
JP21	1-2				LPT IRQ7
	2-3				LPT IRQ5
JP22	1-2				Enable parity check (v1.1 only)
	2-3				Disable

SI55P AIO

P54C

Jumper	Position			Function
JP1	Open			Enable onboard multi I/O
	Short			Disable
JP2	5-6,7-8			IR normal COM2/4
	Open			IR front connector
JP3	1-2			5v EPROM
	2-3			12v Flash ROM
JP4,6	**JP4**	**JP6**		**Parallel Port ECP PRQ & DACK**
	1-2	1-2		DRQ1, DACK1
	2-3	2-3		DRQ3, DACK3
JP5-7	**JP5**	**JP6**	**JP7**	**CPU Clock**
	1-2	2-3	1-2	60 MHz
	2-3	1-2	2-3	66 MHz
JP8	Enable			Enable DRAM parity check
	Disable			Disable
JP14-16	**JP14**	**JP15**	**JP16**	**SRAM**
	2-3	2-3	2-3	3.3v
	1-2	1-2	1-2	3.3/5v mixed
JP17	1-2			3.3v CPU voltage (STD)
	3-4			3.385v CPU voltage (VR)
	5-6			3.525v CPU voltage (VRE)
JP18-19	**JP18**	**JP19**		**L2 cache size**
	2-3	2-3		256K (32Kx8)
	2-3	1-2		512K (64Kx8)
	1-2	1-2		1 Mb (128Kx8)
J15	6-7,21-22			Always set
JP21-22	**JP21**	**JP22**		**CPU clock multiplier**
	Open	Open		1.5x
	Open	Short		2x
	Short	Short		2.5x
	Short	Open		3x
JP25-26	JP25	JP26		Host clock speed
	Short	Open		50 MHz
	Open	Short		60 MHz
	Short	Short		66 MHz

Case Connections – J12

SMI switch	4-5
Reset switch	9-10
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

SI56P AVIO

Jumper	*Position*		*Function*
JP1,2	**JP1**	**JP2**	**Mixed/Pure cache**
	1-2	1-2	Pure
	2-3	2-3	Mixed

Jumper	*Position*		*Function*
JP6,7	**JP6**	**JP7**	**Cache size**
	1-2	1-2	256K
	2-3	1-2	512K
	2-3	2-3	1 Mb
JP11	Open		Enable super I/O
	Short		Disable
JP12,13	**JP12**	**JP13**	**ECP Mode**
	1-2	1-2	DRQ1/DACK1
	2-3	2-3	DRQ3/DACK3
JP15	1-2		50 MHz host clock
	3-4		60 MHz host clock
	1-2,3-4		66 MHz host clock
JP16	1-2		3.3v CPU voltage (STD)
	3-4		3.385v CPU voltage (VR)
	5-6		3.525v CPU voltage (VRE)
JP22,24	**JP22**	**JP24**	**Clock multiplier**
	Open	Open	1.5x
	Open	Short	2x
	Short	Short	2.5x
	Short	Open	3x
JP25	1-2		5v Flash voltage
	2-3		12v Flash voltage
JP26	Short		Clear CMOS
	Open		Normal
JP27	Short		Enable onboard VGA
	Open		Disable

Case Connections – J16

Turbo LED	2-3
SMI switch	4-5
Reset switch	9-10
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

SL 486E

EISA 486

Jumper	*Position*		*Function*
JP1,2	**JP1**	**JP2**	**ALT Bit selection**
	1-2	1-2	64K
	1-2	2-3	128K
	2-3	2-3	256K
JP3,4	**JP3**	**JP4**	**Cache size**
	1-2	1-2	64K
	2-3	1-2	128K
	2-3	2-3	256K
JP5	1-2		8Kx8 SRAM
	2-3		32Kx8 SRAM
JP6	1-2		One bank SRAM
	3-4		2 banks 8Kx8 SRAM

Jumper	*Position*			*Function*
	5-6			2 banks 32Kx8 SRAM
JP7	1-2			CPU <50 MHz
	2-3			CPU 50 MHz
JP8-10	**JP8**	**JP9**	**JP10**	**CPU type**
	2-3	2-3	1-2	486DX
	1-2	1-2	1-2	486SX
	2-3	2-3	1-2	487SX
JP11	1-2			Bus cycle pending, 85C406 system arbitration logic bypasses CPU
	2-3			System arbitration logic in 85C406 includes CPU
JP12	Closed			Local bus memory slaves can receive burst cycles
	Open			Non-burst mode
JP13	1-2*			Refresh signal selection
JP14	Close			Mono display
	Open			Colour display
JP20	1-2 open			Turbo
	1-2 closed			Normal speed

TR 5510 AIO

Item	Description	Notes
Form Factor	¾ Baby AT	4 layer
CPU	Pentium P54C(T)(B)	
Speeds (MHz)	75-166	
Chipset	Intel 430FX or UMC	
BIOS	Award Flash	
Bus	4 PCI/3 ISA	
Memory (Mb)	4-128	FPM/EDO. 4 72-pin SIMM.
Cache (K)	512	256 standard
I/O	2S, 1P, floppy, 2 EIDE	

Jumper	*Position*		*Function*
JP1	1-2*		Enable Onbard I/O
JP2	Open*		Normal CMOS
	Short		Clear CMOS
JP3	1-2		System clock PCI clock/3
	2-3		System clock PCI clock/4*
J4	Open		50 MHz Host clock
	1-2		55 MHz Host clock (IMI604 U10)
	3-4		60 MHz Host clock
	1-2,3-4		66 MHz Host clock
J8	Open		1.5x CPU
	1-2		2x CPU
	1-2,3-4		2.5x CPU
	3-4		3x CPU
JP12,13	**JP12**	**JP13**	**SRAM voltage**
	1-2*	1-2*	5v (mixed SRAM)
	2-3	2-3	3.3v (pure 3.3v or PB SRAM)
J13	6-7,21-22		VRM connector - all CPUs
JP17	1-2		3.52v CPU
	3-4		3.38v CPU*

Jumper	*Position*			*Function*
	5-6			3.3v CPU
JP19	1-2			Tag installed for PB SRAM module
	2-3			Tag not installed for PB SRAM module – install Std SRAM at U17
JP23	Open			Page mode flash BIOS*
	1-2			5v flash program voltage
	2-3			12v flash program voltage
JP7,21,22	**JP7**	**JP21**	**JP22**	**Cache size (standard SRAM)**
	1-2	2-3	1-2	256K*
	2-3	1-2	2-3	512K
	Open	Open	Open	256/512K (PBSRAM)

Case Connections – J12

Turbo LED	2-3
SMI switch	4-5
Turbo switch	6-7
Reset switch	9-10
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

TS 54P AIO

Jumper	*Position*					*Function*
JP1	1-2					Pure 3.3v cache
	2-3					Mixed 5/3.3v cache
JP4	Open					50 MHz host
	1-2					55 MHz host (U22 uses IMI 604 only)
	3-4					60 MHz host
	1-2,3-4					66 MHz host
JP5,10	**JP5**	**JP10**				**Clock multiplier**
	Open	Open				1.5x
	Short	Open				2x
	Short	Short				2.5x
	Open	Short				3x
JP6,27	**JP6**	**JP27**				**CPU voltage**
	Open	Open				3.3v (from power supply)
	1-2,3-4	1-2,3-4				3.3v (from onboard regulator)
JP7	1-2					Enable onboard I/O
	2-3					Disable
JP8,9	**JP8**	**JP9**				**ECP DMA (SMC37C665GT only)**
	1-2	1-2				DMA1
	2-3	2-3				DMA3
J12	5-6,7-8					IR normal COM2/4
	Open					IR connector
JP15	Open					Normal
	Short					Clear CMOS
JP20-24	**JP20**	**JP21**	**JP22**	**JP23**	**JP24**	**L2 cache size**
	1-2	1-2	1-2	2-3	1-2	256K PBSRAM (U17, U18)
	1-2	1-2	2-3	2-3	1-2	256K Standard SRAM (U9-16)
	2-3	1-2	2-3	1-2	2-3	512K Standard SRAM (U9-U16)
JP25	1-2					L1 cache write back

Jumper	*Position*	*Function*
	2-3	L1 cache write through
JP26	2-3	System clock PCICLK/4
	1-2	System clock PCICLK/3
JP28	1-2	3.14-3.46v
	3-4	3.3-3.46v
	5-6	3.45-3.6v
JP50	1-2,3-4,5-6,7-8	U25 not installed
	Open	U25 installed

Case Connections – J11

Turbo LED	2-3
SMI switch	4-5
Reset switch	9-10
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

UA 4982

Jumper	*Position*							*Function*
JP1	1-2							5v Flash ROM
	2-3							12v Flash ROM
JP3	Open							External keyboard control
	Short							Internal keyboard control
JP4-6	**JP4**	**JP5**	**JP6**	**JP10**	**JP11**	**JP12**	**JP13**	**Cache size**
10-13	1-2	1-2	Open	Open	Open	Open	Open	128K (32Kx8)
	1-2	1-2	1-2	Open	Open	Open	Short	256K (64Kx8)
	1-2	2-3	2-3	1-2	Short	Open	Short	512K (128x8)
JP7-9	**JP7**	**JP8**	**JP9**					**CPU speed**
	Short	Open	Open					25 MHz
	Short	Short	Short					33 MHz
	Short	Short	Open					40 MHz
	Open	Open	Short					50 MHz
JP14-19	**JP14**	**JP15**	**JP16**	**JP17**	**JP18**		**JP19**	**CPU Type**
	Open	2-3	Open	Open	2-3		Open	486SX/SX2
	Open	1-2,3-4	1-2	Open	2-3		Open	486DX/DX2/AmDX4
	1-2,3-4	2-3	Open	5-6	1-2		1-2	486SX/SX2 (SL)
	1-2,3-4	1-2,3-4	1-2	5-6	1-2		1-2	486DX/DX2 (SL)
	1-2,3-4	1-2,3-4	1-2	3-4,5-6	1-2,4-5		1-2,4-5	486DX2 (P24D) L1 wb
	1-2,3-4	1-2,3-4	1-2	5-6	1-2		1-2	Intel 486DX4
	Open	2-3	3-4	1-2	2-3		2-3	UMC U5-S Super
	2-3	1-2,3-4	1-2	2-3,4-5	1-2,3-4,5-6	1-2,3-4		Cyrix 486DX/DX2(M7)
	2-3,4-5	2-3	Open	2-3,4-5	1-2,3-4,5-6	1-2,3-4,5-6		Cyrix 486S(M6)
JP20-22	**JP20**	**JP21**	**JP22**					**CPU voltage**
	1-2	1-2	Open					5v
	2-3	2-3	1-2					3.45v
	2-3	2-3	2-3					3.3v
JP24	Open							DX4 internal clock x 3
	Short							DX4 internal clock x 2
JP25	Open							Local bus <=33 MHz
	Short							Local bus >33 MHz
JP26	Open							Local bus write 0 wait state

Jumper	*Position*	*Function*
	Short	Local bus write 1 wait state
JP100,102	Short	Cyrix DX2-50
102,300	Open	Other CPUs
JP400	Open	AMD DX4 3x clock
	Short	AMD DX4 or DX2802x

Case Connections – J90

Turbo LED	2-3
SMI switch	4-5
Turbo switch	6-7
Reset switch	9-10
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

UC 4913

Jumper	*Position*				*Function*
JP1	Open				Local Bus Write 0 wait state
	Closed				Local Bus Write 1 wait state
JP2	Open				Local Bus Speed <=33 MHz
	Closed				Local Bus Speed >33 MHz
JP7	1-2,3-4				80486DX, DX2, P23T, AMD 486DX, M6/C6 module
	2-3				80486SX, M6, AMD486SX
JP9,10	**JP9**	**JP10**			**CPU Clock**
	Short	Short			25 MHz
	Open	Short			33 MHz
	Short	Open			40 MHz
	Open	Open			50 MHz
JP11	1-2				Mono display
	2-3				Colour
JP12	Open				486PQFP
	Closed				486PGA
JP13	**JP13**	**JP15**	**JP16**	**JP17**	**Cache size**
15-17	Open	Open	1-2	Open	64K
	2-3	Open	2-3	Short	128K
	1-2	Short	1-2	Short	256K
JP18	1-2				Weitek Power 9000 VESA VGA card not installed
	2-3				Weitek Power 9000 VESA VGA card installed
JP19-21	**JP19**	**JP20**	**JP21**		**C6 coprocessor**
	1-2	2-3	2-3		Present
	2-3	1-2	1-2		Absent
JP23	1-2				CPU clock 50 MHz
	2-3				CPU clock <=40 MHz

UC 4980

Jumper	*Position*	*Function*
JP1	Open	Normal EPROM
	1-2	5v Flash ROM
	2-3	12v Flash ROM

Jumper	*Position*							*Function*
JP3	Open							External keyboard control
	Short							Internal keyboard control
JP4-6	**JP4**	**JP5**	**JP6**	**JP10**	**JP11**	**JP12**	**JP13**	**Cache size**
10-13	1-2	1-2	Open	Open	Open	Open	Open	128K (32Kx8x4)
	1-2	1-2	1-2	Open	Open	Open	Short	256K (64Kx8x4)
	2-3	2-3	Open	Open	Open	Open	Short	256K (32Kx8x8)
	2-3	2-3	2-3	Open	Short	Open	Short	512K (64Kx8x8)
	1-2	2-3	2-3	1-2	Short	Open	Short	512K (128x8x4)
	2-3	2-3	2-3	2-3	Short	Short	Short	1Mb (128Kx8x8)
JP7-9	**JP7**	**JP8**	**JP9**					**CPU speed**
	Short	Open	Open					25 MHz
	Short	Short	Short					33 MHz
	Short	Short	Open					40 MHz
	Open	Open	Short					50 MHz
JP14-19	**JP14**	**JP15**	**JP16**	**JP17**	**JP18**		**JP19**	**CPU Type**
	Open	2-3	Open	Open	2-3		Open	486SX/SX2
	Open	1-2,3-4	1-2	Open	2-3		Open	486DX/DX2
	1-2,3-4	2-3	Open	5-6	1-2		1-2	486SX/SX2 (SL)
	1-2,3-4	1-2,3-4	1-2	5-6	1-2		1-2	486DX/DX2 (SL)
	1-2,3-4	1-2,3-4	1-2	3-4,5-6	1-2,4-5		1-2,4-5	486DX2 (P24D) L1 wb
	2-3,4-5	2-3	Open	2-3,4-5	1-2,3-4,5-6	1-2,3-4,5-6		Cyrix 486S(M6)
	2-3	1-2,3-4	1-2	2-3,4-5	1-2,3-4,5-6	1-2,3-4		Cyrix 486DX/DX2
	Open	2-3	3-4	1-2	2-3		2-3	UMC U5-S Super
	Open	1-2,3-4	1-2,3-4	1-2	2-3		2-3	AMD DXL/DXL2
	1-2,3-4	1-2,3-4	1-2	5-6	1-2		1-2	Intel 486DX4
JP20-22	**JP20**	**JP21**	**JP22**					**CPU voltage**
	1-2	1-2	Open					5v
	2-3	2-3	1-2					3.45v
	2-3	2-3	2-3					3.3v
JP24	Open							DX4 internal clock x 3
	Short							DX4 internal clock x 2
JP25	Open							Local bus <=33 MHz
	Short							Local bus >33 MHz
JP26	Open							Local bus write 0 wait state
	Short							Local bus write 1 wait state

UM486V

Jumper	*Position*				*Function*
JP13	1-2				Mono display
	2-3				Colour
JP15	Short				VESA ID2 CPU speed > 33 MHz
	Open				VESA ID2 CPU speed <= 33 MHz
JP16	Short				VESA ID3 1 wait state write
	Open				VESA ID3 0 wait state write
JP18-21	**JP18**	**JP19**	**JP20**	**JP21**	**CPU clock**
	Short	Short	Open	Open	25 MHz
	Open	Short	Open	Open	33 MHz
	Open	Open	Open	Open	50 MHz
JP22,23	**JP22**	**JP23**	**JP27**	**JP28**	**Cache size**
27,28	1-2	Open	Open	1-2	64K
	2-3	Open	Short	2-3	128K
	1-2	Short	Short	2-3	256K

Jumper	*Position*		*Function*
JP24	Open		Enable 486SX PQFP setting
	Short		Disable
JP14-15	**JP25**	**JP26**	**CPU Type**
	1-2,3-4	1-2	80486DX (DX2)
	2-3	Open	80486SX
	1-2,3-4	2-3	80487SX (Overdrive)

UM 4980

Jumper	*Position*							*Function*
JP1	Open							Normal EPROM
	1-2							5v Flash ROM
	2-3							12v Flash ROM
JP3	Open							External keyboard control
	Short							Internal keyboard control
JP4-6	**JP4**	**JP5**	**JP6**	**JP10**	**JP11**	**JP12**	**JP13**	**Cache size**
10-13	1-2	1-2	Open	Open	Open	Open	Open	128K (32Kx8x4)
	1-2	1-2	1-2	Open	Open	Open	Short	256K (64Kx8x4)
	2-3	2-3	Open	Open	Open	Open	Short	256K (32Kx8x8)
	2-3	2-3	2-3	Open	Short	Open	Short	512K (64Kx8x8)
	1-2	2-3	2-3	1-2	Short	Open	Short	512K (128x8x4)
	2-3	2-3	2-3	2-3	Short	Short	Short	1Mb (128Kx8x8)
JP7-9	**JP7**	**JP8**	**JP9**					**CPU speed**
	Short	Open	Open					25 MHz
	Short	Short	Short					33 MHz
	Short	Short	Open					40 MHz
	Open	Open	Short					50 MHz
JP14-19	**JP14**	**JP15**	**JP16**	**JP17**	**JP18**		**JP19**	**CPU Type**
	Open	2-3	Open	Open	2-3		Open	486SX/SX2
	Open	1-2,3-4	1-2	Open	2-3		Open	486DX/DX2
	Open	1-2,3-4	1-2	Open	2-3		Open	AMD Am 486DX4
	1-2,3-4	2-3	Open	5-6	1-2		1-2	486SX/SX2 (SL)
	1-2,3-4	1-2,3-4	1-2	5-6	1-2		1-2	486DX/DX2 (SL)
	1-2,3-4	1-2,3-4	1-2	3-4,5-6	1-2,4-5		1-2,4-5	486DX2 (P24D) L1 wb
	2-3,4-5	2-3	Open	2-3,4-5	1-2,3-4,5-6	1-2,3-4,5-6		Cyrix 486S(M6)
	2-3	1-2,3-4	1-2	2-3,4-5	1-2,3-4,5-6	1-2,3-4		Cyrix 486DX/DX2
	Open	2-3	3-4	1-2	2-3		2-3	UMC U5-S Super
	1-2,3-4	1-2,3-4	1-2	5-6	1-2		1-2	Intel 486DX4
JP20-22	**JP20**	**JP21**	**JP22**					**CPU voltage**
	1-2	1-2	Open					5v
	2-3	2-3	1-2					3.45v
	2-3	2-3	2-3					3.3v
JP24	Open							DX4 internal clock x 3
	Short							DX4 internal clock x 2
JP25	Open							Local bus <=33 MHz
	Short							Local bus >33 MHz
JP26	Open							Local bus write 0 wait state
	Short							Local bus write 1 wait state

UM 4981

Jumper	*Position*				*Function*
JP2	Open				Normal EPROM
	1-2				5v Flash ROM
	2-3				12v Flash ROM
JP3	1-2				Enable onboard multi I/O
JP5-6	**JP5**	**JP6**			**ECP Mode**
	1-2	1-2			DRQ1, DACK1
	2-3	2-3			DRQ3, DACK3
JP8	Short				Enable parallel port ECP mode
	Open				Normal mode
JP9-11	**JP9**	**JP10**	**JP11**		**CPU clock**
	Open	Open	Short		25 MHz
	Short	Short	Short		33 MHz
	Open	Short	Short		40 MHz
	Short	Open	Open		50 MHz
JP22-25	**JP22**	**JP23**	**JP24**	**JP25**	**Cache size**
	2-3	Open	Open	Open	64K (8Kx8 – 2 banks)
	1-2	1-2	Open	Short	128K (32Kx8 – 1 bank)
	2-3	2-3	Short	Short	256K (32Kx8 – 2 banks)
JP26,40	**JP26**	**JP40**			**CPU Voltage**
	Short	Open			5v (from power supply)
	Open	1-2,3-4			3.3v (from 3.3v power supply)
	VR100	Open			Others
JP27	Open				VESA 0 wait state
	Short				VESA 1 wait state
JP28	Open				CPU speed <=33 MHz
	Short				CPU speed >33 MHz
JP29	Open				DX4 3x clock
	2-3				DX4 2x clock
JP36	1-2				Enable Primary/Secondary IDE
	2-3				Disable
JP37,38	**JP37**	**JP38**			**Hard Disk Timing**
	2-3	2-3			Active time 15T, Cycle time 30T, Spd 1, 40/50 Mb
	1-2	2-3			Active time 15T, Cycle time 19T, Spd 2, 25/33 Mb
	2-3	1-2			Active time 9T, Cycle time 13T, Spd 3, <20 Mb or EIDE
	1-2	1-2			Active time 18T, Cycle time 37T, Spd 0, <40 Mb/non-ATA
JP41	Open				AMD 486DX2/DX4 3x clock
	Short				AMD 486DX2/DX4 2x clock

CPU Type	JP25	JP31	JP32	JP35	JP36	JP37	JP38	JP45
486SX/SX2	Open	Open	2-3	Open	Open	2-3	Open	Open
486DX/DX2	Open	Open	2-3	Open	1-2	1-2,3-4	Open	Open
486DX/DX2 (SL)	1-2,3-4	5-6	1-2	1-2	Open	2-3	Open	Open
486SX/SX2(SL)	1-2,3-4	5-6	1-2	1-2	1-2	1-2,3-4	Open	Open
486DX2 (P34D)	1-2,3-4	3-4,5-6	1-2,4-5	1-2,4-5	1-2	1-2,3-4	Open	Open
P24T	1-2,3-4	5-6	1-2	1-2	2-3	1-2,3-4	Open	Open
Am486DX4	Open	1-2	2-3	2-3	1-2,3-4	1-2,3-4	Open	Open
Cx486S(M6)	2-3,4-5	2-3,4-5	1-2,3-4,5-6	1-2,3-4	Open	2-3	Open	Open
Cx486DX/DX2(M7)	2-3	2-3,4-5	1-2,3-4,5-6	1-2,3-4	1-2	1-2,3-4	Open	Open
UMC U5S-Super	2-3	4-5	2-3	3-4	Open	2-3	Open	Open

Case Connections – JP30

Turbo LED	2-3
SMI switch	4-5
Turbo switch	6-7
Reset switch	9-10
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

UM8810P AIO

Item	Description	Notes
Form Factor	¾ Baby AT	
CPU	486	Intel/Cyrix, including Pentium Overdrive
Speeds (MHz)		
Chipset		
BIOS	Green Phoenix	
Bus	3 PCI/4 ISA	
Memory (Mb)	2-128	Older versions 64 Mb, in 4 x 16 single-sided or 2 x 32 double-sided SIMMs
Cache (K)	512	
I/O	2S, 1P, IDE	CMD chipset for IDE, SMC chip for built-in ser/par and UMC 888X for PCI.
Problems		
Comments		Later versions have J41 removed for P24T PODP5V

Jumper	*Position*		*Function*
JP4,5	**JP4**	**JP5**	**Parallel Port PRQ & DACK**
	2-3	1-2	DRQ1, DACK1
	1-2	2-3	DRQ3, DACK3*
JP6	Open		System ROM is EPROM
	1-2		System ROM is 5v Flash ROM
	2-3		System ROM is 12v Flash ROM
JP8	1-2		Enable onboard multi I/O 37C665
	2-3		Disable
JP10	All shorted		5v CPU
	VR100/102 JP1 1-2		3.3
	VR100/102 JP1 3-4		3.45
	VR100/102 JP1 5-6		3.6
	VR100/102 JP1 7-8		4v CPU
JP12	Open		Enable onboard IDE
	Short		Controlled by BIOS*
JP17	1-2		25 Mhz host clock speed
	1-2,3-4,5-6		33 Mhz host clock speed
	1-2,3-4		40 Mhz host clock speed
	5-6		50 Mhz host clock speed
JP25	1-2		Am486 DX2/4 Nv8T 3x CPU clock*
	2-3		Am486 DX2/4 Nv8T 2x CPU clock
JP29	Open		i486DX4, AMD DX2/4 SV8B 3x CPU clock*
	Short		i486DX4, AMD DX2/4 SV8B 2x CPU clock
JP30	Open		Normal operation
	Short		Clear CMOS

Cache Size	JP13	JP14	JP16	JP33	JP35
128K (32Kx8)	-	1-2	2-3	-	-
256K (32Kx8)	-	2-3	1-2	-	Short
512K (64Kx8)	-	2-3	1-2	Short	Short
512K (128Kx8)	1-2	2-3	2-3	Short	Short

	i486DX/DX2 A486 DX/2/4 NV8T	i487SX ODP	i486SX	DX/2/4 (SL) ODPR	SX/2(SL)	DX2/4(SL) ADX2/4Sv8B Cx5x86 100/120
JP18	-	-	-	-	-	Short
JP19	-	-	-	-	-	-
JP20	1-2,3-4	1-2,3-4	2-3	1-2,3-4	2-3	1-2,3-4
JP21	1-2	2-2	-	1-2	-	1-2
JP22	-	-	-	1-2	1-2	1-2,3-4
JP23	-	-	-	-	-	-
JP24	1-2	1-2	1-2	2-3	2-3	2-3
JP25	-	-	1-2			-
JP27	-	-	-	2-3,4-5	2-3,4-5	2-3,4-5
JP28	-	-	-	-	-	-
JP36	-	-	-	1-2	1-2	1-2
JP37	1-2	1-2	1-2	1-2	1-2	1-2
JP38	1-2	1-2	1-2	1-2	1-2	1-2
JP44	-	-	-	-	-	-

	P24T	CxDX/2/4 M7	CxDX4 100GP4	Cx486S	U5SD	U5S
JP18	-	-	Short	-	-	-
JP19	-	Short	-	Short	-	-
JP20	1-2,3-4	1-2,3-4	1-2,3-4	2-3	1-2,3-4	2-3
JP21	2-3	1-2	1-2	-	1-2,3-4	1-2,3-4
JP22	1-2	2-3	1-2,3-4	2-3	-	-
JP23	1-2	2-3	-	2-3	-	-
JP24	2-3	2-3	2-3	2-3	1-2	1-2
JP25	-	1-2	1-2	-	-	-
JP27	2-3 4-5	1-2 3-4	2-3 4-5	1-2 3-4	-	-
JP28	1-2	2-3	-	2-3	3-4	3-4
JP36	1-2	1-2	1-1	1-2	2-3	2-3
JP37	1-2	1-2	1-2	1-2	2-3	2-3
JP38	1-2	2-3	2-3	2-3	1-2	1-2
JP44	-	-	-	-	-	-

Case Connections – J11

Turbo LED	2-3
SMI switch	4-5
Turbo switch	6-7
Reset switch	9-10
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

UP 8812 AIO

Jumper	*Position*			*Function*
JP1	Open			EPROM BIOS
	1-2			5v Flash ROM
	2-3			12v Flash ROM
JP3	1-2			Enable onboard multi I/O
	2-3			Disable
JP5	1-2			25 MHz CPU
	1-2,3-4,5-6			33 MHz CPU
	1-2,3-4			40 MHz CPU
	5-6			40 MHz CPU
				50 MHz CPU
JP21	Short			DX4 internal clock 2x
	Open			DX4 internal clock 3x
JP30	**JP30**	**JP32**	**JP33**	**CPU voltage**
32-33	Open	1-2	1-2	5v
	1-2	2-3	2-3	3.3v
	3-4	2-3	2-3	3.45v
	5-6	2-3	2-3	3.6v
	7-8	2-3	2-3	4v

L2 cache	JP6	JP7	JP8	JP14	JP19	JP24
128K (32Kx8 1 bank)	-	-	-	-	-	2-3
256K (32Kx8 2 bank)	Short	-	-	-	-	1-2
256K (64Kx8 1 bank)	Short	-	-	-	1-2	2-3
512K (64Kx8 2 bank)	Short	Short	-	-	2-3	1-2
512K (128Kx8 1 bank)	Short	Short	-	1-2	1-2	2-3
1 Mb (128Kx8 2 bank)	Short	Short	Short	2-3	2-3	1-2

	i486DX/DX2 A486 DX/2/4 NV8T	DX/2/4 (SL) ODPR	i486SX (PGA)	i486SX (SL)	PD5v (P24T)	Cx486S (M6)	CxDX/2/4 M7	DX2/4(SL) ADX2/4Sv8B C5x86 100/120
JP9	Open	2-3	Open	Open	Open	Open	Open	1-2
JP10	Open	Open	Open	Open	Open	Open	Open	Open
JP12	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2
JP13	1-2	1-2	1-2	1-2	1-2	2-3	2-3	1-2
JP15	Open	Open	Open	Open	1-2	2-3	2-3	Open
JP16	Open	Open	Open	Open	Open	2-3	2-3	Open
JP17	Open	1-2	Open	1-2	1-2	1-2	1-2	1-2
JP18	1-2	2-3	1-2	2-3	1-2	2-3	2-3	2-3
JP21	Open	Open	Open	Open	Open	Open	Open	Open*
JP23	Open	Open	Open	Open	Short	Open	Open	Open
JP25	Open	1-2	Open	1-2	1-2	2-3	2-3	1-2,3-4
JP26	1-2	1-2	Open	Open	2-3	Open	1-2	1-2
JP27	Open	Open	Open	Open	1-2	2-3	2-3	Open
JP28	1-2,3-4	1-2,3-4	2-3	2-3	1-2,3-4	2-3	1-2,3-4	1-2,3-4
JP29	Open	2-3,4-5	Open	2-3,4-5	2-3,4-5	1-2,3-4	1-2,3-4	2-3,4-5

*Short for AMD Am5x86-P75

Case Connections – J31

Turbo LED	2-3
SMI switch	4-5
Turbo switch	6-7
Reset switch	9-10
Power LED	11-13
Keyboard lock	14-15
Speaker	17-20

US 3486

Jumper	*Position*		*Function*						
J3	1-2		Colour display						
	2-3		Mono						
JP1	1-2		386 CPU						
	2-3		486 CPU						
JP2	Short		80387 installed						
	Open		Not installed						
W12-13	**W12**	**W13**	**CPU Type**						
	1-2,3-4	1-2	80486DX (DX2)						
	2-3	Open	80486SX						
	1-2,3-4	2-3	80487SX (Overdrive)						
	-	-	386						
W2-9	**Cache size**		**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**W8**	**W9**
	64K		Open	Open	Open	Open	1-2	Open	1-2	1-2
	128K		Open	Open	Short	Short	2-3	1-2	2-3	1-2
	256K		Short	Short	Short	Short	1-2	2-3	2-3	2-3

VESA 486

Jumper	*Position*				*Function*
JP1	1-2				Mono display
	2-3				Colour
JP4-7	**JP4**	**JP5**	**JP6**	**JP7**	**CPU clock**
	Short	Short	Open	Open	25 MHz
	Short	Open	Open	Open	33 MHz
	Open	Open	Open	Open	50 MHz
JP8-11	**JP8**	**JP9**	**JP10**	**JP11**	**Cache size**
	Open	Open	1-2	1-2	64K
	Short	Open	2-3	2-3	128K
	Short	Short	2-3	1-2	256K
JP12-13	**JP12**	**JP13**			**VESA ID Selection**
	Open	Open			0 wait write
	Closed	Closed			1 wait write
JP14-15	**JP14**	**JP15**			**CPU Type**
	1-2,3-4	1-2			80486DX (DX2)
	2-3	Open			80486SX
	1-2,3-4	2-3			80487SX (Overdrive)

VL 486

As for VESA 486

Edom International

www.edom.com

EFA

(408) 987 5400
www.efacorp.com
www.efa.com.tw

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0-00	4DMS-HL3G	AC	P5TVX-AT/P5V580-AT-C
1-00	486 VIP	CC	P55T2PIO-B ver 2.07
1C-00	P54NPCI or P5/MP4	HC	P55T-PIO-B
9	P5V580-AT-3		

EFAR

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1-0B	EF 9417		

Elite Group

See ECS

Elonex

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
U	W14		

88C

Jumper	*Position*	*Function*
J2	In	Enable NMIs
	Out	Disable NMIs
J3	1-2	Enable IRQ3
	2-3	Enable IRQ4
J4	In	Enable reset
	Out	Disable reset
J7	1-2	Enable COM2 2F8-2FF
	2-3	Enable COM1 3F8-3FF
J8	1-2	Real clock time H240
	2-3	Real clock time H340
J10	1-2	Floppy A=720K, B=360K
	2-3	Floppy A=360K, B=720K
	All out	Floppy A=360K, B=360K
	All in	Floppy A=720K, B=720K
J11	None	2764 8K ROM
	1-2,3-4	27512 64K ROM
	3-4	27128 16K ROM
SW1	1-2,7-8	Mono display
	1-2,3-4,7-8	80x25 colour display
	1-2,5-6,7-8	40x25 colour display
	1-2,3-4,5-6,7-8	EGA

88C

Jumper	*Position*		*Function*
J2	In		FDD secondary address 370-377h
	Out*		FDD primary address 3F0-3F7h
J3	In		Enable floppy controller card
	Out		Disable
J4	**A**	**B**	**Floppy settings**
	1-2	1-2	A=360K, B=360K
	1-2	3-4	A=720K, B=720K
	All out		A=1.2 Mb, B=1.2 Mb
	All in		A=1.44 Mb, B=1.44 Mb
J7			Reserved
J8	1-2		HD address 324h
	2-3*		HD address 320h
J9	1-2		HD firmware address CA00h
	2-3*		HD firmware address C800h
J10	1-2		Onboard HD IRQ2
	2-3*		Onboard HD IRQ5
J12	1-2		Enable COM2
	2-3*		Enable COM1
	All out		Disable
J13	1-2		RTC address 240-25Fh
	2-3*		RTC address 340-35Fh
J17	None*		27128 ROM
	1-2		27256 ROM
	1-2,3-4		27512 ROM
J18	In*		Enable game port

Jumper	*Position*		*Function*
J19	1-2*		LPT IRQ7
	2-3		LPT IRQ5
J20	1-2		Serial IRQ3
	2-3*		Serial IRQ4
J21,23	**J21**	**J23**	**Monitor type**
	Out	Out	Mono 80x25
	Out	In	Colour 40x25
	1-2	1-2	Plug in EGA/VGA
J23			Front panel LED
J27	None		Disable parallel port
	B*		Parallel port I/O 3BC-3BFh
	A,B		Parallel port I/O 378-37Fh
J28	Out		Mono display
	In		Colour display

88S

Switch	*Position*		*Function*
S1			Reserved
S2	On*		Maths copro not installed
	Off		8087-1 installed
S3			Reserved
S4			Reserved
S5,6	**S5**	**S6**	**Monitor type**
	On	On	Unused
	Off	On	40x25 colour
	On	Off	80x25 colour
	Off	Off	80x25 Mono
S7,8	**S7**	**S8**	**Floppies**
	On	On	1 fitted
	Off	On	2 fitted
	On	Off	3 fitted
	Off	Off	4 fitted

286C-12

Jumper	*Position*	*Function*
J1	4	Disable COM1
	3	Disable LPT1
	2	Disable COM2
	1	Disable LPT2
J4	Out	System clock divided by 2 for slower I/O
	In	I/O frequency synchronised with system clock
J5	1-2	Clock input used directly
	2-3	80287 divides clock input by 3
J6	2-3	80287 synchronised to CPU
	1-2	80287 synchronised to oscillator
J12		Reserved
J15	1-2	0 wait state
	2-3	1 wait state
J18	1-2	27256 EPROM
	2-3	27128 EPROM

Jumper	*Position*			*Function*
SW1	**S1**	**S2**	**S3**	**Memory (chips)**
S1-3	On			256K or less
	Off			1 Mb
	On	On	On	256K (4 rows of 64K)
	On	On	Off	512K (2 rows of 256K)
	On	Off	On	640K (2 rows of 64K, 2 rows of 256K)
	On	Off	Off	1 Mb (4 rows of 256K)
	Off	On	On	2 Mb (2 rows of 1 Mb)
	Off	On	Off	640K (2 rows of 1 Mb)
	Off	Off	On	2 Mb (2 rows of 1 Mb)
	Off	Off	Off	4 Mb (4 rows of 1 Mb)
SW1	On			Colour monitor
S4	Off			Mono monitor

286C-100

Jumper	*Position*	*Function*
J5	1-2	COM2 IRQ4
J7	1-2	COM1 IRQ3
J8	1-2	COM2 IRQ3
J11	2-3	Mono display
	1-2	CGA, EGA display
J14	In	Enable COM1
	Out	Disable COM1
J15	In	Enable COM2
	Out	Disable COM2
J16	1-2	COM1 IRQ4
J17	1-2	80287 clock direct
	2-3	80287 divide by 3
J22	In	Base memory 512/640K
	Out	Base memory 512K/1 Mb
J23	1-2	80287 clock from system
	2-3	80287 clock from 8234
J24	In	32K BIOS (27256)
	Out	16 K BIOS (27128)
J25	In	0 wait state
	Out	1 wait state

286m

Jumper	*Position*	*Function*
J1	1-10	Disable floppy
	2-9	Disable HD
	4-7	Disable LPT1
	3-8	Disable COM2
	5-6	Disable COM1
J5	1-2	Other BIOS
	2-3	Phoenix BIOS
J6	In	Same DRAM in memory banks
	Out	Different DRAM
J7	1-2*	Quiet bus enabled
	2-3	Disabled

Jumper	*Position*			*Function*				
J11	1-2			27256 EPROM (32K)				
	2-3			27128 EPROM (16K)				
J14	1-2			EGA monitor with digital output				
	2-3			Colour or Mono with digital output				
J16	In			Enable Onboard display				
	Out			Disable Onboard display				
J17	2-3			80287-8 24M				
	1-2			80287-10 24M				
	1-2			80287-6 24M(20M)				
J18	1-2			No oscillator				
	2-3			10 MHz				
	2-3			6 MHz				
J20	Out			Maths copro installed				
J27	Out			Enable VGA IRQ9				
SW1	**S1**	**S2**	**S3**	**Memory Size**				
S1-3	Off	Off	Off	512K (256K*2)				
	Off	Off	On	640K (256K*2+64K*2)				
	Off	On	Off	1 Mb (256K*4)				
	On	Off	Off	2 Mb (1Mb*2)				
	On	On	Off	4 Mb (1Mb*4)				
SW1	On			Enable external colour display				
S4	Off			Enable external Mono display				
SW2	**Display Type**			**S1**	**S2**	**S3**	**S4**	**S5**
S1-6	VGA			On				
	CGA 40x25			Off	On	Off	Off	On
	CGA 80x25			Off	On	Off	Off	Off
	EGA 200 line			Off	Off	On	On	On
	EGA 350 line			Off	Off	On	On	Off
	MGA			Off	Off	On	Off	On
	MGA			Off	Off	On	Off	Off

286M-10TTL

Jumper	*Position*			*Function*
J1	All out			Floppy primary address
	3-14			Floppy secondary address
	4-13			Disable COM1
	5-12			Disable LPT2
	6-11			Disable COM1 (2?)
	1-16 & 2-15			Enable Onboard display
J6	1-2			80287 clock input used directly
	2-3			80287 clock input divided by 3
J7	1-2			80287 clock from system
	2-3			80287 clock from 8234
J28	1-2			27256 EPROM (32K)
	2-3			27128 EPROM (16K)
SW1	On			CPU speed ¼ of CLK 2
S1	Off			CPU speed ½ of CLK 2
SW1	On			I/O half speed
S2	Off			I/O full speed
SW1	**S3**	**S4**	**S5**	**Base Memory**
S3-5	On	On	On	256K

Jumper	*Position*			*Function*
	Off	On	On	512K
	On	Off	On	640K
	Off	Off	On	640+384K
SW1	On			Onboard colour display
S6	Off			Onboard Mono display

286M-12TTL

Jumper	*Position*			*Function*
J1	2-15 In			Enable Onboard display
	5-12 In			Disable LPT1
	6-11 In			Disable COM1
	3-14 In			Out- floppy primary address In - secondary
	4-13 In			Disable COM2
J6	1-2			80287 clock input used directly
	2-3			80287 clock input divided by 3
J7	1-2			80287 clock from system
	2-3			80287 clock from 8234
J14	1-2			0 wait state
	2-3			1 wait state
J20	1-2			80 ns DRAM
	2-3			100 ns DRAM
J28	1-2			27256 EPROM (32K)
	2-3			27128 EPROM (16K)
SW1	On			¼ of CLK*2 (low)
S1	Off			½ of CLK*2 (high)
SW1	On			I/O half speed
S2	Off			I/O full speed
SW1	**S3**	**S4**	**S5**	**Memory Size**
S3-5	Off	On	On	512K
	On	Off	On	640K
	Off	Off	On	1 Mb
	On	On	Off	2 Mb
	Off	On	Off	2 Mb
	On	Off	Off	2 Mb
	Off	Off	Off	4 Mb
SW1	On			Colour display
S6	Off			Mono display

286S-10

Switch	*Position*		*Function*				
SW1	**S1**	**S2**	**Memory**	**Bank 0**	**Bank 1**	**RAM**	
S1-2	On	On	256K		64-12	64-12	0-256K
	On	Off	640K		256-12	256-12	0-640K
	Off	On	512K		256-12	None	0-512K
	Off	Off	1 Mb		256-12	256-12	0-512K 1-1.5 Mb
SW1	On		Colour display				
S3	Off		Mono display				
SW1	On		16Kx2 BIOS				
S4	Off		32Kx2 BIOS				

286S-12

Switch	*Position*		*Function*
SW1	**S1**	**S2**	**CPU Speed**
S1-2	Off	Off	High (12/10 MHz) with I/O low (6/5 MHz)
	Off	On	High, with I/O High
	On		Low, with I/O low
SW1	**S3**	**S4**	**Memory**
S3-4	On	On	256K
	Off	On	512K
	On	Off	640K
	Off	Off	640K
W2	1-2		12 MHz 0 wait state (80 ns DRAM)
	2-3		12 MHz 1 wait state (100 ns DRAM)
W4	1-2		12 MHz
W6	1-2		16Kx2 BIOS (27128)
	2-3		32Kx2 BIOS (27256)
W7	Out		Mono display
	In		Colour display

286S-120

Switch	*Position*		*Function*
J4,5	**J4**	**J5**	**Wait state**
	Out	Out	0 wait state (fixed)
	In	Out	1 wait state (fixed)
	Out	In	0 or 1 (controlled by software)
J11,3	**J11**	**J3**	**Maths copro speed**
	1-2	1-2	12 MHz
	2-3	5-6	10 MHz
	2-3	3-4	8 MHz
	2-3	7-8	4.77 or 6 MHz
SW1	**S1**	**S2**	**EPROM size**
S1-2	On	On	32Kx2 (U51,52) or 32Kx2 and 32Kx3 (U53,54)
	Off	Off	16Kx2 (U51,52) or 16Kx2 and BASIC ROM (U53,54)
S3	On		1 Mb address 00000-9FFFF, 100000-15FFFF
	Off		512K at 00000-7FFFF or 1 Mb 00000-7FFFF, 100000-17FFFF
S4	Off		Mono display
	On		Colour display

386B-25/33

Jumper	*Position*			*Function*
J1-3	**J1**	**J2**	**J3**	**Cache board**
	Out	Out	Out	Disabled
	1-2	1-2	Out	32K cache card
	2-3	2-3	In	64K cache card
J6	In*			Onboard battery
	Out			External battery
J9	1-2			64K EPROM
	2-3			32K EPROM
J10	1-2			Non-pipeline mode
	2-3			Pipeline mode

Jumper	*Position*	*Function*
J12	In*	Colour display
	Out	Mono display
J15	1-2	Maths copro installed

386S

Jumper	*Position*	*Function*
J2	In*	Colour display
	Out	Mono display
J3	1-2 In	Enable 80387
	1-2 Out*	Disable

386s-16

Jumper	*Position*			*Function*
J1	1-2			Enable COM2 (2F8-2FF)
	2-3			Disable
J2	1-2			Enable COM1 (3F8-3FF)
	2-3			Disable
JP22				Reserved
JP23				Reserved
JP25				Reserved
JP26				Reserved
J28				Display type
J29,30	**J29**	**J30**		**EPROM**
	1-2	2-3		16Kx2=32K
	2-3	2-3		32Kx2=64K
	2-3	1-2		64Kx2=128K
J32-34	**J32**	**J33**	**J34**	**Maths coprocessor**
	Out	Out	In	Not installed
	1-2	Out	Out	80287
	1-2	In	Out	80387

386s-20

Jumper	*Position*		*Function*
J1	In		Old 80386
	Out		New 80386
J3			Maths copro
J11			Reserved
J16	Out		Mono display
	In		Colour
J19	1-2		CPU speed software changeable
	2-3		Low speed
	All out*		High speed
J20	1-2		Asynchronous reset
	2-3		Synchronous reset only
J21-22	**J21**	**J22**	**Maths coprocessor**
	In	In	80387 installed
	Out	Out	Not installed

386sx

Jumper	*Position*		*Function*
JP1			Reserved
JP2	In*		Keyboard controller pins 23&24 compatible with Phoenix 8242.
J2	1-2		27512K EPROM
	2-3*		27256K EPROM
J3	1-2		0E0000-0FFFFFh & FE0000-FFFFFFh (27512)
	2-3*		0F0000-0FFFFFh & FF0000-FFFFFFh (27256)
S1	Off		Mono & Hercules mode
	On		Colour (EGA & VGA)
S2	Off		80387sx installed
	On		Not installed
S3,4	**S3**	**S4**	**DRAM Type**
	Off*	Off*	100ns FPM (interleave enabled)
	On	Off	100ns FPM (interleave disabled)
	Off	On	Normal 100 ns
	Off	Off	120 ns (1 wait state)

386SXB-16

Processor board

Jumper	*Position*		*Function*
J1			Reserved
JP2	In*		Keyboard controller pins 23&24 compatible with Phoenix 8242.
J2	1-2		27512K EPROM
	2-3*		27256K EPROM
J3	1-2		0E0000-0FFFFFh & FE0000-FFFFFFh (27512)
	2-3*		0F0000-0FFFFFh & FF0000-FFFFFFh (27256)
S1	Off		Mono & Hercules mode
	On		Colour (EGA & VGA)
S2	Off		80387sx installed
S3,4	**S3**	**S4**	**DRAM Type**
	Off*	Off*	100ns FPM (interleave enabled)
	Off	Off	120 ns (1 wait state)

386SXM-16

Jumper	*Position*	*Function*
JP1	1-14	Disable floppy
	4-11	Disable COM2
	5-10	Disable LPT1
	6-9	Disable COM1
	7-8	Disable HD
JP5	1-2	EGA digital output
	2-3	Colour or Mono with digital output
JP7	In	Enable VGA IRQ9
JP8	In*	Enable VGA
JP9	In*	16-bit VGA
	Out	8-bit VGA
JP15	1-2*	27256 EPROM
	2-3	27512 EPROM

Switch 1

	S1	S2	S3	S4	S5
VGA	On	-	-	-	-
CGA 40x25	Off	On	Off	Off	On
CGA 80x25	Off	On	Off	Off	Off
EGA 200 line	Off	Off	On	On	On
VGA 350 line	Off	Off	On	On	Off
MGA	Off	Off	On	Off	On
MGA	Off	Off	On	Off	-
Reserved	On	On	Off	Off	-
Reserved	Off	On	Off	Off	-
Reserved	On	Off	Off	Off	-
Reserved	Off	Off	Off	Off	-

Switch 2

Switch	*Position*		*Function*
S1	On*		EGA/VGA
	Off		Mono
S2			Reserved
S3	On		256K/1Mb DRAMs
	Off*		Either type
S4	On		Enables 384K
	Off*		Disables 384K
S5	On		1 Mb DRAMs used
	Off*		256K DRAMs used
S6,7	**S6**	**S7**	**Memory banks used**
	Off*	Off*	1
	On	Off	2
	Off	On	3
	On	On	4
S8	On		Enable maths coprocessor

LT386SX/P

Jumper	*Position*		*Function*
J7			Enable floppy
J8,9			System operation
J10			Maths coprocessor
JP1	In*		Keyboard controller pins 23&24 compatible with Phoenix 8242.
JP2	Out*		Reserved
JP3	1-2		Display I/O decoder address is 2FXh
	2-3*		Display I/O decoder address is 3FXh
JP5,6	**JP5**	**JP6**	**EPROM size**
	2-3*	2-3*	27256K
	1-2	1-2	27512K
JP7	Out*		Enable floppy
JP8,9	**JP8**	**JP9**	**DRAM access time**
	1-2	1-2	120 ns (1 wait state)
	Out*	Out*	100 ns FPM, interleave enabled)
J10	Out		80387SX installed

Switch 1

Switch	Position			Function
S1	On*			PS/2 monitor or compatible
	Off			Analogue multi-frequency
S2-4	**S2**	**S3**	**S4**	
	On	On	On	Automatic configuration
	On	Off	On	MGA-locked
	Off	On	On	CGA-locked
	Off	Off	On	EGA-locked
	On	On	Off	VGA-locked

Switch 2

Switch	Position			Function
S1-3	S1	S2	S3	
	On	On	Off	PS/2 monitor or compatible
	On	On	Off	Analogue multi-frequency
S4	Off			Timing registers write-protected
	On			Not write-protected

PCSX20C

Jumper	Position	Function
J4	Out	Reserved
J5	Out	Reserved
J6	Out	Colour VGA
	In	Mono VGA
J7	Out	Non-interlaced monitor
	In	Interlaced
J9	1-2	Enable VGA
J11	2-3	Drain CMOS
	2-3*	Retain CMOS
	Out	Disconnect battery
J12,17	1-2	16K cache
	2-3	64K cache

386V-33E

Jumper	Position		Function
JP1	Out*		AT-compatible mouse interrupt
	In		PS/2 mouse interrupt
JP2	Out		Enable 80387
	In*		Disable
JP3	Out*		Synchronise copro with CPU
	In		Asynchronous
JP5,6	**JP5**	**JP6**	**Keyboard type**
	1-2	1-2	PS/2
	2-3*	2-3*	AT-compatible
SW1-4	On*		Mono or Hercules display
	Off		CGE, EGA or VGA

386SXB/486B

Switch 1

Switch	*Position*		*Function*
S1-2	**S1**	**S2**	**Onboard VGA**
	On*	On*	VGA
	On	Off	EGA
	Off	On	CGA
	On	On	MDA
S3	Off		Monitor scan rate 48-49KHz
	On*		Monitor scan rate less than 48KHz
S4			Reserved
S5	Off		Slow address decode
	On*		Fast address decode
S6	On		8-bit ROM data width
	Off*		16-bit ROM data width

Jumper	*Position*			*Function*
J1				Connection for KB1 keyboard connector on CPU card
J3	1-2			Enable or disable hardware with indivisual jumper settings
	2-3			Automatic configuration with port address 3F3h
J4,7	**J4**	**J7**		**Parallel port**
	2-3	2-3		LPT2 (378)
	2-3	1-2		LPT1 (3BC)
	1-2	2-3		LPT3 (278)
	1-2	1-2		Disable
J5,8,10	**J5**	**J8**	**J10**	**Serial ports**
	2-3	2-3	2-3	COM1=UART1, COM2=UART2
	1-2	2-3	2-3	Disable COM1, COM2=UART2
	2-3	1-2	2-3	COM1=UART1, Disable COM2
	1-2	1-2	Out	Disable both
	2-3	2-3	1-2	COM2=UART1, COM1=UART2
	1-2	2-3	1-2	Disable COM2, COM1=UART2
	2-3	1-2	1-2	COM2=UART1, Disable COM1
J6	2-3			Enable floppy
J9	2-3			2 floppies
	1-2			Reserved
J12	2-3			Enable hard disk
	1-2			Disable Hard Disk
J17,18	**J17**	**J18**		**Video memory**
	2-3	1-2		44256x2
	1-2*	2-3*		44256x4
	2-3	2-3		44256x8
J19,23	**J19**	**J23**		**Onboard VGA**
	1-2	Out		Disable VGA
	2-3	1-2		Enable VGA
J20	In*			44256x4 or 44256x2
J21	Out			44256x8
J22	1-2*			Enable VGA IRQ9

Elpina

Ability Electron Co
www.ability-tw.com
see Amptron

ENPC

www.enpc.com.tw
www.enpcusa.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C-00	EP PT11	HC-00	EP PT11
BC	KL-21		

EPoX

Formerly Soltek
www.epox.com
See also Pronix

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	PP6-NF/NB	AC	P55-TH/P54C-SP
9C	P55-IT	AC-00	P55TX2/BT/KV/VP
9C-00	P55TV/TX/VX/VP	CC-00	P55TV2
9C-00	EP 58MVP3C-m	EC	KP6-FX/FX2
0C-00	P55-TF	HC	P55-IT
1C-00	P55-IT	IC	P55-IT
1-00/02	P54C-SP	JC	P55-IT
3C	P55-SA	KC	P55-IT
4C-00	GXA 486SPM	LC	P55-IT UMC I/O
AC	KP6-LA/PP6-NS (PPro)	MC	P55-IT Winbond I/O

EP-3WXA4

Item	Description	Notes
Form Factor	ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		

Item	Description	Notes
Chipset	Intel 810	
BIOS		
Bus	5 PCI	UDMA/66
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	2 EIDE, floppy	
Video		
Performance		
Comments		

EP-6CXA2C

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III/Celeron	Slot 1
Speeds (MHz)		
Chipset	820	
BIOS	Award 4.51PG	
Bus	5 PCI/1 ISA	UDMA/66 66-133
Memory (Mb)	1024 Mb	2 RIMM sockets
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video	AGP	
Comments		CMI8738 sound. Good performance

EP-6VBA

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III/Celeron	Slot 1
Speeds (MHz)	550	
Chipset	Via Apollo Pro Plus	
BIOS	Award 4.51PG	
Bus	5 PCI/1 ISA	UDMA/66
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video		AGP
Comments		2 year warranty

EP-GXB-M

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Xeon	SMP Slot 2
Cache		
Chipset	Intel 440GX	
Bus	5 PCI/2 ISA	
Memory (Mb)	2 Gb	4 DIMM sockets
I/O	2 EIDE, floppy USB, IR	
Video		AGP 2x

EP-MVP3G2

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium/K6	Super Socket 7
Cache	1 Mb	
Chipset	Via MVP3	
BIOS		
Bus	5 PCI/2 ISA	UDMA/66
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2 EIDE, floppy USB, IR	
Video		AGP 2x
Performance		
Comments		

P2-112A

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III/Celeron	Slot 1
Speeds (MHz)	550/366	
Chipset	Via Apollo Pro	
BIOS	Award 4.51PG	
Bus	5 PCI/2 ISA	124 MHz
Memory (Mb)	384 Mb	3 DIMM sockets
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video		AGP
Performance		Similar to Soyo SY-6BA+

P55-TH

Same as Astar P55-TH

P55-VP

Same as California Graphics Sunray VIA

Epson UK

AX Portable

Jumper	*Position*		*Function*
J1,2	**J1**	**J2**	
	A	A	Reserved
	A	B	128K ROMs
	B	A	512K ROMs
	B	B	256K ROMs

Jumper	*Position*		*Function*
J3,4	**J3**	**J4**	
	A	A	640K base memory
	A	B	Reserved
	B	A	512K base memory
	B	B	256K base memory
J5	A		1 ROM wait state inserted
	B		2 ROM wait states inserted
J6,7	**J6**	**J7**	
	A	A	1 16-bit ext RAM wait state inserted
	A	B	2 16-bit ext RAM wait states inserted
	B	A	3 16-bit ext RAM wait states inserted
	B	B	4 16-bit ext RAM wait states inserted
J8,9	**J8**	**J9**	
	A	A	8 MHz 80287
	A	B	Reserved
	B	A	Reserved
	B	B	Reserved
J10	In		USA character set
	Out		Danish character set
S1,2	**S1**	**S2**	
	Off*	Off*	No expansion RAM
	Off	On	Reserved
	On	Off	2 Mb expansion RAM
	On	On	4 Mb expansion RAM

Switch 1

Switch	*Position*	*Function*
S1	Off	Normal LCD
	On	Reverse video LCD
S2	On	LCD greyscale switch 1
S3	On	LCD greyscale switch 2
S4	On	LCD display
	Off	CRT display

Switch 2

Switch	*Position*	*Function*
S1	On	External floppy select
	Off	Parallel printer port select
S2	On	External floppy = A
	Off	External floppy = B
S3	On	Enable COM2
	Off	Enable COM1
S4	On	Double-width LCD fOnt
	Off	Normal width LCD fOnt
S5	On	Enable internal video
S6	On	Add-in video is colour
	Off	Add-in video is Mono

PC AX

Jumper	*Position*		*Function*
J1	A-C*		CPU clock 6/8/10
	B-C		Inhibit
J2,3	**J2**	**J3**	
	A-C*	A-C	Reserved
	B-C	A-C	CPU clock as NPX clock (1/3)
	A-C	B-C*	8 MHz AS npx CLOCK
	B-C	B-C	Reserved
J4	A-C*		2 wait cycles for EPROM access at 10 MHz
	B-C		1 wait cycles for EPROM access at 10 MHz
J5,6	**J5**	**J6**	**Device access**
	A-C*	A-C*	4 wait cycles for ext 16-bit device access at 10 MHz
	B-C	A-C	3 wait cycles for ext 16-bit device access at 10 MHz
	A-C	B-C	2 wait cycles for ext 16-bit device access at 10 MHz
	B-C	B-C	1 wait cycle for ext 16-bit device access at 10 MHz

PC AX2

Jumper	*Position*		*Function*
J1	A		1 wait cycle for EPROM access
	B		2 wait cycles for EPROM access
J2,3	**J2**	**J3**	**Device access**
	B	B	4 wait cycles for ext 16-bit expansion bus DRAM
	A	B	3 wait cycles for ext 16-bit expansion bus DRAM
	B	A	2 wait cycles for ext 16-bit expansion bus DRAM
	A	A	1 wait cycle for ext 16-bit expansion bus DRAM
J4,5	**J4**	**J5**	
	A	A	NPX clock speed=8 MHz
	A	B	Reserved
	B	A	Reserved
	B	B	NPX clock=2/3 CPU speed

PC AX3-25

Jumper	*Position*		*Function*
J1	1-2		Enable HD
J3,10	**J3**	**J10**	**System clock speed**
	1-2*	1-2*	25 MHz
	2-3	2-3	24 MHz
J5	1-2		512K (Dip sw 8 must be Off)
	2-3		256K (Dip sw 8 must be On)
J6	1-2*		CPU reset time 16CLK2
	2-3		CPU reset time 256CLK2
J7	1-2		82385 reset time as CPU (J6=1-2)
	2-3*		82385 reset time as system reset
J8	1-2		IRQ 12 to mouse
	2-3		IRQ 12 available to system bus
J9	1-2*		Enable password
	2-3		Disable (reset)

Switches

Switch	*Position*					*Function*				
S1,2	**S1**	**S2**				**Base memory**				
	Off	Off				256K				
	On	Off				512K				
	On*	On*				640K				
S3-7	**S3**	**S4**	**S5**	**S6**	**S7**	**Bk3**	**Bk2**	**Bk1**	**Bk0**	**Total**
	Off			Off	Off				1Mb	1Mb
	On			Off	Off			1Mb	1Mb	2Mb
	On	Off	Off	On	Off		1Mb	1Mb	1Mb	3Mb
	On	Off	On	On	Off	1Mb	1Mb	1Mb	1Mb	4Mb
	Off			Off	On				4Mb	4Mb
	On	On	Off	On	Off		4Mb	1Mb	1Mb	6Mb
	On			Off	On			4Mb	4Mb	8Mb
	On	Off	Off	On	On		1Mb	4Mb	4Mb	9Mb
	On	Off	On	On	On	1Mb	1Mb	4Mb	4Mb	10Mb
	On	On	On	On	Off	4Mb	4Mb	1Mb	1Mb	10Mb
	On	On	Off	On	On		4Mb	4Mb	4Mb	12Mb
	On	On	On	On	On	4Mb	4Mb	4Mb	4Mb	16Mb
S8	Off					512K ROM				
	On					256K ROM				
S9	On					80ns DRAM, 4 wait states				
	Off					100ns DRAM, 5 wait states				
S10	Off					CGA monitor				
	On					Mono monitor				

PC Portable

Front Panel Switches

Switch	*Position*		*Function*
S1	On		Normal LCD
	Off		Reverse LCD
S2,3	**S2**	**S3**	**LCD Screen Mode**
	On	On	0
	Off	On	1
	On	Off	2
	Off	Off	3
S4	On		LCD
	Off		External CRT

Rear Panel Switches

Switch	*Position*	*Function*
S1	On	External floppy
	Off	Parallel printer
S2	On	External floppy is B
	Off	External floppy is A
S3	On	1 floppy
	Off	2 floppies
S4	On	Serial port is secondary (378-3FFh)

Switch	Position	Function
	Off	Serial port is primary (2F8-2FFh)

Jumpers

Jumper	Position		Function
J1	**SHB**	**SHA**	**RAM Speed**
	L	L	125ns
	L	H	250ns
	H	L	375ns
	H	H	500ns
J2	A		64/128K System ROM
	B		256K System ROM
J3	**HSPD**	**WSO**	
	Out	*	0 wait states
	In	In	0 wait states
	In	Out	1 wait state
J4	**-V**	**EQ1**	**CPU select**
	In	In	8088
	In	Out	8086
	Out	In	V20
	Out	Out	V30
J5	A		Floppy LED installed
	B		HD installed

PC

Switch	Position					Function
J1	In					8087 installed
J2,3						Reserved
SW1	**S1**	**S2**	**S3**	**S4**	**S5**	**Total**
S1-5	On	Off	Off	Off	Off	256K
	Off	Off	Off	On	On	288K
	On	On	On	Off	On	320K
	Off	On	On	Off	On	352K
	On	Off	On	Off	On	384K
	Off	Off	On	Off	On	416K
	On	On	Off	Off	On	448K
	Off	On	Off	Off	On	480K
	On	Off	Off	Off	On	512K
	Off	Off	Off	Off	On	554K
	On	On	On	On	Off	576K
	Off	On	On	On	Off	608K
	On	Off	On	On	Off	640K
S6,7	**S6**	**S7**				**Display type**
	Off	Off				Mono
	On	Off				Colour 80x25
	Off	On				Colour 40x25
	On	On				Reserved
S8	On					1 floppy
	Off					2 floppies
S9	Off					Disable serial port
S10	Off					Serial port on RS232 card

PC+

Switch 1

Switch	Position		Function
S1	On		A=360K
	Off		A=1.2Mb
S2	Off		Maths copro installed
	On		Not installed
S3			Reserved
S4	Off		Parallel is primary
	On		Parallel is secondary
S5,6	**S5**	**S6**	**Display type**
	On	On	Internal video disabled
	Off	On	Colour mode 40x25
	On	Off	Colur mode 80x25
	Off	Off	Mono
S7,8	**S7**	**S8**	**Floppies**
	On	On	1
	Off	On	2

Switch 2

Switch	Position		Function
S1			Reserved
S2			Reserved
S3			Reserved
S4			Reserved
S5	Off		Enable parity checking
	On		Disable parity checking
S6			Reserved
S7	Off		Primary internal serial interface
	On		Secondary internal serial interface
S8	Off		Enable internal serial interface
	On		Disable internal serial interface
J1,2	**J1**	**J2**	
	1-2	1-2	Invalid setting of DACKO of 8237
	2-3*	2-3*	Valid setting of DACKO of 8237

PCE

Switch	Position	Function
J1	A	Enable floppy
	B	Disable floppy
J2	A	Parity RAM not installed
	B	Parity RAM installed
J3	A	BIOS ROM 128/64K
	B	BIOS ROM 256K

Switch 1

Switch	Position		Function
S1	On		Unenhanced keyboard
	Off*		Enhanced keyboard
S2	On*		NPX not installed
	Off		NPX installed
S3,4	**S3**	**S4**	**RAM Size**
	On	On	256K
	Off	On	512K
	On	Off	576K
	Off*	Off*	640K
S5,6	**S5**	**S6**	**Display Type**
	On	On	Reserved
	Off	On	Colour 40x25
	On	Off	Colour 80x25
	Off*	Off*	Mono
S7,8	**S7**	**S8**	**Floppies**
	On*	On*	1
	Off*	On*	2
	On	Off	3
	Off	Off	4

Switch 2

Switch	Position		Function
S1,2	**S1**	**S2**	
	On	On	Disable parallel port
	Off	On	LPT3 IRQ7 enabled
	On	Off	LPT2 IRQ7 enabled
	Off*	Off*	LPT1 IRQ7 enabled
S3,4	**S3**	**S4**	
	On	On	Disable serial port
	Off	On	Disable serial port
	On	Off	COM2 IRQ3 enabled
	Off*	Off*	COM1 IRQ4 enabled

EL2

Jumper	Position	Function
JP1	A*	Enable password
JP2	A*	Auxiliary device has IRQ12
	B	IRQ12 available to other devices
JP3		Reserved
JP4	In*	HD I/O channel On
JP5		Reserved
JP6		Reserved
JP7	A*	IRQ9 available to other devices
	B	IRQ9 assigned to video
JP8	A	HMD549 default setting for 40 Mb HD
	B	Other HDC-embedded HDs (20 Mb)
JP9	A	256K EPROM
	B	512K EPROM

EL3-33

Jumper	*Position*	*Function*
JP1	A*	Enable password
	B	Disable password
JP2	A*	Auxiliary device has IRQ12
	B	IRQ12 available to other devices
JP3		Reserved
JP4	In*	HD I/O channel On
	Out	HD I/O channel Off
JP5		Reserved
JP6		Reserved
JP7	A*	IRQ9 available to other devices
	B	IRQ9 assigned to video
JP8	A*	Enable HD
	B	Disable HD
JP9	A*	Enable internal VGA
	B	Disable internal VGA
JP10	A	2 wait states of 16-bit device on exp bus
	B*	1 wait state
JP11		Reserved

EL3S

Jumper	*Position*	*Function*
JP1	A	Enable password
	B	Disable password
		To reset password set J1 to B and turn power Off, then On, then Off. Set J1 to A.
JP2	A*	Auxiliary device has IRQ12
	B	IRQ12 available to other devices
JP3		Reserved
JP4	A*	Enable I/O channel assignment
	B	Disable I/O channel assignment
JP5		Reserved
JP6		Reserved
JP7	A*	IRQ9 available to devices in option slot
	B	IRQ9 assigned to video

CPU Board

Jumper	*Position*	*Function*
JP8	A*	NPX not installed
	B	NPX installed
JP9	A*	Enable HD
	B	Disable HD
JP10	A*	VGA colour enabled
	B	VGA colour disabled
JP11	A	2 wait states of 16-bit device on exp bus
	B*	1 wait state
JP12		Reserved
JP13	A	256K ROM
	B*	512K ROM

Video Board

Jumper	Position		Function
JP1	A		Turbo disabled
	B		Turbo enabled
JP2	A		Write buffer disabled
	B		Write buffer enabled
JP3,4	**JP3**	**JP4**	**Data Transfer Rate**
	A	A	16-bit
	A	B	Reserved
	B	A	Reserved
	B	B	8-bit

EL3s+

Jumper	Position	Function
JP12	A	NPX not installed
	B	NPX installed
JP13		Reserved
JP14	A*	Video BIOS duplicated at C0000h
	B	Not duplicated
JP15	A*	Bus wait state for HD access=2
	B	Bus wait state for HD access=1
JP16	Out*	DRAM parity Off

Multi I/O board

Jumper	Position	Function
JP1	A	Disable HD
	B*	Enable HD
JP2	A	Disable ROM setup
	B*	Enable
JP3	A	Enable floppy write protect
	B*	Disable
JP4	A	Erase CMOS password
	B*	Enable CMOS password
JP5	Out*	Reserved
JP6	In*	I/O channel ready On
	Out	I/o channel ready Off
JP7		Reserved
JP8		Reserved
JP9	A	DS1287 fitted
	B*	Not fitted
JP10	A	Video interlaced
	B*	Not interlaced
JP11		Reserved
JPT	Out	Power supply auto fan control
	In*	Disable

EL4s

Jumper	*Position*	*Function*
JP12	In	2 wait states of 16-bit device on exp bus
	Out*	1 wait state
JP13	In*	AT bus clock is ½ CPU clock
	Out	Enables JP15
JP14	In*	20 MHz CPU
	Out	Reserved for 33 MHz 80486
JP15	In*	AT bus clock is 1/3 CPU clock
	Out	AT bus clock is ¼ CPU clock
JP16	A*	486SX
	B	486DX
JP17	A*	486SX
	B	486DX
JP18	A*	486SX
	B	486DX

EISA TE/DE

Jumper	*4*	*Function*
J1	2-3*	Password Enabled

Equity 486SX/25+

Jumper	*Position*		*Function*				
JP1	A		487SX installed				
	B*		486SX installed				
JP2	A		487SX NMI signal				
	B*		486SX NMI signal				
JP3	A		487SX FERRsignal				
	B*		486SX FERR signal				
JP4	A*		Enable VGA				
	B		Disable				
JP5	A*		Power on password enabled				
	B		Disabled				
JP6	A*		Colour display				
	B		Mono display				
JP7	A*		Mouse enabled				
JP8-12	**Memory**		**JP8**	**JP9**	**JP10**	**JP11**	**JP12**
	4 Mb*		B	B	B	B	A
	8 Mb		B	B	B	A	A
	9 Mb		A	B	B	A	A
	10 Mb		A	A	B	A	A
	12 Mb		A	B	A	A	A
	16 Mb		A	A	A	A	A
JP13,14	**JP13**	**JP14**	**Base Memory**				
	A	A	640K*				
	B	A	512K				
	B	B	256K				
JP15	A		Early I/O ready signal enabled				
	B*		Normal I/O ready signal				

Equity 486DX2/50+

As for Equity 486SX/25+

Eupacomputer

www.eupacomputer.com

Eurone LA

www.eurone.com

M919

Item	Description	Notes
Chipset	UMC 8881/8886	
BIOS	AMI WinBIOS	
Bus	3 PCI/4 ISA/1 VESA	
I/O	2S, 1P	
Problems		Look for v1.5 or 3.4, or make sure cable pinouts are correct. Use identical Memory (Mb) SIMMs
Comments		Possibly manufactured by PC Chips. V 1.x same as Amptron DX-9500 and v3.x same as DX-9700.

Cache Settings

1 bank

	Config	JP8	JP8	JP8	JP8	JP9A	JP9B	JP9C	JP9D
512K	128Kx8	1-2	3-4	5-6	7-8	Off	On	On	On
256K	64Kx8	1-2	3-4	5-6		Off	Off	On	On
128K	32Kx8	1-2	3-4			Off	Off	Off	On

2 banks

	Config	JP8	JP8	JP8	JP8	JP9A	JP9B	JP9C	JP9D
1024K	128Kx8	2-3	4-5	6-7	8-9	On	On	On	On
512K	64Kx8	2-3	4-5	6-7		Off	On	On	On
256K	32Kx8	2-3	4-5			Off	Off	On	On
128K	16Kx8	2-3				Off	Off	Off	On

Everex

286

Jumper	*Position*		*Function*
SW1	**S1**	**S2**	**8-bit slot wait states**
S1,2	On	On	3

Jumper	*Position*			*Function*
	On	Off		4
	Off	On		5
	Off	Off		3
SW1	**S1**	**S2**		**16-bit slot wait states**
S3,4	On	On		0
	On	Off		1
	Off	On		2
	Off	Off		0
SW2	**S2**	**S3**	**S4**	**Total RAM**
S2,-4	On	On	On	512K
	On	On	Off	1Mb
	Off	On	On	2Mb
	On	Off	Off	2.5Mb
	Off	On	Off	2.5+Mb
	Off	Off	Off	4Mb
W3	On			Adds wait state
W12,13	**W12**	**W13**		**Coprocessor speed**
	1-2	1-2		10 MHz copro
W15	Off			286/16 using 60 ns RAM
	On			286/16 using 80 ns RAM

386 (Rev D)

Jumper	*Position*	*Function*
W3	In	Maths copro installed
	Out	Not installed
W14	In	STEP UP not installed
	Out	STEP UP installed
W15	In	256Kx9 installed
	Out	1Mbx9 installed
W16	In	512K base memory
	Out	640K base memory
W17	In	Bus speed 6.7 MHz
	Out	Bus speed 10 MHz

386 (Rev E)

Jumper	*Position*	*Function*
W3	In	Maths copro installed
	Out	Not installed
W14	In	STEP UP not installed
	Out	STEP UP installed
W15	In	256Kx9 installed
	Out	1Mbx9 installed
W16	In	512K base memory
	Out	640K base memory
W17	In	Bus speed 6.7 MHz
	Out	Bus speed 10 MHz
W20	In	Disable STEP UP parity checking
W21	In	1 bank memory
	Out	2 banks memory

AGI 286-12

Jumper	*Position*	*Function*
W2	6 In*	8-bit access 6 wait-states
W3	2 In*	16-bit access 2 wait-states
W6	3-4 In	512K RAM
	3-4 Out	1Mb RAM
W7	2-3*	Reserved
W8	2-3*	Reserved

AGI 386-12

Jumper	*Position*	*Function*							
S1-8	**Bootup Sequence**	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**
	1Mb memory	Off	On	Off	Off	Off	N/A		
	8 MHz boot speed				Off	N/A	On		
	16 MHz boot speed				Off	N/A	Off		
	Mono display				Off	N?A		Off	
	Colour display				Off	N/A		On	
J5	1-2	10 MHz 80287							
	2-3	6 MHz 80287							

AGI 386-20

Jumper	*Position*				*Function*
S1-4	**S1**	**S2**	**S3**	**S4**	**Mobo memory 32-bit card**
	On	On	On	On	1Mb + 0
	Off	On	On	On	1Mb + 4
	Off	Off	On	On	1Mb + 8
	Off	Off	Off	On	1Mb + 14
W1	1-2				4 wait states for 8-bit cycle
	2-3				5 wait states for 8-bit cycle
W2	1-2				2 wait states for 16-bit cycle
	2-3				1 wait state for 16-bit cycle

EV 1800

Jumper	Position				Function
W1	**S1**	**S2**			**Total RAM**
S1-2	On	On			256K
	On	Off			512K
	Off	On			640K
	Off	Off			1Mb
W2	**S1**	**S2**	**S3**	**S4**	**EPROM size**
S1-4	On	On	Off	Off	128K EPROM
	Off	Off	On	On	256K EPROM

EV 1801

Jumper	*Position*				*Function*
W1	**S1**	**S2**	**S3**	**S4**	**EPROM size**

Jumper	*Position*				*Function*
S1-4	On	On	Off	Off	128K EPROM
	Off	Off	On	On	256K EPROM
W1	On				Zero wat-state
S5	Off				16-bit wait-state set by W12
W1	Off*				Reserved
S6					
W1	**S7**	**S8**			**Total RAM**
S7-8	On	On			256K
	On	Off			512K
	Off	On			640K
	Off	Off			1Mb
W4	**S1**	**S2**	**S3**	**S4**	**Parallel Port**
S1-4	On	Off	On	Off	LPT1*
	On	On	Off	On	LPT2
	Off	Off	Off	Off	Disable
W7,12	**W7** (8-bit)	**W12** (16-bit)			**Wait-state**
			1		1
			2*		2
			3		3
	4*		4		4
	5				5
	6				6
W8,11	**W8**	**W11**			**Maths Coprocessor**
	B	B			5 MHz 80287
	A	A			8 MHz 80287
	A	B			10 MHz 80287
W9					Reserved
W10					Reserved
W13					Reserved
W14	**A**	**B**			**COM1/3**
	On	On			COM1
	On	Off			COM3
	Off	On			Disable
	C	**D**			**COM2/4**
	On	On			COM2
	On	Off			COM4
	Off	On			Disable
W16					Reserved

EV 1811

Jumper	*Position*				*Function*
SW1	**S1**	**S2**	**S3**	**S4**	**EPROM size**
S1-4	On	On	Off	Off	128K EPROM
	Off	Off	On	On	256K EPROM
SW2					Colour/Mono
E2	**S1**	**S2**			**Total RAM**
S1-2	On	On			256K
	On	Off			512K
	Off	On			640K
	Off	Off			1Mb
E3					Reserved

Jumper	*Position*			*Function*
E9				Reserved
E12				Reserved
E13				Reserved
E20				Reserved
E21-23	**E21**	**E22**	**E23**	**Hard/Floppy Disk Controller**
	On	On	On	Enable
	Off	Off	Off	Disable
E24				Reserved

Step 286-12/16

Jumper	*Position*			*Function*		
SW1	**S1**	**S2**		**8-bit slot wait states**		
S1,2	On	On		3		
	On	Off		4		
	Off	On		5		
	Off	Off		3		
SW1	**S1**	**S2**		**16-bit slot wait states**		
S3,4	On	On		0		
	On	Off		1		
	Off	On		2		
	Off	Off		0		
SW2	**S2**	**S3**	**S4**	**Total RAM Bank 0**	**Bank 1**	
S2,-4	On	On	On	512K	256K	
	On	On	Off	1Mb	256K	256K
	Off	On	On	2Mb	1Mb	
	On	Off	Off	2.5Mb	256K	1Mb
	Off	On	Off	2.5Mb	1Mb	256K
	Off	Off	Off	4Mb	1Mb	1Mb
W3	In			Adds wait state		
W4-11				Reserved		
W12,13	W12	W13		Coprocessor speed		
	1-2	1-2		10 MHz		
W15	Out			286/16 using 60 ns RAM		
	In			286/16 using 80 ns RAM		
	In			286/12		

Step 386/20/25/33

Jumper	*Position*	*Function*
P1	In	256K cache
	Out	128K cache

Step 386-20 (Rev D)

As for 386 (Rev D).

Step 386-20 (Rev E)

As for 386 (Rev E).

Step 386sx 20

Jumper	Position	Function
JP3	Out*	Enable cache light
JP8	In	512K EPROM
	Out*	256K EPROM
J9	1-2	82C711 chip floppy selector

Tempo 286-16c

Jumper	Position	Function
JP2	1-2,5-6,7-11	Reserved
JP4	3-4,10-11	Reserved
JP5	2-3,4-5	Reserved
JP9	On*	Enable video
	Off	Disable

Tempo 386sx

Jumper	Position			Function
P2-4	**P2**	**P3**	**P4**	**Total RAM**
	Out	In	In	512K
	In	Out	In	1Mb
	Out	Out	In	2Mb
	Out	In	Out	2Mb
	In	Out	Out	4Mb
	Out	Out	Out	8Mb
P5	In			ROM 3 wait-states
	Out*			ROM 2 wait-states
P6	In*			0 wait states RAM Read
	Out			1 wait state RAM Read
P7	In*			0 wait state RAM Write
	Out			1 wait state RAM Write
P8	In*			Disable shadow RAM

Tempo 386-25/33c

Jumper	Position		Function
SW1	**S1**	**S2**	**Monitor Type**
S1-2	On	On	Super multifrequency
	Off	On	Multifrequency
	On	Off	Super VGA
	Off	Off	VGA, IBM, PS/2 and 8514
JP1			Floppy type
JP2	1-2		Enable IRQ2
	5-6		Enable Onboard video

4045

Jumper	*Position*				*Function*
JP1-4	**JP1**	**JP2**	**JP3**	**JP4**	**Cache Size**
	Open	Open	2-3	1-2	128K
	1-2	Open	2-3	2-3	256K
	2-3	Short	1-2	2-3	512K
JP6	1-2				Intel CPU
	2-3				Cyrix CPU
JP7-9	**JP7**	**JP8**	**JP9**		**CPU clock**
	Open	Open	Short		25 MHz
	Short	Short	Short		33 MHz
	Open	Short	Short		40 MHz
JP16	Open				CPU 3x
	8-9				CPU 2.5x
	7-8				CPU 2x
JP18,33	**JP18**	**JP33**			**CPU voltage**
	Open	Open			3.3v (Q3 present)
	Short	Short			5v (Q3 absent)
JP39	Short				Colour display
	Open				Mono

CPU	**486SX**	**DX/DX2**	**486 Enh**	**Cyrix M6**	**Cyrix M7**	**P24D**	**P24C**	**P24T**
JP17	Open	Short	Short	Open	Short	Short	Short	Short
JP19	1-2	1-2	1-2	2-3	2-3	1-2	1-2	1-2
JP20	Open	Open	Short	Short	Short	Short	Short	Short
JP21	Open	Open	Open	2-3,4-5	2-3,4-5	Open	Open	Open
JP22	Short	Short	Short	2-3	Short	Open	Short	Open
JP23	Open	Open	Open	Open	Open	1-2	Open	Open
JP24	open	Open	Open	Open	Open	1-2	Open	Open
JP25	1-2,3-4	1-2,3-4	1-2,3-4	2-3,4-5	2-3,4-5	1-2,3-4	1-2,3-4	1-2,3-4
JP26	Open	Short	Short	Open	Short	Short	Short	Short
JP27	Open	Open	Open	Open	Open	Open	Open	1-2
JP28	2-3	1-2	1-2	2-3	1-2	1-2	1-2	1-2
JP29	Open	Short	Short	Open	Short	Short	Short	Short
JP30	Open	Short	Short	Open	Short	Short	Short	Open
JP31	Open	Open	Open	Open	Open	Open	Open	Open
JP32	Open	Open	Open	Open	Open	Short	Short	Short
JP34	Open	Open	Open	Short	Short	Open	Open	Open
JP36	Open	Open	Short	Short	Short	Short	Short	Short

F

Famous Technology

Magic pro
www.magic-pro.com.hk

Fentech

See Taemung/Fentech

Ferranti

2086

Links

Link	*Position*	*Function*
1	On	512K
	Off	640K
2	On	CGA
	Off	Mono
3		Reserved
4		Not used
5		Not used

Link	*Position*	*Function*
6	On	8 MHz
	Off	6 MHz
7		Always on

FIC

First International Computer
(510) 252 7777
www.fica.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
00-00	486 PVT, VIP-IO/IO2, 486GVT2	9C	PA 2012/VA 503+ or PA 2013
2C-00	PN 2000	9C	PA 2002/2005
8C	PA 2005 (Vobis)/2006/VA501/2	9C-00	PT 2006/2007/VT 530
8C	PA 2007	H	PT 2003/PA 2000
9	PA 2002/2005	H-00	PT 2000
9-00	PA 2000	HC-00	PT 2000 or 2003/PA 2000

CPIIZ

Item	Description	Notes
Form Factor	ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		
Chipset	Intel 440ZX	
BIOS		
Bus	5 PCI/2 ISA	UDMA/33
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	2 EIDE, floppy	
Video		AGP
Performance		
Comments		

KA-6100

Item	Description	Notes
Form Factor	AT	
CPU	Pentium II/Celeron	Slot 1
Speeds (MHz)		
Chipset	VIA Apollo Pro	
BIOS	Award 4.51PGMA	
Bus	3 PCI/2 ISA	1 each shared
Memory (Mb)	768 Mb	3 DIMM sockets

Item	Description	Notes
Cache (K)		
I/O	2 EIDE, floppy, USB	
Audio	Yamaha OPL3-6AX	
Video		AGP
Performance		Slow, but still faster than the ECS P6BX-A+

KA-6110

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Speeds (MHz)	900	If slot 1 survives
Chipset	VIA Apollo Pro Plus	
BIOS	Award 4.51PGMA	
Bus	5 PCI/2 ISA	1 each shared UDMA/66 (33 cable)
Memory (Mb)	1 Gb	4 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	
Audio	Yamaha OPL3-6AX	
Video		AGP
Performance		

PA-2012

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium/K6	Socket 7
Speeds (MHz)	366 MHz	
Chipset	VIA VP3	
BIOS		
Bus	4 PCI/2 ISA	
Memory (Mb)	384 Mb SDRAM 768 Mb EDO	3 DIMM sockets
Cache (K)	1 Mb	
Video		AGP
Performance		Fast

SD11

Item	Description	Notes
Form Factor	ATX	
CPU	Athlon	Slot A
Speeds (MHz)		
Chipset	AMD 751/VIS 686A	
BIOS	AMI	
Bus	5 PCI/1 ISA	UDMA/66
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2 EIDE, floppy	

Item	Description	Notes
Video		AGP
Performance		Fast
Comments		

VB-601

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Speeds (MHz)	450	
Chipset	440 BX	
BIOS	Award 4.51PGMA	
Bus	5 PCI/2 ISA	1 each shared
Memory (Mb)	1 Gb	4 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video		AGP
Performance		Average
Problems		
Comments		

VL-601

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	333 MHz	
Chipset		
BIOS		
Bus	5 PCI/2 ISA	
Memory (Mb)	384 Mb SDRAM	3 DIMM sockets
Cache (K)		
Video		AGP
Performance		Bus speed 66 MHz. Fair performance.
Problems		Removal of SDRAM means removing AGP card.

Fine-Pal Company

www.finepal.com

Firenze

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1-00	486 VL.VII		

486 VL.VII

Maybe Genoa or Freetech models

First International Computer

See FIC

Fittec

www.spiderwebhk.com/fittec

FKI

See Fong Kai Industrial

Flagpoint

Some association with Vtech.

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C-00	FPM P5VX		
BC-00	Road Runner VIA 512K		

Flamingo

Something to do with Lucky Star?

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
CC-00	MB-FLM-TX01		
FC	5I-VX1C		

MB-FLM-TX01

Same as Lucky Star 5ITX1

5I-VX1C

Same as Lucky Star P54CE

Flexus

Flytech

Fong Kai Industrial

www.fkusa.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
AC-00	SL586VT-II		

SL 586V

Rev 1.1

Jumper	*Position*		*Function*
J7/8			EPROM Voltage
J9-10	**J9**	**J10**	**Host bus speed**
	On	On	50 MHz
	On	Off	60 MHz
	Off	On	66 MHz
J11			CMOS Clear
J13-14	**J13**	**J14**	**CPU Clock Multiplier**
	Off	Off	1.5x
	On	Off	2x
	Off	On	3x
	On	On	2.5x
A-E	A		3.5v
	B		3.3v
	C		3.2v
	D		2.9v
	E		2.8v
	Off		2.5v

SL 586VT-II

Same as Winco SL 586VT-2

Fordlian

See also RedFox

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	6IFXA	AC	5IVXB
AC	FL51HXA	BC	5ITXA rev A
AC	5IVXA		

5IVXA

Same as Aprocom Nex586v

Formosa

Freetech

Free Computer Technology
(510) 226 2777
www.freetech.com
If you cannot find a FAB # underneath, your board is not a Freetech motherboard. May make boards for AMP.

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0-01	486F38X	CC-00	586F63T
9C	586F62	DC-00	586F60
AC	P586F62T	HC	586F52
AC	586F63T	HC-00	486F55
BC-00	586F60	NC(-00)	586F61(-PB)
CC	P5F76 (Falcon)	NC-01	586F52XS ver D

486F38(X)

X model same as Genoa 486VLGX4

CPU Clock

Speed (MHz)	JP20	JP19	JP17
25	On	Off	On
33*	Off	On	On
40	On	Off	Off
50	Off	On	Off

L2 Cache Size

Size (Kb)	JP12	JP21	Tag	Data
128	1-2	Off	8K8	32K8x4
256*	2-3	Off	16K8	32K8x8
256	1-2, 3-4	Off	16K8	64K8x4
512	2-3, 4-5	On	32K8	64K8x8
512	1-2,3-4	On	32K8	128K8x8

486F39

As for 486F38

486F41

As for 486F38

P5F76

Activei?

Freeway

www.freeway.co.jp

Fugutech

Fugu Tech Enterprise Co
www.fugu.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1C	M530	9C	M701
2C(-00)	M 505/Neptune DP	HC	M 507
4C	M507		

M507

Aka Concord COA-507, ATC 1000 or Amptron PM 7600

M530

Aka Concord COA-530

Full Yes International

See FYI

FYI

Full Yes Industrial Corp
www.fyi.com.tw

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	82430VX P55C (SMC)	BC	82430VX P55C/MMX
AC	FYI VIA 597	C-00	FYI 597
AC	82430VX P55C (UMC)		

82430VX P55C

UMC chipset. Same as BJMT Nimble VX

Notes

G

Gateway

See ALR

Gemlight

www.gemlight.com.hk
www.gemlight.com
Makes DTK boards

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0	GMB 486SG	A	GMB P54SPS P54C PCI
2	GMB P54SPS	AC-00	GMB P54SPV/P56SPC
2C	GMB P54SPS	JC	GMB P54PSI
9C	GMB P56IPS	KC	GMB P54PSI v1

GMB-P54PSI

Same as DTK PAM 00541-E1?

Genoa

Genoa Systems Corp
www.genoasys.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
AC	Turbo Express 586HX v T1B		

486VLGX4

Same as Freetech 486F38X

Turbo Express PII

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Memory (Mb)	512 Mb SDRAM 1 Gb EDO	4 DIMM sockets
Video		AGP
Performance		Fastish
Comments		Poor layout

Turbo Express 586HX v T1B

Actually a Freetech P586F62T - same as Genoa Turbo Express 586HX v T1B

G-host

G486PLB

Jumper	*Position*					*Function*
JP1	On					Colour
	Off					Mono
JP2	1-2					External power good
	2-3					Internal power good
JP3	1-2					Discharge CMOS
	2-3					Charge CMOS
JP5-9	**JP5**	**JP6**	**JP7**	**JP8**	**JP9**	**Cache size**
	Off	Off	Off	Off	Off	64K
	On	On	Off	On	Off	256K
JP10-12	1-2*					W/B dirty bit – leave On

Jumper	Position			Function
JP14-16	**JP14**	**JP15**	**JP16**	**CPU type**
	On	1-2	2-3	486DX
	Off	2-3	Off	486SX
	On	1-2	1-2	487SX
JP100	On			Local bus video card is G-HOSTS3/ISA
	Off			Local bus video card is G-HOST4000

Giantec

Gigabyte

(626) 854-9338 (tech support)
www.gbt-tech.co.uk
www.giga-byte.com
www.gigabyte.com.tw

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
02-00	GA 586AP rev2	AC	GA 6BA
03-00	GA 586AL/S rev 2A	AC	GA 586ATV
1	GA 486VF Rev 8B	BC(-00)	GA 586HX/VX/(ATX)
1-00	GA 486 IM or 486VS	DC-00	GA 586TX3
1C-00	GA 586IP v1.6	HC	GA 586AT/T2 or 486AM/S
3	GA 486AM	IC	GA 586AT
9C	GA 686BX/LX or 586DX/TX	KC	GA 586ATE/ATM
9C	GA 586AS	NC	GA 586-ATEP
9C-00	GA 586AVS/S	PC	GA 586ATM/P Rev 5 or ATE
9C-00	GA 5486AL		

GA-486AM

Item	Description	Notes
Form Factor	Baby AT	22 x 25 cm
CPU	486	Intel/Cyrix, including P24
Speeds (MHz)		
Chipset	UMC 888X	
BIOS	Award Flash	V4.50pg
Bus	3 PCI/4 ISA	
Memory (Mb)	128	4 72-pin sockets
Cache (K)	1 Mb	
I/O	2S, 1P, Floppy, EIDE	
Comments		Video card in third PCI slot

GA-486IM

Item	Description	Notes
Form Factor		
CPU	486	Intel/Cyrix
Speeds (MHz)		
Chipset	UMC 888X	
BIOS	Award Flash	V4.50b
Bus		
Memory (Mb)		
Cache (K)	256	
I/O		
Performance		
Problems		Will not boot OS/2 with an NCR controller made by Intel or Asus and a Cardex Challenger in a PCI slot. An S3/864 card will allow booting, but serial ports go undetected, or may work poorly

GA-486IS

Item	Description	Notes
Form Factor		
CPU	486	SX, DX, DX2, P24T. 5v only.
Speeds (MHz)	25, 33	
Chipset	Saturn I	Rev 2
Bus	4 PCI/ 4 ISA	
Memory (Mb)		4 72-pin SIMMs (parity, non-parity)
Cache (K)	256	
I/O		NCR On-board SCSI

GA-586AL/S

Item	Description	Notes
CPU	Pentium	
Speeds (MHz)	60/66	
Chipset	ALi	
BIOS	Award	
Comments		Doesn't like OS/2

GA-586AP

Item	Description	Notes
CPU	Pentium	
Speeds (MHz)	75, 90, 100	
Chipset	ALi	
BIOS	Award Green Flash	Supports NCR 53c810-based GA-410 NCR 810 PCI SCSI card
Bus	3 PCI/4 ISA	1 each shared
Memory (Mb)		Up to 6 sockets
Cache (K)	1 Mb	Asynchronous, write-back
I/O	2 S, 1P, Floppy (2.88)	IDE CMD 640

GA-586AT(E)

Item	Description	Notes
Form Factor	¾ Baby AT	
CPU	Pentium/P54CT	3.3v
Speeds (MHz)	75-133	
Chipset	Triton	
BIOS	Green Flash Award	
Bus	3 PCI/4 ISA	None shared
Memory (Mb)	4-128	Up to 6 72-pin sockets (double/single)
Cache (K)	512	
I/O	2S, 1P, Floppy, 2 EIDE	
Comments		ATE version may not like ATI cards – possible BIOS upgrade to fix. Chipset IDE drivers may not like Warp.

Jumper	*Position*		*Function*
A6-7	A6-A7		Single voltage 3.3v CPU
B6-7	B6-B7		Dual voltage 2.5v/3.3v CPU
JP2	Close		VRE spec CPU
	Open		VR or standard spec CPU
JP3	1-2		256K cache
	2-3		512K cache
JP4,5	**JP4**	**JP5**	**Host bus speed**
	2-3	2-3	50 MHz
	1-2	1-2	60 MHz
	1-2	2-3	66 MHz
JP6	None		75-100 MHz (CPU 1.5x)
	1-2		120/133 MHz (CPU 2x)
	1-2,3-4		150/166 MHz (CPU 3x)
	3-4		Reserved
			Ver 3.x mainboard
JP6	Close		120/133 MHz (CPU 2x)
	Open		75-100 MHz CPU (CPU 1.5x)
			Ver 2.x mainboard
JP12			Reserved

Connectors

Jumper	*Function*
J4	Green connector
J5	Green LED
J6	Reset
J7	Turbo Switch
J8	Turbo LED
J9	Speaker
J10	Power LED & Keylock

GA-586IP

Item	Description	Notes
CPU	P54CT	
Speeds (MHz)	60/90 or 66/100	
BIOS	Award Flash 4.50g	
Bus	4 PCI/4 ISA	All PCI allow busmastering
Memory (Mb)	768	6 72-pin slots
Cache (K)	256 or 512 Kb	
Problems		Add /A:0 /I switches to basedev line of Adaptec 2940 driver. Also, set the Int A jumper on the board itself. Some problems with ATI cards due to PCI slots 0 and 1 being modified.
Comments		

GA-586SGM

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium	Socket 7. AMD, Cyrix and Intel
Speeds (MHz)	233	
Chipset	SiS 5591	
BIOS		
Bus	3 PCI/3 ISA	
Memory (Mb)	768	3 DIMM sockets. 3.3 v
Cache (K)		
I/O		
Video		AGP
Audio	Yamaha 715E-S	No wavetable
Performance		Slow

GA-5AX

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium/K6	Socket 7
Speeds (MHz)	550	
Chipset	ALi Aladdin V	
BIOS	Award 4.51PG	
Bus	4 PCI/3 ISA	1 each shared
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)	512	
I/O	2 EIDE, floppy, USB	
Video		AGP
Performance		Average

GA-686BLX

Item	Description	Notes
Form Factor	Baby AT	

Item	Description	Notes
CPU	Pentium II	Slot 1
Speeds (MHz)	366	
Chipset		
BIOS		
Bus	4 PCI/2 ISA	1 each shared
Memory (Mb)	512 SDRAM 1 Gb EDO	4 DIMM sockets
Cache (K)		
I/O		
Video		AGP
Performance		Above average
Problems		
Comments		AT/ATX power connectors

DIP Switches

Switch	*Position*				*Function*		
1-4	**1**	**2**	**3**	**4**	**Ratio**	**Ext Clk**	**CPU**
	On	Off	On	On	3x	66 MHz	200 MHz
	Off	Off	On	On	3.5	66 MHz	266 MHz*
	On	On	Off	On	4	66 MHz	233 MHz*
	Off	On	Off	On	4.5	66 MHz	300 MHz
	On	Off	Off	On	5	66 MHz	333 MHz
	Off	Off	Off	On	5.5	66 MHz	366 MHz

*Manual says opposite

66 MHz = JP2, 3, 4 at 1-2

GA-6BXF

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Speeds (MHz)	550	
Chipset	440 LX	
BIOS	Award 4.51PG	
Bus	4 PCI/3 ISA	1 each shared
Memory (Mb)	1 Gb	4 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	Adaptec AIC-7890 LVD SCSI
Video		AGP
Performance		SCSI good, otherwise average

GA-6CX

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III	Slot 1
Speeds (MHz)		

Item	Description	Notes
Chipset	Intel 820	
BIOS	Award 4.51PG	Dual BIOS
Bus	5 PCI/1 AMR	depends on board
Memory (Mb)	RDRAM	2 RIMM sockets
Cache (K)		
I/O	The usual	
Video	AGP	4x
Performance		Look also at Aopen AX6C or SuperMicro PIIISCE

GA-6WMM7

Item	Description	Notes
Form Factor	ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		100 FSB
Chipset	Intel 810	
BIOS	Award	
Bus	3 PCI/1 ISA	UDMA/66
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	The usual, plus joystick and audio	
Audio		
Performance		
Comments		Secret jumper not in docs for 100 FSB

GA-6WXM7

Item	Description	Notes
Form Factor	ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		
Chipset	Intel 810	
BIOS		
Bus	5 PCI/1 ISA	UDMA/66
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	2 EIDE, floppy	
Audio	Yamaha YMF744BR	
Performance		
Comments		

GA-71X

Item	Description	Notes
Form Factor	ATX	
CPU	Athlon	Slot A
Speeds (MHz)		
Chipset	AMD-750	
BIOS	Award	
Bus	5 PCI/2 ISA	UDMA/66

Item	Description	Notes
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	The usual	
Video		AGP 2x
Performance		
Comments		

Global Circuit Technologies

www.gcttech.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
8C	GCT 8IV	9C-00	MediaGX-GCT
9C	GCT 6IV	EC-00	GCT 8ITB

GCT 8ITB

Same as DataExpert ExpertColor TX430II

Global Impact

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
GC	C586HX		

C586HX

Same as DFI G586IPC or Crusader C586HX

Global Legate

Zaapa
www.zaapa.com

GVC

Notes

H

Hewlett Packard

www.hp.com

Vectra 286-12

Jumper	*Position*	*Function*
S1	Off*	Video IRQ9 disabled
	On	Enabled
S2	Off*	VGA Enabled
	On	Disabled
S3	Off*	Mouse IRQ12 enabled
	On	Disabled
S4	Off*	Power on password enabled
S5	Off*	Option ROMs on backplane enabled
	On	Option ROMs on memory board enabled
S6		Reserved

Vectra 386-25

Jumper	*Position*	*Function*
S1	On*	Power on password enabled
	Off	Disabled
S2	On*	Option ROMs Enabled
	Off	Disabled
S3	On*	Cache memory enabled
	Off	Disabled

Jumper	Position	Function
S4	On*	I/O channel synchronous 8.3MHz
	Off	I/O channel asynchronous 8MHz
S5	On*	Mouse IRQ12 enabled
	Off	Disabled
S6		Reserved

Vectra 386/N

Jumper	Position	Function
S1	Off*	Mouse IRQ12 enabled
	On	Disabled
S2	Off*	Video IRQ9 disabled
	On	Enabled
S3	Off*	VGA Enabled
S4	Off*	Passwords enabled
	On	Disabled
S5	Off*	EPROM information valid
	On	EPROM information erased
S6	Off*	Security mode disabled
	On	Enabled
S7		Reserved

Vectra 386s-20

As for 386/N, except S8 is reserved.

Vectra ES

Jumper	Position		Function
SW1	On		Option ROMs Off
C1	Off		Option ROMs On
SW1	On		80287 uses system clock
C2	Off		80287 system clock divided by 3
SW2	Both On*		Reserved
C1-2			
SW3	**S1**	**S2**	**Base memory**
S1-2	On	On	640K
	Off	Off	512K
	On	Off	256K
SW3	On		I/O channel 8 MHz
S3	Off		I/O channel 12 MHz
SW3	On		Fast boundary at 640K
S4	Off		Fast boundary at 512K
SW3	On		HP-HIL enabled
S5	Off		HP-HIL disabled
SW3			Reserved
S6			
SW4	On		Extended memory up to 000000h
S1-5			
SW4	On		16-bit boards using MEMCS16 at 8 MHz
S6	Off		16-bit boards using MEMCS16 at 12 MHz

Vectra ES12

As for Vectra ES

Holco

See Shuttle

HSB

HSB Computer Labs
(216) 498-0382 (tech. support)
www.hsb-labs.com

MB/MS4144PC100

Item	Description	Notes
Form Factor		
CPU	486	Does not work with a DX4-50/100
Chipset	SiS 85C496/85C497	
BIOS	AMI Green	Non-flash
Bus	3 PCI/4 ISA	None shared
Memory (Mb)	128	72-pin SIMMs
Cache (K)	1 Mb	256 standard
I/O	2 S, 1 P, Floppy, IDE	IDE is Winbond chipset. NCR SCSI controller

Hsing Tech

See PC Chips

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1-00	Cheetah		

Hyundai

Super 286x

Jumper	*Position*	*Function*
A1-2	In*	Enable floppy
	Out	Disable

Jumper	*Position*			*Function*	
B1-2	In*			Enable HD	
	Out			Disable	
A3-4	In*			Enable LPT1	
B3-4	In*			Enable LPT1	
	Out			Disable	
A4-5	In*			Enable LPT2	
B4-5	In*			Enable LPT2	
	Out			Disable	
A6-7	In*			Enable COM1	
B6-7	In*			Enable COM1	
	Out			Disable	
A7-8	In*			Enable COM2	
B7-8	In*			Enable COM2	
	Out			Disable	
SW1	**S1**	**S2**	**S3**	**Base**	**Ext Memory**
S1-3	On	On	On	512K	0K
	Off	On	On	640K	0K
	On	Off	On	640K	384K
	Off	Off	On	640K	1408K
	On	On	Off	640K	3456K
SW1	On*			Colour monitor	
S4	Off			Mono	

Super 286E

Jumper	*Position*			*Function*	
SW1	**S1**	**S2**	**S3**	**Base**	**Ext Memory**
S1-3	On	On	On	512K	0K
	Off	On	On	640K	0K
	On	Off	On	640K	384K
	Off	Off	On	Reserved	
SW1	On*			Colour monitor	
S4	Off			Mono	
W1	On*			Enable HD	
	Off			Disable	
W2	On*			Enable FD	
	Off			Disable	
W3,6	1-2*			COM1	
	2-3			COM2	
	Off			Disable	
W4,5	1-2*			LPT1	
	2-3			LPT2	
	Off			Disable	

Super 286E+

Jumper	*Position*				*Function*
SW2					Reserved
S1					
SW2	Off				Mono monitor
S2	On				Colour
S3-6	**S3**	**S4**	**S5**	**S6**	**Parallel port**

Jumper	*Position*				*Function*
	On	Off	Off	On	LPT1
	Off	On	On	On	LPT2
				Off	Disabled
S7	On*				Serial port COM2
	Off				Disabled
S8	On*				Serial port COM1
	Off				Disabled
S9	Off*				Enable HD
	On				Disable
S10	Off*				Enable FD
	On				Disable
S11					Reserved
S12					Reserved

Super 286TR

Jumper	*Position*	*Function*
J5	Out*	Mono display
	In	Colour
J9	1-2*	COM1 I/O 3F8
	2-3	COM2 I/O 2F8
	All out	Disable
J7	1-2*	LPT1 I/O 378
	2-3	LPT2 I/O 278
	All out	Disable

Super 386C

Motherboard

Jumper	*Position*				*Function*
J8,9	**J8**	**J9**			**Printer**
	1-2*	1-2*			LPT1
	2-3	2-3			LPT2
J10-13	**J10**	**J11**	**J12**	**J13**	**Serial ports**
	1-2	1-2	1-2	1-2	Port 1=COM2, Port 2=COM1
	2-3	2-3	2-3	2-3	Port 1=COM1, Port 2=COM2
J11-12	**J11**	**J12**			**Serial ports**
	1-2	1-2			COM2 at port 1 enabled
	2-3	2-3			COM1 at Port 1 enabled

CPU Board

Jumper	*Position*	*Function*
JMP1	1-2	Mono display
	2-3	Colour
JMP2	In	Enable pipeline
	Out	Disable
JMP3	In	Enable 80387
	Out	Disable

Super 386D

Jumper	*Position*		*Function*
W1	In		8 MHz DMA clock
	Out		4 MHz DMA clock
W2,3	**W2**	**W3**	**Cache size**
	1-2	1-2	64K (16Kx4)
	2-3	2-3	256K (64Kx4)
W4			Reserved
W6	1-2		Low CPU speed
	2-3		Reserved
	All out*		High CPU speed
W7	In		Mono display
	Out		Colour display
W8	1-2		1Mb RAM chips in Bank 1
	2-3		256K RAM chips in Bank 1
W9	1-2		1Mb RAM chips in Bank 0
	2-3		256K RAM chips in Bank 0
SW1 S1-2	Both On		Total 32-bit RAM installed
S3			Reserved
S4			Enables 2nd bank on motherboard

Super 386N

Jumper	*Position*		*Function*
S1	On*		80387 installed
	Off		Not installed
S2	On*		1 Mb DRAMs
	Off		256K DRAMs
S3	On*		2 banks memory (U98-U105)
	Off		1 bank memory (U98-U101)
S4	On*		Enable extended memory (384K)
	Off		Disable
S5	On*		Colour display
	Off		Mono
S6	On*		Enable cache
S7			Reserved
S8			Reserved
E1,2	**E1**	**E2**	**EPROM**
	1-2	1-2	27256
	2-3	2-3	27512

Super 386N+

As for Super 386D

Super 386S/20L

Jumper	*Position*	*Function*
S1	On*	Colour display
	Off	Mono

Jumper	Position		Function
S2,3	**S2**	**S3**	**Video**
	On*	Off*	Enable
	Off	On	Disable
S4	On		Enable 8514
	Off*		Disable

Super 386SE

Jumper	Position	Function
S1	On	Half speed I/O cycle (8 MHz)
	Off*	Full speed (16 MHz)
S2	On	Coprocessor installed
	Off*	Not installed
S3	On*	Colour display
	Off	Mono
S4	On	IRQ7
	Off	Not selected
S5	On	IRQ5
	Off	Not selected
S6	On	Enable parallel port LPT2
	Off*	Select parallel port LPT1
S7	On*	Enable parallel port LPT1
	Off	Disable
S8	On*	Enable serial port COM2 (2F8h)
	Off	Disable
S9	On*	Enable COM1
	Off	Disable
S10	On	Disable IDE
	Off*	Enable
S11	Off*	Enable floppy
S12		Reserved

Super 386ST

Jumper	Position	Function
S1	On	IRQ5 enabled
	Off*	Disabled
S2	On	IRQ7 enabled
	Off*	Disabled
S3	On*	HD enabled
	Off	Disabled
S4	On*	Enable COM1
	Off	Disable
S5	On*	Enable LPT1
	Off	Disable
S6	On*	Floppy enabled
	Off	Disabled
S7	On*	Enable COM2
	Off	Disable
S8	On*	CRTC colour mode
	Off	CRTC Mono

Super 386STC

Jumper	*Position*	*Function*
S1	On*	Enable COM2
	Off	Disable
S2	On*	Colour video tape
	Off	Mono
S3	On*	Enable parallel port
	Off	Disable
S4	On	Enable HD
	Off*	Disable
S5	On	Disable floppy
	Off*	Enable
S6	On	Enable LPT2
	Off*	Enable LPT1
S7	On*	Enable COM1
	Off	Disable
S8	On	IRQ5 for LPT2
	Off*	Not selected
S12	On*	IRQ7 for LPT1
	Off	Not selected

Super 386T

Jumper	*Position*			*Function*
SW1-2				Reserved
S-4	**S4**	**W8**	**W9**	**SIMMs**
W8,9	On	Front	Front	1Mb
	Off	Rear	Rear	256K
SW2	Off			Enable COM1
S1	On			Disable
S2	Off			Enable COM2
	On			Disable
S3	Off			Enable LPT
	On			Disable
S4	Off			LPT1
	On			LPT2
SW3	On			IRQ4 for COM1
S1				
S2	On			IRQ3 for COM2
S3	On			IRQ5 for LPT
S4	On			IRQ7 for LPT
W1	On			Fast DMA clock
W2-3	**W2**	**W3**		**Cache size**
	1-2	1-2		64K
	2-3	2-3		256K
W4				Reserved

Super 486/33i

Jumper	*Position*	*Function*
W1	Out*	Reserved

Jumper	*Position*		*Function*
W2,3	**W2**	**W3**	**Cache size**
	1-2*	1-2*	64K (16Kx4)
	2-3	2-3	256K (64Kx4)
W4	1-2*		Reserved
W5	2-3*		Reserved
W6	1-2		Low CPU speed (not used)
	2-3		Reserved
	Out		High speed (not used)
W7	In		Mono display
	Out		Colour
W8	1-2*		Reserved
W9	1-2*		Reserved
S1			Enable 2nd bank on motherboard
S2			SIMM type
S3			Total 32-bit RAM
S4			Total 32-bit RAM

Notes

I

IBM

IntelliStation

6588

Jumper	*Position*		*Function*
A,B	**A**	**B**	**CPU Speed**
	3-5	3-5,4-6	233 MHz
	1-3	1-3,2-4	266 MHz
	1-3	2-4,3-5	300 MHz
A	2-4		FDD read-Only
	4-6		FDD read/write
C	2-4		Clear CMOS
	4-6		Normal CMOS
	3-5		Reserved
D	2-4		Setup disabled
	4-6		Setup normal enabled
D	1-3		Reset password
	3-5		Normal password
Boot Block	5-6*		Normal
	4-5		Recover

6888

As for 6588

6899

Switch	*Position*	*Function*					
1-6	**CPU speed**	**1**	**2**	**3**	**4**	**5**	**6**
	200 MHz	On	Off	On	On	Off	N/A
7	On*	Enable serial B					
	Off	Disable					
8	Off*	Normal diskette operation					
	On	Diskette Read-only					
J8	1-2*	Password enabled					
	2-3	Disabled (Clear CMOS)					

Leopard 486SLC2 Rev C

See Opal

Opal

Jumper	*Position*	*Function*
JP6	1-2	128K cache
	2-3	64K cache

PC 300

6272

Switch	*Position*				*Function*
1-4	**1**	**2**	**3**	**4**	**CPU speed**
	Off	Off	On	On	75 MHz
	Off	Off	On	Off	90 MHz
	Off	Off	Off	On	100 MHz
	On	Off	On	Off	120 MHz
	On	Off	Off	On	133 MHz
	On	On	On	Off	150 MHz
	On	On	Off	On	166 MHz
5	Off*				Reserved
6	Off*				Enable diskette write
	On				Write protected
J6	1-2*				Password enabled
	2-3				Disabled (Clear CMOS)

6282

As for 6272

6562

Switch	Position				Function
1-4	**1**	**2**	**3**	**4**	**CPU speed**
	On	On	On	Off	166 MHz
	Off	On	On	Off	200 MHz
	Off	Off	On	Off	233 MHz
					1&2 = bus/processor core ratio
					3&4 = local bus frequency
5	Off*				Reserved
6	Off*				Enable Ethernet
7	Off*				Privilege Access Password (PAP) disable
8	Off*				Enable diskette write
	On				Write protected
J15	1-2*				Normal
	2-3				CMOS reset

6592

Switch	Position		Function
1,2	**1** (BF0)	**2** (BF1)	**Bus/CPU core ratio**
	On	On	2/5
	On	Off	½
	Off	On	1/3
	Off	Off	2/3 (2/7 P55C)
3,4	**3 CLK0**	**4 CLK1**	**Host bus speed**
	On	On	50 MHz
	Off	On	60 MHz
	On	Off	66 MHz
	Off	Off	Test Mode
5	Off*		Reserved
6	Off*		Enable Ethernet
7	Off*		Privilege Access Password (PAP) disable
8	Off*		Enable diskette write
	On		Write protected
J15	1-2*		Normal
	2-3		CMOS reset

PC 330/350

6577

Switch	Position				Function
1-4	**1**	**2**	**3**	**4**	**CPU speed**
	Off	Off	On	On	75 MHz
	Off	Off	On	Off	90 MHz
	Off	Off	Off	On	100 MHz
	On	Off	On	Off	120 MHz
	On	Off	Off	On	133 MHz
	On	On	On	Off	150 MHz
	On	On	Off	On	166 MHz
	Off	On	Off	On	200 MHz

Switch	Position	Function
6	Off*	Normal diskette operation
	On	Diskette Read-Only
J15	1-2	Password disabled (Clear CMOS)
	2-3*	Enabled

6587

As for 6577

PC 340

6560

Switch	Position		Function
JP3	Short*		Enable Onboard VGA
JP4	Short*		Enable PS/2 mouse
JP9	1-2*		Normal CMOS
	2-3		Clear CMOS
JP11	1-2*		Enable Flash
	2-3		Flash lock
JP13	1-2*		256K cache
	2-3		512K cache
JP14,17	**JP14**	**JP17**	**CPU speed**
	1-2	Open	75 MHz
	3-4	Open	90 MHz
	1-2,3-4	Open	100 MHz
	3-4	1-2	120 MHz
	1-2,3-4	1-2	133 MHz
	1-2,3-4	1-2,3-4	166 MHz
JP19	1-2		STD 3.3v
	2-3*		VRE 3.52v
JP21	1-2*		FDD normal
	2-3		FDD write protect
JP22	1-2*		Non-linear burst, async cache
	2-3		Linear burst sync cache
JP23	1-2*		HDD detect
	2-3		Don't detect

PC 330/350

65X5

Jumper	Position	Function
MRD	1-2	Modem no answer on ring
	2-3*	Modem answer on ring
WP	1-2	Disable writing to diskette
	2-3*	Enable
PWD	1-2*	Password enabled
	2-3	Password reset

65X6

Pentium based

Switch	Position			Function
SW1	**1**	**2**		**L2 cache size**
1-2	On	N/A		0
	Off	Off		256K
	Off	On		512K
SW1	**3**	**4**	**5**	**CMOS setup**
3-5	Off*	Off	Off	Password enabled
	On*	Off	Off	Password reset
	Off	Off*	Off	Normal CMOS
	Off	Off	Off	Reset CMOS
SW1	**6**	**7**	**8**	**Host bus/CPU speed**
6-8	Off	Off	Off	50/75 MHz
	Off	On	Off	60/90 MHz
	Off	Off	On	66/100 MHz
	Off	N/A	N/A	Reserved
J4A2	1-2*			Normal BIOS
	2-3			Flash enabled
	4-5			Reserved
J4J1-2	**J4J1**	**J4J2**		**CPU speed**
	2-3,4-5	2-3,4-5		75 MHz
	2-3,5-6	2-3,4-5		90 MHz
	1-2,4-5	2-3,4-5		100 MHz
	2-3,5-6	2-3,5-6		120 MHz
	1-2,4-5	2-3,5-6		133 MHz
	2-3,5-6	1-2,5-6		150 MHz
	1-2,4-6	1-2,5-6		166 MHz
J4K1	1-2*			ISA ¼ PCI
	2-3			ISA 1/3 PCI
	4-5*			CMOS setup access enabled
	5-6			CMOS setup access disabled
J4K2	1-2*			Normal CMOS
	2-3			Reset CMOS
	4-5*			Normal password
	5-6			Reset password
J5J1	1-3			Normal BIOS flash reset
	1-2			Reset
	5-7 In			ISA 1/8 clock speed
	5-7 Out			ISA 1/6 clock speed
	4,6,8			Reserved
J9C1	1-3*			STD voltage CPU
	5-7			VRE voltage CPU

657X

Switch	Position		Function
JP3,4	**JP3**	**JP4**	**Local Bus**
	1-2	1-2	VESA
	2-3	2-3	PCI
JP8,9	**JP8**	**JP9**	**ECP DMA**
	1-2	1-2	DRQ3*
	2-3	2-3	DRQ1

Switch	Position			Function
JP10	None*			3x clock speed
	3-4			2x clock speed
	1-2			Other
J13	1-2*			Program flash disable
	2-3			Enable
JP14	1-2*			Normal CMOS
	2-3			Clear CMOS
JP15	1-2*			Enable Onboard VGA
	2-3			Disable
JP16,17	**JP16**	**JP17**		**Cache size**
	1-2*	Close*		256K
	2-3	Open		128K
J23-24	**J23**	**J24**		**CPU**
	1-2	Open		486SX*
	2-3	Open		486DX
	2-3	Closed		P24T
JP35-37	**JP35**	**JP36**	**JP37**	**CPU speed**
	On	Off	Off	20 MHz
	Off	On	On	25 MHz*
	Off	On	Off	33 MHz
	Off	Off	On	40 MHz
	Off	Off	Off	50 MHz

658X

As for 657X

PC 360-S150

6598

Switch	Function
1-2,4-5,7-8,11-12	150 MHz CPU, 60 MHz bus, 30 MHz PCI, 7.51 MHz ISA
2-3,5-6,7-8,10-11	150 MHz CPU, 60 MHz bus, 30 MHz PCI, 7.51 MHz ISA
13-14	Password reset
14-15*	Password enabled
16-17	CMOS reset
17-18*	CMOS Normal
19-20	Setup disabled
20-21*	Setup enabled
22-23	Flash recovery enabled
23-24*	Normal
26-27	Reserved

PC730/750

6875

Switch	*Position*				*Function*
J19	Open*				2/3 bus core ratio
	Short				½ bus core ratio
J21-24	**J21**	**J22**	**J23**	**J24**	**Cache size**
	Off	Off	On	On	256K
J26-27	**J2t**	**J27**			**Bus/CPU speed**
	2-3	2-3			50/75
	2-3	1-2			60/90 (120)
	1-2	1-2			66/100 (133)
J28	1-2*				Mouse enabled
	2-3				Disabled
J29	1-2				Diskette read-Only
WP	2-3*				Normal diskette operation
J40	1-2*				Password enabled
PWD	2-3				Password reset (Clear CMOS)

6876

As for 6875

6877

Switch	*Position*				*Function*
1-4	**1**	**2**	**3**	**4**	**CPU speed**
	Off	Off	On	On	75 MHz
	Off	Off	On	Off	90 MHz
	Off	Off	Off	On	100 MHz
	On	Off	On	Off	120 MHz
	On	Off	Off	On	133 MHz
	On	On	On	Off	150 MHz
	On	On	Off	On	166 MHz
5	On*				Enable Administrator password
	Off				Disable
6	Off*				Normal diskette operation
	On				Diskette read-Only
J15	1-2*				Password enabled
	2-3				Disabled (Clear CMOS)

6885

As for 6875

6886

As for 6875

6887

As for 6877

PC/XT

The PC has two sets of switches and 5 expansion slots; the XT 1 set of switches and 8 slots.

Switch Bank 1

Switch	*Position*		*Function*
1	Off		PC – boot from floppy
			XT – normal POST
	On		PC – boot into basic (e.g. not floppy)
			XT – loop POST
2	Off		Coprocessor installed
3,4	**3**	**4**	**Memory banks used on XT** (PC memory)
	On	On	0 only (16K)
	Off	On	0 and 1 (32K)
	On	Off	0, 1 and 2 (48K)
	Off	Off	All 4 (64K)
5,6	**5**	**6**	**Video adapter**
	Off	Off	Mono or more than 1
	Off	On	CGA 40 x 25
	On	Off	CGA 80 x 25
	On	On	With own BIOS
7,8	**7**	**8**	**Floppies**
	On	On	1
	Off	On	2
	On	Off	3
	Off	Off	4

Switch Bank 2

PC only

Memory	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
16	1	1	1	1	0	0	0	0
32	1	1	1	1	0	0	0	0
48	1	1	1	1	0	0	0	0
64	1	1	1	1	0	0	0	0
96	0	1	1	1	0	0	0	0
128	1	0	1	1	0	0	0	0
160	0	0	1	1	0	0	0	0
192	1	1	0	1	0	0	0	0
224	0	1	0	1	0	0	0	0
256	1	0	0	1	0	0	0	0
288	0	0	0	1	0	0	0	0
320	1	1	1	0	0	0	0	0
352	0	1	1	0	0	0	0	0
384	1	0	1	0	0	0	0	0
416	0	0	1	0	0	0	0	0
448	1	1	0	0	0	0	0	0
480	0	1	0	0	0	0	0	0
512	1	0	0	0	0	0	0	0
544	0	0	0	0	0	0	0	0
576	1	1	1	1	0	0	0	0
608	0	1	1	1	0	0	0	0
640	1	0	1	1	0	0	0	0

AT

Jumper	Position	Function
Display	Front	Colour
	Rear	Mono
J18	Front	512K
	Rear	256K

PS/1

486SX - 20/25

Jumper	Position	Function
JP1	In	Enable Video MEMCS16
	Out	Disable
JP3	In	Normal CLK/2
	Out	Turbo
JP7	In	Reset
	Out	Run
JP8	1-2	Internal Battery
	2-3	External
JP9	In	Colour
	Out	Mono
JP10	1-2	Disable onboard VGA
	2-3	Enable
JP14		Reserved
JP15		Reserved
JP16	In	Parity Check enable
	Out	Disable
JP17	In	Enable Video INT9
	Out	Disable
JP23	In	486SX
	Out	486DX
JP24	In	Enable PS/2 interrupt (12)
	Out	Disable
JP26	In	1-2 Beeper
	Out	Speaker

486SX - 20/25

Jumper	Position	Function
JP3	In	Normal CLK/2
	Out	Turbo
JP4	In	27512 EPROM
	Out	27256 EPROM
JP7	In	Reset
	Out	Run
JP8	1-2	Internal Battery
	2-3	External
JP9	In	Colour
	Out	Mono

Jumper	*Position*	*Function*
JP10	1-2	Disable onboard VGA
	2-3	Enable
JP16	In	Parity Check enable
	Out	Disable
JP17	In	Enable VideoMEMCS16
	Out	Disable
JP20	In	1-2 Beeper
	Out	Speaker
JP200	1-2	Direct cache
	2-3	2-way mapping
JP 201	1-2	Direct cache
	2-3	2-way mapping
JP206	In	128K cache
	Out	>128K
JP207	1-2	Reserved
	2-3	Reserved
JP208	In	486SX
	Out	486DX
JP209	In	Enable PS/2 Mouse Interrupt (12)
	Out	Disable
JP304	1-2	Disable video BIOS
	2-3	Enable
JP305	In	Enable Video INT9 (may be shorted)
	Out	Disable

Value Point

386SLC

Jumper	*Position*	*Function*
J8		Password bypass
J12		Beeper bypass
J13	1-2	Power on LED
	3-4	HD LED
J16		IRQ9
J17		VGA enable

486SX-25

Jumper	*Position*	*Function*
JP8	1-2	Battery select
JP10	1-2	VGA disable
JP11	1-2	Power on LED
	4-5	HD LED
JP17		VGA enable
JP23	Open*	SX CPU
	Close	DX CPU
JP24	In	Enable mouse
J26	1-2	Beeper enable

486DX-33

Jumper	*Position*	*Function*
JP4		BIOS select (DX/DX2)
JP8	To rear	Battery select
JP10	To front	VGA enable
JP17	Open	VGA enable
JP11	1-2 4-5	Power on LED HD LED
JP23	Open* Close	SX CPU DX CPU
JP200,1,6		Cache configuration
JP209	In*	Enable mouse
J20	Left	Beeper enable

ICP

Impression Products

www.impression-brand.com

Informtech

(310) 836 8993

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
CC-00	533T-AT		

533T-AT

Same as Kamei something or Mentor BN 533T

Intel

(800) 628-8686 (tech support)
www.intel.com

Advanced/AL

Item	Description	Notes
Form Factor		

Item	Description	Notes
CPU	Pentium	
Speeds (MHz)	75-133	
Chipset	Triton	
BIOS	AMI	NCR 53c810 SCSI not supported
Bus	3 PCI/4 ISA	1 each shared. Use triton.exe
Memory (Mb)	128	FPM/EDO
Cache (K)	256	Pipeline burst
I/O	Floppy, IDE, serial, parallel, game, PS/2 mouse and keyboard.	
Video	ATI Mach64	Up to 2 MB of DRAM. For OS/2, install for VGA then latest Mach64 drivers.
Comments		Used by Gateway.

Advanced/MN

Item	Description	Notes
CPU	Pentium	
Speeds (MHz)	75-133	
Chipset	Triton	
BIOS	AMI	NCR 53c810 SCSI not supported
Bus	3 PCI/4 ISA	1 each shared. Use triton.exe.
Memory (Mb)	128 Mb conventional/EDO	
Cache (K)	256 Kb asynchronous	
I/O	Floppy, IDE, serial, parallel, game	
Video	S3/Trio32	Up to 2 MB of DRAM
Audio		

Advanced MN/LPX

Low profile version of Advanced MN.

Advanced/ZP

Item	Description	Notes
CPU	Pentium	
Speeds (MHz)	75-133	
Chipset	Triton	
BIOS	AMI	NCR 53c810 SCSI not supported
Bus	3 PCI/4 ISA	1 each shared. PCI Bus mastering. Use triton.exe. Large capacitor next to CPU prevents full-length PCI in adjacent slot.
Memory (Mb)	128	FPM/EDO
Cache (K)	256 Kb asynchronous	Asynchronous
I/O	Floppy, IDE, serial, parallel, game	
Video	S3 Trio64	European model
Performance		Turn off PCI bursting for slow video cards.

Advanced/ZE

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	75-133	
Chipset	Triton	
BIOS	AMI	NCR 53c810 SCSI not supported
Bus	4 PCI/5 ISA	1 each shared. PCI Bus mastering. Use triton.exe. Large capacitor next to CPU prevents full-length PCI in adjacent slot.
Memory (Mb)	128	FPM/EDO
Cache (K)	256	Asynchronous
I/O	Floppy, IDE, serial, parallel, game	
Video	S3 Trio64	European model
Audio		
Performance		Turn off PCI bursting for slow video cards.

Advanced/EV

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	75- 166	
Chipset	Triton	
BIOS	AMI	NCR 53c810 SCSI not supported
Bus	3 PCI/4 ISA	1 each shared. PCI Bus mastering. Use triton.exe. Large capacitor next to CPU prevents full-length PCI in adjacent slot.
Memory (Mb)	128	FPM/EDO
Cache (K)	512	Synchronous
I/O	Floppy, IDE, serial, parallel, game	
Video	S3 Trio64	European model
Audio	SoundBlaster 16	
Performance		Turn off PCI bursting for slow video cards. To overclock 120 -33, set:
Problems		
Comments		Does not like Adaptec 2940UW

Performance overclock settings:

CPU	Sw 2	Sw 6	Sw 7	Sw 8
75	OFF	OFF	On	OFF
90	OFF	OFF	OFF	OFF
100	OFF	OFF	On	On
120	On	On	OFF	OFF
133	On	On	On	On

AL440LX

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		
Chipset	440LX	
BIOS		

Item	Description	Notes
Bus	4 PCI/2 ISA	1 each shared
Memory (Mb)	384	SDRAM. 3 DIMM sockets
Cache (K)		
I/O	2S, 1P, USB, IR, PS/2, EIDE, floppy	
Video		AGP
Audio	Yamaha OPL3-SAX	Sometimes
Performance		Average

Jumper	*Position*		*Function*
J8B2	Normal		BIOS uses current configuration and passwords for booting
	2-3	Config	After POST, setup runs automatically (use to change setup)
	None	Recovery	BIOS attempts to recover BIOS configuration (needs diskette)

Front Panel header	
1-2	Power On
3-4	Sleep
6-11	IR
13-16	HDD LED
18-20	Power LED
22-23	Reset
24-27	Speaker

AltServer

Item	Description	Notes
Form Factor		
CPU	2 Pentium	
Speeds (MHz)	75-90	
Chipset	Neptune	
BIOS	AMI Flash	NCR 53c810 SCSI not supported
Bus	3 PCI/4 ISA	1 each shared. Bus mastering
Memory (Mb)	256	8 72-pin sockets
Cache (K)	256	Asynchronous
I/O		AIC7870 fast/wide SCSI controller.
Video	Cirrus Logic 5430	512 Kb- 1 Mb RAM
Audio		
Performance		Only increases by 30% with 2nd 90 MHz CPU and SMP OS.
Problems		
Comments		Primarily for servers

B1440ZX

Item	Description	Notes
Form Factor	ATX	
CPU		Socket 370
Chipset	440 ZX	
BIOS	AMI	
Bus	2 PCI	66 MHz

Item	Description	Notes
Memory (Mb)	256 Mb	
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video	AGP	
Performance		

B486ED (D)

Item	Description	Notes
Form Factor		
CPU	486	DX4, P24T. CPU gives board's model number; e.g. with DX2 it would be B486ED8D266.
Speeds (MHz)	33-100	
Chipset		
BIOS		
Bus	PCI	
Memory (Mb)	64	72-pin SIMMs (parity/non-parity)
Cache (K)	256	128 standard
I/O	2S, 1P, IDE	

CA 810

Item	Description	Notes
Form Factor	Micro-ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		
Chipset	Intel 810	
BIOS		
Bus	4 PCI	UDMA/66
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	2 EIDE, floppy	
Video		
Performance		
Comments		

E186194

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Xeon	SMP Slot 2
Cache		
Chipset	Intel 440GX	
BIOS		
Bus	6 PCI/1 ISA	UDMA/33
Memory (Mb)	2 Gb	4 DIMM sockets
I/O	2 EIDE, floppy USB, IR, Intel 82558 LAN	
Video		AGP 2x
Performance		
Comments		

KN-6000

CPU Speed	Clock Ratio	FREQ1	FREQ2	FREQ3	FREQ4
233 MHz	3.5x	Off	Off	On	On
266 MHz	4x	On	On	Off	On
300 MHz	4.5x	Off	On	Off	On
333 MHz	5x	On	Off	Off	On

Leave jumpers for clock multiplier set to defaults CLK1: 1-2, CLK2: 2-3.

KN-6010

As for KN-6000

PA-2005

Intel

CPU	Host	CLK1	CLK2	CLK3	Ratio	FREQ1	FREQ2
200 MHz	66	1-2	2-3	1-2	3x	1-2	2-3
166 MHz	66	1-2	2-3	1-2	2.5x	2-3	2-3
150 MHz	60	2-3	1-2	1-2	2.5x	2-3	2-3
133 MHz	66	1-2	2-3	1-2	2x	2-3	1-2
120 MHz	60	2-3	1-2	1-2	2x	2-3	1-2
100 MHz	66	1-2	2-3	1-2	1.5x	1-2	1-2
90 MHz	60	2-3	1-2	1-2	1.5x	1-2	1-2
75 MHz	50	2-3	2-3	1-2	1.5x	1-2	1-2

AMD

CPU	Host	CLK1	CLK2	CLK3	Ratio	FREQ1	FREQ2
K6-200	66	1-2	2-3	1-2	3x	1-2	2-3
K6-166	66	1-2	2-3	1-2	2.5x	2-3	2-3
K5-PR200	60	1-2	2-3	1-2	2x	1-2	2-3
K5-PR166	66	1-2	2-3	1-2	1.75x	2-3	2-3
K5-PR150	60	2-3	1-2	2-3	1.75x	2-3	2-3
K5-PR133	66	2-3	1-2	1-2	1.5x	1-2	1-2
K5-PR120	60	1-2	2-3	1-2	1.5x	1-2	1-2
K5-PR100	66	2-3	1-2	1-2	1.5x	1-2	1-2
K5-PR90	60	1-2	2-3	1-2	1.5x	1-2	1-2
K5-PR75	50	2-3	2-3	1-2	1.5x	1-2	1-2

Cyrix

CPU	Host	CLK1	CLK2	CLK3	Ratio	FREQ1	FREQ2
200MX	66	2-3	1-2	1-2	2.5x	2-3	2-3
166MX	60	1-2	2-3	1-2	2.5x	2-3	2-3
P200+	75	1-2	1-2	2-3	2x	2-3	2-3
P166+	66	2-3	1-2	1-2	2x	2-3	1-2
P150+	60	1-2	2-3	1-2	2x	2-3	1-2

CPU	Host	CLK1	CLK2	CLK3	Ratio	FREQ1	FREQ2
P133+	55	1-2	1-2	1-2	2x	2-3	1-2
P120+	60	2-3	2-3	1-2	2x	2-3	1-2

CPU Voltage	VR1	VR2
P54C VRE (3.384)	1-2	1-2,3-4
P54C STD,VR(3.4-3.6)	3-4	1-2,3-4
P55C (2.8V/3.3V)	5-6	5-6,7-8
2.5V/3.3V	5-6	5-6,7-8
2.7-2.9V/3.3V	5-6	5-6,7-8
2.9V/3.3V	7-8	5-6,7-8

Performance

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium Pro	
Speeds (MHz)		
Chipset	450KX (Mars)	
BIOS	Intel Flash	
Bus	4 PCI/3 ISA	2 each shared
Memory (Mb)	128	Parity, non-parity or ECC FPM RAM (60 ns)
Cache (K)		
I/O	2S, 1P, IR	

PIO-3

Intel

	JC1	JC2	JC3	JC4	JC5	RNA	RNC	RNI
486SX	2-3	1-2	Off	Off	Off	Off	Off	Pin1
486DX/DX2/P24S	1-2	1-2	Off	2-3	Off	Off	Off	Pin1
DX4ODP/P24D	1-2	1-2	Off	2-3	Off	Off	Off	Pin1
P24T	1-2	1-2	Off	1-2	On	Off	Off	Pin1
DX4	1-2	1-2	Off	1-2	Off	Off	Off	Pin1

AMD

	JC1	JC2	JC3	JC4	JC5	RNA	RNC	RNI
486DX2 (V)	1-2	1-2	On	Off	Off	On	Off	Off
Enh DX2 (SV)	1-2	1-2	Off	2-3	Off	Off	Off	Pin1
DX4 (V)	1-2	1-2	Off	Off	Off	On	Off	Off
Enh486DX4(NV,SV)	1-2	1-2	Off	1-2	Off	Off	Off	Pin1
X5	1-2	1-2	Off	2-3	Off	Off	Off	Pin1

Other CPUs

	JC1	JC2	JC3	JC4	JC5	RNA	RNC	RNI
UMC U5SD	1-2	1-2	Off	Off	Off	On	Off	Off
UMC U5S, U5SLV	2-3	2-3	Off	Off	Off	On	Off	Off
Cyrix DX, DX2	1-2	1-2	Off	Off	Off	Off	On	Off
TI DX2, DX4	1-2	1-2	Off	Off	Off	Off	On	Off
Cyrix DX4, 5x86	1-2	1-2	Off	1-2	Off	Off	Off	Last pin

Function	*Pins*				*Description*
JPW1,2	**JPW1**	**JPW2**			**CPU voltage**
	1-2	Off			3.3v
	2-3	Off			3.45v
	Off	1-2			3.6v
	Off	2.3			4v
	Doesn't matter				5v
JK1-4	**JK1**	**JK2**	**JK3**	**JK4**	**CPU clock**
	1-2	1-2	2-3	2-3	50 MHz
	2-3	1-2	2-3	1-2	40 MHz
	1-2	2-3	1-2	2-3	33 MHz
	1-2	1-2	1-2	1-2	25 MHz
JCP	On				Clear password
Video	Off				CGA
	On				Others
JW1,2	1-2				COM2 standard
	2-3				Infra Red
JW3,4	1-2				ECP DMA1
	2-3				ECP DMA 3
J1	1-2				Intel 28F001BX-T EPROM (12v)
	2-3				SST 29EE101 (5v)
J3	On				TB LED Green mode
	Off				TB LED Turbo mode
J11	On				LPT output only
	Off				Bidirectional
JT1,JCK	1-2				50MHz or 40MHz clock
	2-3				25MHz or 33MHz clock

Plato

Function	*Pins*	*Description*
J1H3	1-2	50 MHz host bus clock
	2-3	60 MHz host bus clock
J1H4	1-2	66 MHz (undocumented)

In front of 2nd PS/2 slot (from the right).

Premiere

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	60/66	

Item	Description	Notes
Chipset	Mercury	
BIOS	AMI Flash	
Bus	3 PCI/5 ISA	1 each shared
Memory (Mb)	128	4 72-pin sockets
Cache (K)	256	
I/O	2S, 1P, IDE	CMD for IDE. NCR SCSI built in.
Problems		Problems with SCSI? With ATI card and internal modem, turn off intelligent remapping of COM ports to avoid conflicts with ATI card and COM 4. For NCR SCSI controller, set IRQ9 to “used by ISA card” during install. If running SCSI as boot drive, turn off drive C: timeout for faster boot.
Comments		

Premiere II

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	75/90/100	
Chipset	Neptune	
BIOS	AMI Flash	
Bus	3 PCI/5 ISA	1 each shared
Memory (Mb)	128	4 72-pin sockets
Cache (K)	256	
I/O	2S, 1P, IDE	RZ1000 for IDE. NCR SCSI built in. The SMC chip controlling serial ports should have the letters "GT" after it for trouble-free communications.
Video		
Audio		
Performance		To overclock to 100 MHz, move "reserved" jumper (J13) to pins 1 & 2 (75 MHz side) from 2 & 3 (75/90 side).
Problems		Need v1.00.10.AX1 of BIOS to fix problems with Access Timing (GAT) and BackMaster 1.1. With ATI card and internal modem, turn off intelligent remapping of COM ports to avoid conflicts with ATI card and COM 4. For NCR SCSI controller, set IRQ9 to 'used by ISA card' during install. If running a SCSI as boot drive, turn off drive C: timeout for faster boot.
Comments		

PN-6010

Function	*Pins*			*Description*
CLK1,2	**CLK1**	**CLK2**		**External clock**
	1-2	Off		66 MHz
	2-3	Off		60 MHz
JK1-4	**FREQ1**	**FREQ2**	**FREQ3**	**Clock Ratio**
	Close	Close	Open	4x
	Open	Open	Close	3.5x
	Close	Open	Close	3x
	Open	Close	Close	2.5x
VR1	All open			ATX power supply
	1-2,3-4			Standard power supply

PN-6210

Function	*Pins*				*Description*
CLK1,2	CLK1	CLK2			External clock
	1-2	2-3			66 MHz
	2-3	1-2			60 MHz
	2-3	2-3			50 MHz
JK1-4	**FREQ1**	**FREQ2**	**FREQ3**	**FREQ4**	**Clock Ratio**
	On	On	Off	On	4x
	Off	Off	On	On	3.5x
	On	Off	On	On	3x
	Off	On	On	On	2.5x
	On	On	On	On	2x

PT-2006

Intel

CPU	Host	CLK1	CLK2	Ratio	FREQ1	FREQ2
233 MHz*	66	2-3	1-2	1.5x	1-2	1-2
200 MHz	66	2-3	1-2	3x	1-2	2-3
166 MHz	66	1-2	2-3	2.5x	2-3	2-3
150 MHz	60	1-2	2-3	2.5x	2-3	2-3
133 MHz	66	2-3	1-2	2x	2-3	1-2
120 MHz	60	1-2	2-3	2x	2-3	1-2
100 MHz	66	2-3	1-2	1.5x	1-2	1-2
90 MHz	60	1-2	2-3	1.5x	1-2	1-2
75 MHz	50	2-3	2-3	1.5x	1-2	1-2

* use P55C voltage (for MMX)

AMD

CPU	Host	CLK1	CLK2	Ratio	FREQ1	FREQ2
K5-PR166	66	2-3	1-2	2.5x	2-3	2-3
K5-PR133	66	2-3	1-2	2x	2-3	1-2
K5-PR120	60	1-2	2-3	2x	2-3	1-2
K5-PR100	66	2-3	1-2	1.5x	1-2	1-2
K5-PR90	60	1-2	2-3	1.5x	1-2	1-2
K5-PR75	50	1-2	1-2	1.5x	1-2	1-2

Cyrix

CPU	Host	CLK1	CLK2	Ratio	FREQ1	FREQ2
M2 200	66	2-3	1-2	3x	1-2	2-3
M2 180	60	1-2	2-3	3x	1-2	2-3
M2 166	66	2-3	1-2	2.5x	2-3	2-3
P166+	66	2-3	1-2	2x	2-3	1-2
P150+	60	1-2	2-3	2x	2-3	1-2
P133+	55	1-2	1-2	2x	2-3	1-2
P120+	50	2-3	2-3	2x	2-3	1-2

CPU Voltage <10/96	VR1	VR2
P54C STD, VR (3.384V)	1-2	5-6,7-8
P54C VRE (3.49V)	3-4	5-6,7-8
P55C (2.8V/3.3V)	7-8	1-2,2-3

CPU Voltage >10/96	VR1	VR2
P54C STD, VR (3.4-3.6)	1-2	5-6,7-8
P54C VRE (3.3)	3-4	5-6,7-8
P55C (2.8V/3.3V)	7-8	1-2,3-4
2.5V/3.3V	9-10	1-2,3-4
2.9V/3.3V	5-6	1-2,3-4

Function	*Pins*		*Description*	
CPS	Open		Normal	
	Close		Clear password	
SRAM1	**SRAM1**	**R146**	**Onboard cache**	**Module (>COAST 3)**
R146	1-2	On	256K	0
	1-2	On	0	256K
	2-3	On	256K	256K
	2-3	Open	512K	0
	2-3	Open	0	512K

PT-2011

Intel

CPU	Host	CLK1	CLK2	CLK3	Ratio	FREQ1	FREQ2	FREQ3
233 MHz	66	1-2	1-2	2-3	1.5x	1-2	1-2	1-2
200 MHz	66	1-2	1-2	2-3	3x	1-2	2-3	1-2
166 MHz	66	1-2	1-2	2-3	2.5x	2-3	2-3	1-2
150 MHz	60	2-3	1-2	2-3	2.5x	2-3	2-3	1-2
133 MHz	66	1-2	1-2	2-3	2x	2-3	1-2	1-2
120 MHz	60	2-3	1-2	2-3	2x	2-3	1-2	1-2
100 MHz	66	1-2	1-2	2-3	1.5x	1-2	1-2	1-2
90 MHz	60	2-3	1-2	2-3	1.5x	1-2	1-2	1-2
75 MHz	50	Not supported						

AMD

CPU	Host	CLK1	CLK2	CLK3	Ratio	FREQ1	FREQ2	FREQ3
K6-233	66	1-2	1-2	2-3	3.5x	1-2	1-2	1-2
K6-200	66	1-2	1-2	2-3	3x	1-2	2-3	1-2
K6-166	66	1-2	1-2	2-3	2.5x	2-3	2-3	1-2
K5-PR200	66	1-2	1-2	2-3	2x	1-2	2-3	1-2
K5-PR166	66	1-2	1-2	2-3	1.75x	2-3	2-3	1-2
K5-PR150	60	2-3	1-2	2-3	1.75x	2-3	2-3	1-2
K5-PR133	66	1-2	1-2	2-3	1.5x	1-2	1-2	1-2
K5-PR120	60	2-3	1-2	2-3	1.5x	1-2	1-2	1-2

CPU	Host	CLK1	CLK2	CLK3	Ratio	FREQ1	FREQ2	FREQ3
K5-PR100	66	1-2	1-2	2-3	1.5x	1-2	1-2	1-2
K5-PR90	60	2-3	1-2	2-3	1.5x	1-2	1-2	1-2
K5-PR75	50	Not supported						

Cyrix

CPU	Host	CLK1	CLK2	CLK3	Ratio	FREQ1	FREQ2	FREQ3
M2 200	66	1-2	1-2	2-3	3x	1-2	1-2	1-2
M2 180	60	2-3	1-2	2-3	3x	1-2	2-3	2-3
M2 166	66	1-2	1-2	2-3	2.5x	2-3	2-3	2-3
M2 150	60	2-3	1-2	2-3	2.5x	2-3	2-3	2-3
P200+		Not supported						
P166+	66	1-2	1-2	2-3	2x	2-3	1-2	1-2
P150+	60	2-3	1-2	2-3	2x	2-3	1-2	1-2
P133+	55	2-3	2-3	2-3	2x	2-3	1-2	1-2
P120+	50	Not supported						

CPU Voltage >10/96	VR1	VR2
P54C STD, VR (3.384V)	1-2	1-2,3-4
P54C VRE (3.49V)	3-4	1-2,3-4
P55C (2.8V/3.3V)	9-10	5-6,7-8
K5 "B" (3.5V)	1-2	1-2,3-4
K6-233 (3.2/3.3V)	5-6	5-6,7-8
K6-166/200 (2.9V/3.3V)	7-8	5-6,7-8
Cyrix 3.52V (028)	1-2	1-2,3-4
Cyrix 6x86L (2.8V/3.3V)	9-10	5-6,7-8

PT-2200

Intel

CPU	Host	CLK1	CLK2	Ratio	FREQ1	FREQ2
233 MHz	66	1-2	2-3	1.5x	1-2	1-2
200 MHz	66	1-2	2-3	3x	2-3	2-3
166 MHz	66	1-2	2-3	2.5x	2-3	2-3
150 MHz	60	2-3	1-2	2.5x	2-3	2-3
133 MHz	66	1-2	2-3	2x	2-3	1-2
120 MHz	60	2-3	1-2	2x	2-3	1-2
100 MHz	66	1-2	2-3	1.5x	1-2	1-2
90 MHz	60	2-3	1-2	1.5x	1-2	1-2
75 MHz	50	2-3	2-3	1.5x	1-2	1-2

AMD

CPU	Host	CLK1	CLK2	Ratio	FREQ1	FREQ2
P166	66	1-2	2-3	2x	2-3	1-2
P150	50	2-3	1-2	2x	2-3	1-2
P133	66	1-2	2-3	1.5x	1-2	1-2

CPU	Host	CLK1	CLK2	Ratio	FREQ1	FREQ2
P120	60	2-3	1-2	1.5x	1-2	1-2
P100	66	1-2	2-3	1.5x	1-2	1-2
P90	60	2-3	1-2	1.5x	1-2	1-2
P75	50	2-3	2-3	1.5x	1-2	1-2

Cyrix

CPU	Host	CLK1	CLK2	Ratio	FREQ1	FREQ2
M2 200	66	1-2	2-3	3x	1-2	2-3
M2 180	60	2-3	1-2	3x	1-2	2-3
M2 166	66	1-2	2-3	2.5x	2-3	2-3
P166+	66	1-2	2-3	2x	2-3	1-2
P150+	60	2-3	1-2	2x	2-3	1-2
P133+	55	1-2	1-2	2x	2-3	1-2
P120+	50	2-3	2-3	2x	2-3	1-2

CPU Voltage > 10/96	VR1	VR2
P54C STD, VR (3.4-3.6)	1-2	1-2,2-3
P54C VRE (3.3)	3-4	1-2,3-4
P55C (2.8V/3.3V)	5-6	5-6,7-8
2.5V/3.3V	7-8	5-6,7-8

CPU Voltage < 10/96	VR1	VR2
P54C STD, VR (3.384V)	1-2	1-2
P54C VRE (3.49V)	3-4	3-4
P55C (2.5V/3.3V)	5-6	5-6

Function	*Pins*	*Description*
CPS	Open	Normal
	Close	Clear password

SE 440BX(2)

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Katmai	Slot 1
Speeds (MHz)		
Chipset	440BX	
BIOS	AMI	
Bus	3 PCI/1 ISA	
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video	AGP	
Audio	Yamaha XG	
Performance		Poor
Problems		Poor documentation
Comments		

SR 440BX

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		
Chipset	440BX	
BIOS		
Bus	4 PCI/2 ISA	
Memory (Mb)	512 Mb	2 DIMM sockets
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA/33
Video	nVIDIA Riva TNT	16 Mb
Audio	SB PC164D	ESS?

VC 820

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III	Slot 1
Speeds (MHz)		
Chipset	Intel 820	
BIOS		
Bus	5 PCI/1 AMR	
Memory (Mb)	1024 Mb RDRAM	3 RIMM sockets
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA/66 100-133
Video	AGP	
Audio	ES1373	
Performance		Poor
Comments		Also look at the SuperMicro PIIISCE

VS440FX

CPU speed	Host bus speed	Pins		
200 MHz	66 MHz	19-21	12-14	9-11
180 MHz	60 MHz	17-19	12-14	9-11
166 MHz	66 MHz	19-21	10-12	11-13
150 MHz	60 MHz	17-19	10-12	11-12

Function	*Pins*	*Description*
CMOS Clear	20-22	Keep*
	18-20	Clear
Password Clear	27-29	Keep*
	25-27	Clear
Setup Access	28-30	Enabled*
	26-28	Disabled
BIOS Recovery	4-6	Normal*
	2-4	Recovery mode

Front Panel header	
1-2	Power On
3-4	Sleep
6-11	IR
13-16	HDD LED
18-20	Power LED
22-23	Reset
24-27	Speaker

VL-601

Clock settings set in CMOS

CPU	Bus	Ratio	FREQ4	FREQ3	FREQ2	FREQ1
333 MHz	66	5x	Close	Open	Open	Open
300 MHz	66	4.5x	Close	Open	Close	Open
266 MHz	66	4x	Close	Open	Close	Close
233 MHz	66	3.5x	Close	Close	Open	Open

VT-502

Intel

CPU	Host	CLK1	CLK2	CLK3	Ratio	FREQ1	FREQ2	FREQ3
233 MHz	66	1-2	1-2	1-2	3.5x	1-2	1-2	1-2
200 MHz	66	1-2	1-2	1-2	3x	1-2	2-3	1-2
166 MHz	66	1-2	1-2	1-2	2.5x	2-3	2-3	1-2
150 MHz	60	2-3	1-2	1-2	2.5x	2-3	2-3	1-2
133 MHz	66	1-2	1-2	1-2	2x	2-3	1-2	1-2
120 MHz	60	2-3	1-2	1-2	2x	2-3	1-2	1-2
100 MHz	66	1-2	1-2	1-2	1.5x	1-2	1-2	1-2
90 MHz	60	2-3	1-2	1-2	1.5x	1-2	1-2	1-2
75 MHz	50	Not supported						

AMD

CPU	Host	CLK1	CLK2	CLK3	Ratio	FREQ1	FREQ2	FREQ3
K6-233	66	1-2	1-2	1-2	3.5x	1-2	1-2	1-2
K6-200	66	1-2	1-2	1-2	3x	1-2	2-3	1-2
K6-166	66	1-2	1-2	1-2	2.5x	2-3	2-3	1-2
K5-PR200	66	1-2	1-2	1-2	2x	1-2	2-3	1-2
K5-PR166	66	1-2	1-2	1-2	1.75x	2-3	2-3	1-2
K5-PR150	60	2-3	1-2	1-2	1.75x	2-3	2-3	1-2
K5-PR133	66	1-2	1-2	1-2	1.5x	1-2	1-2	1-2
K5-PR120	60	2-3	1-2	1-2	1.5x	1-2	1-2	1-2
K5-PR100	66	1-2	1-2	1-2	1.5x	1-2	1-2	1-2
K5-PR90	60	2-3	1-2	1-2	1.5x	1-2	1-2	1-2
K5-PR75	50	Not supported						

Cyrix

CPU	Host	CLK1	CLK2	CLK3	Ratio	FREQ1	FREQ2	FREQ3
M2 200	66	2-3	1-2	2-3	3x	1-2	1-2	1-2
M2 166	60	2-3	1-2	1-2	2.5x	2-3	2-3	2-3
P200+		Not supported						
P166+	66	1-2	1-2	2-3	2x	2-3	1-2	1-2
P150+	60	2-3	1-2	2-3	2x	2-3	1-2	1-2
P133+	55	2-3	2-3	2-3	2x	2-3	1-2	1-2
P120+	50	Not supported						

CPU Voltage	VR1	VR2
P54C STD, VR (3.3V)	1-2	Open
P54C VRE (3.5V)	3-4	Open
P55C (2.8V/3.3V)	9-10	1-2,3-4
AMD K5 "B" (3.5V)	1-2	Open
AMD K6-166/200 (2.9V/3.3V)	7-8	1-2,3-4
Cyrix 3.52V (028)	1-2	open
Cyrix 6x86L (2.8V/3.3V)	9-10	1-2,3-4
Cyrix 6x86MX (2.9V/3.3V)	7-8	1-2,3-4

VT-503

Clock speed is determined in CMOS.

Intel

CPU	Host	Ratio	FREQ1	FREQ2	FREQ3
233 MHz	66	1.5x	1-2	1-2	1-2
200 MHz	66	3x	1-2	2-3	1-2
166 MHz	66	2.5x	1-2	2-3	2-3
150 MHz	60	2.5x	1-2	2-3	2-3
133 MHz	66	2x	1-2	1-2	2-3
120 MHz	60	2x	1-2	1-2	2-3
100 MHz	66	1.5x	1-2	1-2	1-2
90 MHz	60	1.5x	1-2	1-2	1-2
75 MHz	50	1.5x	1-2	1-2	1-2

AMD

CPU	Host	Ratio	FREQ1	FREQ2	FREQ3
K6-300	66	4.5x	2.3	2-3	2-3
K6-266	66	4x	2-3	1-2	2-3
K6-233	66	3.5x	1-2	1-2	1-2
K6-200	66	3x	1-2	2-3	1-2
K6-166	66	2.5x	1-2	2-3	2-3
K5-PR200	66	2x	1-2	2-3	1-2
K5-PR166	66	1.75x	1-2	2-3	2-3
K5-PR150	60	1.75x	1-2	2-3	2-3
K5-PR133	66	1.5x	1-2	1-2	1-2

CPU	Host	Ratio	FREQ1	FREQ2	FREQ3
K5-PR120	60	1.5x	1-2	1-2	1-2
K5-PR100	66	1.5x	1-2	1-2	1-2
K5-PR90	60	1.5x	1-2	1-2	1-2

CPU	Host	Ratio	FREQ1	FREQ2	FREQ3
M2 266	66	3.5x	1-2	1-2	1-2
M2 233	66	3x	1-2	1-2	1-2
M2 200	60	3x	1-2	1-2	1-2
M2 166	60	2.5x	1-2	2-3	2-3
P166+	66	2x	1-2	1-2	2-3
P150+	60	2x	1-2	1-2	2-3
P133+	55	2x	1-2	1-2	2-3

CPU Voltage	VR1
P54C STD, VR (3.3V)	1-2,5-6,7-8
P54C VRE (3.5V)	1-2,3-4,5-6,7-8
P55C (2.8V/3.3V)	7-8
AMD K6 166,200 (2.9V/3.3V)	1-2,7-8
AMD K6 233 (3.2V/3.3V)	5-6,7-8
AMD K6 266,300 (2.1V/3.3V)	1-2
Cyrix 6x86MX (2.9V/3.3V)	1-2,7-8

Inventa

Inventec

Itri

Iwill

Quick Technology
(800) 950 8999
www.iwill.com
www.iwillusa.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
AC	P54TS/P55TV Lite	DC	P55TU
BC	P55XUB	EC	P54TSW2
DC	T54TS		

DBS100

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	SMP Slot 1
Cache		
Chipset	Intel 440BX	
BIOS		
Bus	4 PCI/2 ISA	
Memory (Mb)	1 Gb	4 DIMM sockets
I/O	2 EIDE, floppy USB, IR	Adaptec AIC-7895P
Video		AGP 2x
Performance		
Comments		

J

Jamicon

(818) 333 9168

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C-00	KM-T5-V2		

Jaton Corp

www.jaton.nl

JBond

J. Bond Computer Systems
(408) 946-9622
www.jbond.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1-00	PCI 400C-C	A-00	PCI 500C-D
1C-00	PCI 500C-B or -C	AC-01	PCI 500C-H2
9C-02	PCI 500C-H	HC-00	PCI 500C-E

PCI400C-A

Item	Description	Notes
Form Factor		
CPU	486	DX2-66, P24T
Speeds (MHz)	66	
Chipset	Saturn	
BIOS	Phoenix	
Bus	3 PCI/4 ISA	2 PCI/5 ISA? 1 each shared
Memory (Mb)		4 72-pin 36-bit SIMMs, in identical pairs
I/O		Built-in NCR SCSI
Problems		Disable L2 Cache for reliable SCSI operation.

PCI400C-C

Item	Description	Notes
Form Factor		
CPU	486	P24T. 5 and 3.3v
Chipset	SiS	
Bus	3 PCI/4 ISA	PCI are busmasters
Memory (Mb)	128	
I/O	2S, 1P	
Comments		Later revision of 400-A

PCI500C-A

Item	Description	Notes
Chipset	Mercury	
BIOS	Phoenix	
Bus	4 PCI/4 ISA	
Memory (Mb)		4 72-pin sockets
Cache (K)	512 Kb	
I/O		NCR 53c810 SCSI
Performance		Disable CPU Cache (L1) for reliable operation, at least on early boards.

JDR Microdevices (HK)

2theMax
www.2themax.com

Jetta

(908) 329 9651

Jetway

Also known as Jet Fair or maybe Jetboard
(818 856 5800
www.jetway.com.tw

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0	J 403TG	AC	J 656HXA
1	J 403TG	AC-00	J 656VXA
1-00	J 433, 435 or 437	CC	J 656B
1C	J 656-VXD/J 646C	CC-00	J 656VXB v3.0 or 656VXC/P
1-00	J 636/J 446 A v2.0	DC	J 656C/VXB
9	J 636	U	J 756A (P Pro)
9C	J 656/VXB	H	J 426
9C-00	J 5TXBR2/J 648A/J 636	HC	J 426
9C-00	J 446 A V2.0	W	J 646A

J 5TXC/L

Jumper	*Position*				*Function*
JP2	2-3				Normal
	3-4				Clear CMOS
JP3	1-2				12v Flash ROM
	2-3				5v Flash ROM
JP4	**1-2**	**3-4**	**5-6**	**7-8**	**CPU voltage**
	In	In	In	In	3.52 (single)
	Out	In	In	In	3.45
	In	Out	In	In	3.3
	Out	Out	In	In	3.2
	In	Out	Out	In	2.9
	Out	Out	Out	In	2.8
	In	Out	Out	Out	2.1
U22	**1**	**2**	**3**		**Clock multiplier**
	Off	Off	Off		1.5x
	Off	Off	On		2x
	Off	On	On		2.5x
	Off	On	Off		3x
	Off	Off	Off		3.5x
	On	Off	On		4x
	On	On	On		4.5x
	4	**5**	**6**		**Bus frequency**
	Off	Off	On		60 MHz
	Off	Off	Off		66 MHz
	Off	On	Off		75 MHz
	On	On	On		83 MHz

J 571B

Item	Description	Notes
Form Factor	Baby AT	22 x 22 cm
CPU	Pentium	P54C/Cyrix M1/AMD K5, Intel P55C (MMX)/Cyrix M2 (MMX)/AMD K6 (MMX)
Speeds	75-300	
Chipset	SiS 5571	
Bus	3 PCI/4 ISA	
Memory	256	FPM, EDO, SDRAM. 2 x 72-pin SIMMs and 2 x 168-pin DIMMs (3.3V).
Cache (K)	512	Pipelined Burst SRAM
I/O	2S, 1P, IR, Floppy, EIDE, PS/2, USB	

Jumper	*Position*	*Function*
JP3	1-2	5v Flash ROM (SST, Winbond)
	2-3	12v (Intel)
JP7	1-2	Normal
	2-3	Clear CMOS
JP13	1-2	3.3v CPU
	2-3	3.45v CPU
TB-SW	1-2	SMI suspend switch
	2-3	Turbos switch

Voltage	1-2	3-4	5-6	7-8	9-10	11-12	13-14
2.1V	open	open	open	open	open	open	Short
2.8V	open	open	open	open	open	Short	open
2.9V	open	open	open	open	Short	open	open
3.2V	open	open	open	Short	open	open	open
3.3V	open	open	Short	open	open	open	open
3.45V	open	Short	open	open	open	open	open
3.52V	Short	open	open	open	open	open	open

JossTech

www.josstech.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1-00	JT 586IP4	BC	JT 586TS4
9C-00	JT 586TS4/IV4	C-00	J 646C
AC	JT 586TS4		

K

Kaimei

Association with Jamicon?

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0C-00	KM-S4-1 PCI rev 5.1	2C-00	KM-S4-1 v4.2/4.3

KM-S4-1 PCI rev 5.1

Same as Azza 4SIG or Rectron RT-4S3

Kam-Tronic

MegaStar
megastar.kamtronic.com

Kapok

Kinpo

Koutech Systems

www.koutech.com

Notes

L

LAN Plus

www.lan-plus.com

Lanix

www.lanix.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1C	PM 900		

Lanner

Leading Edge

D3/SX

Jumper	*Position*	*Function*
15	1-2	Enable mouse
	2-3	Disable

Lexar

Out of Business.

LXM-510(D)

Item	Description	Notes
CPU	486	P24T. For 3.3v CPUs, use Model 99 Regulator
Chipset	IMS	Integrated Micro Solutions
BIOS	Award/AMI Flash	
Bus	2 PCI/2 ISA/2 VL	
Memory (Mb)	128	8 30-pin sockets
I/O	2S, 1P, PS/2	
Comments		Early boards had separate connectors for PCI 3.3v, later replaced with separate voltage regulator. Manual is rubbish.

Lucky Star

www.lucky-star.com.tw
Something to do with Flamingo?

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
2C-00	P 407 rev 2	AC	6AIX2 (Jumperless)
3	4C-1	BC-00	P55CE Rev DW83707/87
3C	LS 486E	CC-00	P55CE-C2/P54CE
9C	6LX2/ P54CE/5V-2	FC	P54CE
9C-00	CH5T		

P54CE

Same as Flamingo 5I-VX1C

5I-VX1C

Same as Flamingo MB-FLM-TX01

6ABX2V

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	550 MHz	Faster with DIP switch version of board
Chipset	440BX	
BIOS	Award 4.51PG	
Bus	5 PCI/2 ISA	
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2S, 1P, USP, PS/2	UDMA 3
Video		AGP
Comments		Only 2 jumpers

Lucky Tiger

Notes

M

Macrotech

Matra

(818) 855 1820

Matsonic

www.matsonic.com

Megastar

www.megastar.kamtronic.com

Mega System Co

www.computersources.com.hk/mega/

Megatrends Technology

www.megacom.com

Memorex Telex

7006

Jumper	*Position*	*Function*
JP1	1-2*	256K SIP DRAM for EMS
	2-3	1 Mb SIP DRAM for EMS
JP5	Out	Disable video IRQ2

7010

Jumper	*Position*		*Function*
JB1	A		Mono monitor
JB2	In		EGA
	Out		Mono
JB3	In		Hercules video
	Out		Disable
JB4	A		27256 Video BIOS EPROM
	B		27128 Video BIOS EPROM
JB5,7	**JB5**	**JB7**	**Boot Select**
	Out	Out	Unused
	Out	In	Boot from network
	In	Out	Unused
	In	In	Unused
JB6	A		27256 BIOS EPROM
	B		27512 BIOS EPROM
JB8	A		RAM size select unsued
	B		640K
JB9	In		Enable COM2
	Out		Disable
JB10	In		Enable extended diagnostics
	Out		Disable
JB11	A		LAN IRQ9
	B		LAN IRQ5
JB12	A		Disable LAN
	B		Enable LAN
JB13,14	**JB13**	**JB14**	**LAN response time**
	Out	Out	74.7 ms
	Out	In	283.4 ms
	In	Out	561.8 ms
	In	In	1118.6 ms

7022

Jumper	*Position*	*Function*
W2	1-2*	0.7 wait state
	2-3	0 wait state
W3	1-2	Mono display
	2-3*	Colour display

Jumper	*Position*	*Function*
W4	1-2	Disable floppy
	2-3*	Enable floppy
W5	1-2*	HD floppy write current
	2-3	HD floppy RPM
W9	1-2	12 MHz maths copro
	2-3*	16 MHz maths copro
W11	1-2	Disable VGA
	2-3*	Enable VGA
W12		IDE access
W15	1-2*	Enable IRQ9
	2-3	Disable
W16	In*	Enable PS2 mouse (IRQ12)
	Out	Disable

7025

Jumper	*Position*	*Function*
W2	Out	Enable VGA
	In	Disable
1W8	Out	ANSI 3.5" (ignore pin 2)
	1-2	AT 3.5" diskette
	2-3	PS/2 3.5" diskette
W9	Out	Normal POST
	In	Continuous POST
W12	Out	Mono display (not with VGA)
	In	Colour display (not with VGA)

7040

Jumper	*Position*	*Function*
ST1	1-2*	IRQ10=SCSI HD
	2-3	IRQ14=ST506 HD
ST2	In*	SCSI controller enabled
ST3	In*	SCSI DMA (DACK3) enabled
	Out	Disabled
ST4	1-2*	27256 ROM BIOS
	2-3	27512 ROM BIOS
ST6	In*	Enable COM1
ST7	In*	Enable PS/2 mouse (IRQ12)
	Out	Disable
ST9	In*	Enable COM2
ST10	In*	Floppy enabled
	Out	Disabled
ST11	In	Extension 512K or 2 Mb enabled
	Out*	Disabled
ST12	In*	640K onboard RAM enabled
	Out	Disabled
ST18	In*	Enable VGA
ST22	In*	I/O wait state generator enabled
	Out	Disabled
ST23	In*	Enable DMA2 for floppy

Jumper	*Position*		*Function*
	Out		Disable
ST26	1-2*		Enable LPT1 (378h)
	2-3		Enable LPT2 (278h)
ST32	In*		Long ALE enabled
	Out		Disabled
ST34	1-2		LPT2 IRQ5 enabled
	2-3*		LPT1 IRQ7 enabled
ST37	In		6v battery
	Out*		2 x 3v batteries
ST 38	In*		Enable SCSI DMA (DRQ3)
ST39	In*		COM2 IRQ3 enabled
	Out		Disabled
ST40	1-2		External battery
	2-3*		Internal battery
ST42	In*		COM1 IRQ4 enabled
	Out		Disabled
ST44,45	**ST44**	**ST45**	**VGA**
	In*	In*	Enable
	Out	Out	Disable
SW2	**S1**	**S2**	**Display Type**
S1-2	Off	Off	VGA
	On	On	EGA
	On	Off	Mono
	Off	On	CGA
SW2	**S3**	**S4**	**Language**
S3-4	Off	Off	French
	On	Off	Spanish
	On	On	English
	Off	On	German
SW2	On		ST506 interface
S5	Off		SCSI interface
SW2	On		HD IRQ14 (ST 506)
S6	Off		HD IRQ10 (SCSI)

7045/D

Jumper	*Position*	*Function*
JP1	1-2	COM1 IRQ4
	2-3*	COM2 IRQ3
JP2	1-2*	COM2 IRQ4
	2-3	COM1 IRQ3
JP3		Reserved
JP4	1-2	27128 EPROM
	2-3*	27256 EPROM
JP5	1-2*	12 MHz CPU clock
	2-3	8 MHz CPU clock
JP6	1-2	Auto reset
	2-3*	POST once
JP7	1-2	Enable HD controller port 157h
	2-3*	Disable HD
JP8	Out*	Reserved
JP9	1-2*	Enable floppy

Jumper	*Position*	*Function*
	2-3	Disable
JP10	Out*	Reserved
JP11	1-2	Floppy address 37xh
	2-3*	Floppy address 3Fxh
JP12	1-2*	16-bit video
	2-3	8-bit video
JP13		Reserved
JP14	1-2	COM1 2F8h
	2-3*	COM1 3F8h
	All out	Disable
JP15	1-2	COM2 2F8h
	2-3*	COM2 3F8h
	All out	Disable
JP17	1-2	Not used
	2-3*	36 MHz video clock (800x600)
JP18	1-2	Disable video
	2-3	Enable video
JP19	1-2	LPT IRQ7
	2-3	LPT IRQ5
JP20	1-2	Enhanced colour display
	2-3	Mono/colour display

Display	S2	S3	S4	S5	S6	JP12	JP18	JP20
Analogue	Off	Off	Off	Off	Off	1-2	2-3	1-2
Enh RGB	On	On	Off	On	Off	1-2	2-3	1-2
Colour RGB	Off	Off	On	On	Off	1-2	2-3	2-3
TTL mono	Off	On	Off	On	Off	1-2	2-3	2-3
Disabled	Off	Off	Off	Off	Off	2-3	1-2	1-2

7065

Jumper	*Position*		*Function*
JP5	1-2*		LPT1 IRQ7
	2-3		LPT2 IRQ5
JP6-7	**JP6**	**JP7**	**COM IRQ**
	1-2	1-2*	COM2 IRQ4
	2-3*	2-3	COM1 IRQ3
JP8	1-2		LPT2 278h
	2-3*		LPT1 378h
JP9-10	**JP9**	**JP10**	**COM Address**
	1-2	1-2*	COM2 2F8h
	2-3*	2-3	COM1 3F8h
JP11	1-2		HD adapter installed
	2-3*		Not installed
JP12	1-2*		Floppy enabled
	2-3		Disabled
JP13	1-2		Floppy address 38xh
	2-3*		Floppy address 3Fxh
JP20,21	**JP20**	**JP21**	**Clock speed**
	In*	Out*	8 MHz
	Out	In	10 MHz

Jumper	*Position*	*Function*
JP22	1-2	Reserved
	2-3*	Normal boot
JP24	1-2	80387 installed
	2-3*	Not installed

7070

Jumper	*Position*				*Function*
JP5	1-2				27512 ROM
	2-3*				27256/27128 ROM
JP6-8	**JP6**	**JP7**	**JP8**		**Maths copro**
	1-2	1-2	1-2		Enable
	2-3	2-3	2-3		Disable or WTL1167*
JP9	1-2*				Disable maths copro
	2-3				Enable
JP9 (?)	1-2				4 Mb DRAM
	2-3*				2 Mb DRAM
JP9	In				4 Mb DRAM
	Out				2 Mb DRAM
					Rev C & C1 boards
SW1	**S1**	**S2**	**S3**	**S4**	**ROM Type**
S1-4	Off	Off	On	On	27256/27512
	On	On	Off	Off	27128*
SW1	Off*				MDA/EGA display
S5	On				CGA
SW1	Off				20 MHx system speed
S6	On*				Smart mode
SW1	Off*				Modes 3 & 4 memory mapping
S7	On				Reserved
SW1	Off*				RAM BIOS location
S8	On				ROM BIOS location

Mentor

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
CC-00	BN 533T		

BN 533T

Same as Informtech 533T-AT

Mercury Computer Corp

www.m-group.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	W586VX/TXA	AC	W586VXL

Microfive

Made boards (with BIOSes) for Samsung.

Microgram

Micronics

www.micronics.com Recently acquired by Diamond Multimedia, together with Orchid.

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
DC	D5CUB		

80386SX Cache

Jumper	*Position*	*Function*
W1	1-2	CGA
	Out	Mono
W2	Out	Reserved
W3	Out	Reserved
W4	1-2*	Normal Operations
	2-3	Clear CMOS
W5	1-2,3-4	4 Mb SIMMs not installed
	2-3	4 Mb SIMMs installed
W6	Out	Reserved

80386SX (Non-Cache)

Jumper	*Position*	*Function*
J2	1-4	External battery
	2-3	Enable Onboard battery
	3-4	Clear CMOS
JP2	In	Colour monitor
	Out	Mono
JP13	12-13	Turbo LED
	15,16,17	Turbo switch
	19-20	Reset switch
	7,8,9,10	Speaker
	1,2,3,4,5	Keylock/Power

80486-50 EISA 2

Jumper	*Position*				*Function*
W1					Reserved
W2,6,8	**W2**	**W6**	**W8**		**COM ports**
	1-2	1-2	1-2		Enable COM1 & 2
	1-2	1-2	2-3		Enable COM1, disable COM2
	2-3	1-2	1-2		Enable COM2, disable COM1
	2-3	1-2	2-3		Disable COM1 & 2
W3	1-2				Enable onboard floppy (2-3 disable)
W4,5,7	**W4**	**W5**	**W7**		**Parallel Port**
	1-2	2-3	2-3		LPT1 3BC-3BE
	1-2	2-3	1-2		LPT2 378-37A
	2-3	2-3	1-2		LPT3 278-27A
	2-3	2-3	2-3		Disabled
W9					Reserved
W10					Reserved
W11					Reserved
W12					Reserved
W14, 17-19	**W14**	**W17**	**W18**	**W19**	**Cache interleave**
	2-3	Out	Out	Out	64K
	1-2	1-2	1-2	1-2	256K

Switch 1

Switch	*Position*					*Function*
S1-5	**S1**	**S2**	**S3**	**S4**	**S5**	**Total Memory (Mb)**
	On	On	On	On	On	1
	Off	On	On	On	On	2
	On	Off	On	On	On	3
	Off	Off	On	On	On	4
	On	On	Off	On	On	4
	On	On	Off	Off	On	5
	On	Off	On	Off	On	6
	Off	On	On	Off	On	7
	Off	On	Off	On	On	8
	On	Off	Off	Off	On	9
	Off	Off	On	Off	On	10
	On	Off	Off	On	On	12

Switch	Position					Function
	Off	Off	Off	Off	On	13
	Off	Off	Off	On	On	16
	On	On	Off	On	Off	16
	On	On	Off	Off	Off	20
	On	Off	On	Off	Off	24
	Off	On	On	Off	Off	28
	Off	On	Off	On	Off	32
	On	Off	Off	Off	Off	36
	Off	Off	On	Off	Off	40
	On	Off	Off	On	Off	48
	Off	Off	Off	Off	Off	52
	Off	Off	Off	On	Off	64
S6	On*					Reserved
S7	Off*					Reserved
S8	On*					Colour display
	Off					Mono

80486 ASIC EISA

Jumper	Position				Function
W1, 11,12,45					Reserved
W2,8 ,9	**W2**	**W8**	**W9**		**COM ports**
	1-2	1-2	1-2		Enable COM1 & 2
	1-2	1-2	2-3		Enable COM1, disable COM2
	2-3	1-2	1-2		Enable COM2, disable COM1
	2-3	1-2	2-3		Disable COM1 & 2
W3,4,10	**W3**	**W4**	**W10**		**Parallel Port**
	1-2	2-3	2-3		LPT1 3BC-3BE
	1-2	2-3	1-2		LPT2 378-37A
	2-3	2-3	1-2		LPT3 278-27A
	2-3	2-3	2-3		Disabled
W13	1-2				Enable onboard floppy
W20,21	**W20**	**W21**	**W41**	**W44**	**Cache interleave**
W41,44	Out	Out	Out	2-3	64K
	1-2	1-2	1-2	1-2	256K

Switch 1

As for 80486-50 EISA 2

EISA 3

Jumper	Position		Function
J7,10	**J7**	**J10**	**CPU settings**
	In	In	SX25, DX2-50
	Out	In	SX33, DX33, DX2-66
	Out	Out	DX50
J6	1-2,3-4		486DX
	3-4		486SX
J12	In		Colour display
	Out		Mono

Baby Gemini 386

Switch 1

Switch	*Position*					*Function*
S1-5	**S1**	**S2**	**S3**	**S4**	**S5**	**Total Memory (Mb)**
	On	On	On	On	On	1
	Off	On	On	On	On	2
	On	Off	On	On	On	3
	Off	Off	On	On	On	4
	On	On	Off	On	On	4
	On	On	Off	Off	On	5
	On	Off	On	Off	On	6
	Off	On	On	Off	On	7
	Off	On	Off	On	On	8
	On	Off	Off	Off	On	9
	Off	Off	On	Off	On	10
	On	Off	Off	On	On	12
	Off	Off	Off	Off	On	13
	Off	Off	Off	On	On	16
	On	On	Off	On	Off	16
	On	On	Off	Off	Off	20
	On	Off	On	Off	Off	24
	Off	On	On	Off	Off	28
	Off	On	Off	On	Off	32
	On	Off	Off	Off	Off	36
	Off	Off	On	Off	Off	40
	On	Off	Off	On	Off	48
	Off	Off	Off	Off	Off	52
	Off	Off	Off	On	Off	64
S6	On*					Reserved
S7	Off*					Reserved
S8	On*					Colour Display
	Off					Mono

Switch 2

Jumper	*Position*	*Function*
W3	Out*	Reserved
S1	Off*	Reserved
S2	On	33 MHz
	Off	40 MHz Possibly same for SW1-8
S3	Off*	Reserved
S4	Off*	Reserved
S5	Off*	Reserved
S5	Off*	Reserved
S7	Off*	Reserved
S8	Off*	Reserved

Baby Gemini 486(/50)

Jumper	Position	Function
W1	1-2	256K cache
	Out	64K cache
W4	1-2	32Kx8 SRAM
	Out	8Kx8 SRAM
W15	1-2	256K cache interleave
	2-3	64K cache interleave
J100	1-2	Reserved
J101	2-3	Reserved

Switch 1

Jumper	Position	Function
S1	Off*	Reserved
S2	Off*	Reserved
S3	On*	Reserved
S4	Off*	Reserved
S5	Off*	Reserved
S5	Off*	Reserved
S7	On*	Reserved
S8	Off*	Reserved

Switch 2

Switch	*Position*					*Function*
S1-5	**S1**	**S2**	**S3**	**S4**	**S5**	**Total Memory (Mb)**
	On	On	On	On	On	1
	Off	On	On	On	On	2
	On	Off	On	On	On	3
	Off	Off	On	On	On	4
	On	On	Off	On	On	4
	On	On	Off	Off	On	5
	On	Off	On	Off	On	6
	Off	On	On	Off	On	7
	Off	On	Off	On	On	8
	On	Off	Off	Off	On	9
	Off	Off	On	Off	On	10
	On	Off	Off	On	On	12
	Off	Off	Off	Off	On	13
	Off	Off	Off	On	On	16
	On	On	Off	On	Off	16
	On	On	Off	Off	Off	20
	On	Off	On	Off	Off	24
	Off	On	On	Off	Off	28
	Off	On	Off	On	Off	32
	On	Off	Off	Off	Off	36
	Off	Off	On	Off	Off	40
	On	Off	Off	On	Off	48
	Off	Off	Off	Off	Off	52
	Off	Off	Off	On	Off	64

Baby Gemini 486DX2

Jumper	*Position*		*Function*
W3,4	**W3**	**W4**	**External cache**
	Out	Out	64K
	In	In	256K
W15	1-2		256K cache interleave
	2-3		64K cache interleave

Switch 1

Jumper	*Position*	*Function*
S1	Off*	Reserved
S2	Off*	Reserved
S3	On*	Reserved
S4	Off*	Reserved
S5	Off*	Reserved
S5	Off*	Reserved
S7	On*	Reserved
S8	Off*	Reserved

Switch 2

Switch	*Position*					*Function*
S1-5	**S1**	**S2**	**S3**	**S4**	**S5**	**Total Memory (Mb)**
	On	On	On	On	On	1
	Off	On	On	On	On	2
	On	Off	On	On	On	3
	Off	Off	On	On	On	4
	On	On	Off	On	On	4
	On	On	Off	Off	On	5
	On	Off	On	Off	On	6
	Off	On	On	Off	On	7
	Off	On	Off	On	On	8
	On	Off	Off	Off	On	9
	Off	Off	On	Off	On	10
	On	Off	Off	On	On	12
	Off	Off	Off	Off	On	13
	Off	Off	Off	On	On	16
	On	On	Off	On	Off	16
	On	On	Off	Off	Off	20
	On	Off	On	Off	Off	24
	Off	On	On	Off	Off	28
	Off	On	Off	On	Off	32
	On	Off	Off	Off	Off	36
	Off	Off	On	Off	Off	40
	On	Off	Off	On	Off	48
	Off	Off	Off	Off	Off	52
	Off	Off	Off	On	Off	64
S6	On*					Reserved
S7	Off*					Reserved
S8	On*					Colour Display
	Off					Mono

Switch	*Position*	*Function*
		256K cache?
		64K cache?

Baby Gemini 486SX

Switch	*Position*				*Function*
S1-4	**S1**	**S2**	**S3**	**S4**	**Total Memory (Mb)**
	On	On	On	On	4
	Off	On	On	On	8
	On	Off	On	On	12
	Off	Off	On	On	16
	On	On	Off	On	16
	On	On	Off	Off	20
	On	Off	On	Off	24
	Off	On	On	Off	28
	Off	On	Off	On	32
	On	Off	Off	Off	36
	Off	Off	On	Off	40
	On	Off	Off	On	48
	Off	Off	Off	Off	52
	Off	Off	Off	On	64
S5,8	On*				Reserved
S6,7	Off*				Reserved

C400

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Celeron	Slot 1
Speeds (MHz)		
Chipset	440 BX	
BIOS	Award 4.51PG	
Bus	5 PCI/2 ISA	1 each shared
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video		AGP
Performance		Substandard

Mini 486

Jumper	*Position*	*Function*
W1	1-2*	Normal ops
	2-3	Discharge CMOS
W3	In	Colour display
	Out	Mono
W12	1-2	Overdrive/487SX
	2-3	SX/DX/DX2

JX 30

Part number 09-00183-xx. There is an LED between slots #5 and #6

Item	Description	Notes
Form Factor	Baby AT	
CPU		ZIF socket for Overdrive
Speeds (MHz)		
Chipset		
BIOS		
Bus	7 ISA/2 VL	
Memory (Mb)		4 SIMM sockets
Cache (K)		
I/O	IDE, floppy, 2S 1P	

Jumper	*Position*					*Function*
S1-4	**S1**	**S2**	**S3**	**S4**		**Motherboard Speed**
	Off	On	Off	Off		33 MHz
	On	On	Off	Off		25 MHz
W5	1-2					LPT Input mode (scanner)
	2-3					LPT Output mode
W6	In					Colour monitor installed
	Out					Mono
W8	1-2					Flash ROM in recovery mode
	2-3					Normal - jumper NOT moved for Flash update
W11						IDE LED
W12						Reset
W13						Turbo LED
W14						Turbo switch
W31						Clear CMOS
W40						Must be removed to support local bus DMA when Local Bus Master controllers are installed.
W64-68	**W64**	**W65**	**W66**	**W67**	**W68**	**Cache**
	1-2	**1-2**	**2-3**	**2-3**	**1-2**	64K
	2-3	**1-2**	**1-2**	**1-2**	**2-3**	128K
	2-3	**2-3**	**2-3**	**2-3**	**2-3**	256K
W70	1-2					486SX
	2-3					486DX, 486DX2 & P24T
W71	1-2					PQFP 486SX with Overdrive SX
	2-3					PQFP 486SX with DX, or DX2 CPU
J6						Battery Connector
J33						Speaker
J34						Keylock/Power

JX 30G

Part number 09-00189-xx. There is an LED between slots #5 and #6

Item	Description	Notes
Form Factor	Baby AT	
CPU		ZIF socket for Overdrive
Speeds (MHz)		
Bus	7 ISA/2 VL	

Item	Description	Notes
Memory (Mb)		4 SIMM sockets
Cache (K)		
I/O	IDE, floppy, 2S 1P	

Jumper	*Position*					*Function*
S1-4	**S1**	**S2**	**S3**	**S4**		**Motherboard Speed**
	Off	On	Off	Off		33 MHz
	On	On	Off	Off		25 MHz
W2	In					Colour monitor installed
	Out					Mono
W3	In					PS/2 mouse IRQ12 enabled
	Out					Disabled
W4						Must be removed to support local bus DMA when Local Bus Master controllers are installed.
W5						Clear CMOS
W7	1-2					LPT Input mode (scanner)
	2-3					LPT Output mode
W8	1-2					Flash ROM in recovery mode
	2-3					Normal - jumper NOT moved for Flash update
W10,11	**W10**	**W11**	**W22**	**W23**	**W24**	Cache
22-24	1-2	1-2	2-3	2-3	1-2	64K
	1-2	2-3	1-2	1-2	2-3	128K
	2-3	2-3	2-3	2-3	2-3	256K
W12	1-2					486SX
	2-3					486DX, 486DX2 & P24T
W13	1-2					PQFP 486SX Enabled
	2-3					Disabled
W16,17	**W16**	**W17**				Cache
	1-2	2-3				64K
	1-2	2-3				128K
	2-3	2-3				256K
W18						Turbo LED
W19						Turbo switch
W20						Reset
W21						IDE LED
W71	1-2					with Overdrive SX
	2-3					PQFP 486SX with DX, or DX2 CPU
J8						Battery Connector
J30						Speaker
J31						Keylock/Power

JX 30GC

Part number 09-00203-xx. There is an LED between slots #5 and #6

Item	Description	Notes
Form Factor	Baby AT	
CPU		ZIF socket for Overdrive
Speeds (MHz)		
Chipset		
BIOS		
Bus	7 ISA/2 VL	

Item	Description	Notes
Memory (Mb)		4 SIMM sockets
Cache (K)		
I/O	IDE, floppy, 2S 1P	

Jumper	*Position*					*Function*
S1-4	**S1**	**S2**	**S3**	**S4**		Motherboard Speed
	Off	On	Off	Off		33 MHz
	Off	On	Off	Off		25 MHz
W2	In					Colour monitor installed
	Out					Mono
W4						Must be removed to support local bus DMA when Local Bus Master controllers are installed.
W5						Clear CMOS
W8	1-2					Flash ROM in recovery mode
	2-3					Normal - jumper NOT moved for Flash update
W12	1-2					486SX
	2-3					486DX, 486DX2, 486DX/4 & P24T
W13	1-2					PQFP 486SX Enabled
	2-3					Disabled
W10,11	**W10**	**W11**	**W22**	**W23**	**W24**	Cache (W/T)
22-24	1-2	1-2	2-3	2-3	1-2	64K
	1-2	2-3	1-2	1-2	2-3	128K
	2-3	2-3	2-3	2-3	2-3	256K
W16,17	**W16**	**W17**				Cache (W/B)
	1-2	2-3				64K
	1-2	2-3				128K
	2-3	2-3				256K
W18						Turbo LED
W19						Turbo switch
W20						Reset
W21						IDE LED
W36	1-2					LPT IRQ7
	2-3					LPT IRQ5
W37						Reserved
W38						Reserved
W71	1-2					with Overdrive SX
	2-3					PQFP 486SX with DX, or DX2 CPU
J8						Battery Connector
J30						Speaker
J31						Keylock/Power

VL-Bus

Jumper	*Position*	*Function*
W13	1-2	DX/DX2
	2-3	SX
W16	2-3	LPT output mode
	1-2	LPT input mode
W20	2-3	Flash memory normal
	1-2	Flash memory recovery

SW 8

Switch	*Position*				*Function*
S1-4	**S1**	**S2**	**S3**	**S4**	**Total Memory (Mb)**
	On	On	On	On	4
	Off	On	On	On	8
	On	Off	On	On	12
	Off	Off	On	On	16
	On	On	Off	On	16
	On	On	Off	Off	20
	On	Off	On	Off	24
	Off	On	On	Off	28
	Off	On	Off	On	32
	On	Off	Off	Off	36
	Off	Off	On	Off	40
	On	Off	Off	On	48
	Off	Off	Off	Off	52
	Off	Off	Off	On	64
S5-8	**S5**	**S6**	**S7**	**S8**	**CPU**
	Off	On	Off	Off	33 MHz DX2-66
	On	Off	On	Off	25 MHz DX2-50

M4Pi

Item	Description	Notes
Speeds (MHz)	486	DX4, P24T
Chipset	Intel 82420 (Saturn)	
BIOS	Phoenix Flash	
Bus	3 PCI/6 ISA	1 each shared. Extra dedicated ISA slot
Memory (Mb)	128 Mb	4 72-pin sockets
Cache (K)	512 W/B	256 standard

M5Pi

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	60, 66	
Chipset	Intel 82430 (Mercury?)	
BIOS	Phoenix Flash	
Bus	3 PCI/5 ISA	1 each shared
Memory (Mb)	128 Mb	4 72-pin sockets
Cache (K)	512 W/B	256 standard

M54pi

Item	Description	Notes
CPU	Pentium	
Speeds (MHz)	90	
Chipset	Neptune	
BIOS	Phoenix Flash	

Item	Description	Notes
Bus	3 PCI/5 ISA	1 each shared
Memory (Mb)	128	4 72-pin sockets
Cache (K)	512 W/B	256 standard

Micom

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0C-00	MTX A512 TXPro+		

MicroStar International (MSI)

(510) 623 8818
www.msi.com.tw

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0C-00	586MC1 MS 5103	AC	MS 6119
1-00	MS 4135	AC-00	MS 5148
1C-00	MS 5106 or 596MC2	AC	MS 5128
9-00	MS 5117	AL-00	MS 5148
9C	MS 6117/5145/5146/5147	BC-00	Ingersoll 17M
9C-00	MS 5137/5117	CC-00	MS 5156 v1.1

LX1

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	200-333	
Chipset		
BIOS	AMI 1.2	
Bus	4 PCI/3 ISA	
Memory (Mb)	512 SDRAM 1 Gb EDO	4 DIMM sockets
Video		AGP
Audio		
Performance		Average

LX4

Item	Description	Notes
Form Factor	ATX	
CPU	2 Pentium II	Slot 1
Speeds (MHz)	333	
Bus	5 PCI/2 ISA	
Memory (Mb)	512 SDRAM 1 Gb EDO	4 DIMM sockets
Performance		Below average

MS 5169

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium	Super Socket 7
Speeds (MHz)		4.5 x CPU clock
Chipset	ALi Aladdin V	
BIOS	AMI HiFlex 1.2	
Bus	4 PCI/3 ISA	100 MHz
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)	512K	
I/O	2S, 1P, USP, PS/2	UDMA 3
Video		AGP
Performance		Good – but behind TMC T15VG+
Comments		Inexpensive

MS 6119

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Chipset	440 BX	
BIOS	Award 4.51PG	
Bus	4 PCI/3 ISA	100 MHz
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2S, 1P, USP, PS/2	UDMA 3
Video		AGP
Performance		Quick, but Soyo SY-6BA+ is faster
Comments		Good documentation

MS 6167

Item	Description	Notes
Form Factor	ATX	
CPU	Athlon	Slot A
Speeds (MHz)		100 FSB
Chipset	AMD-750	
BIOS	Award	

Item	Description	Notes
Bus	5 PCI/2 ISA	UDMA/66
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	The usual	
Video		AGP 2x
Performance		
Comments		

MS 6182

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III	Slot 1 500 MHz
Chipset	Intel 810E	
BIOS		
Bus	6 PCI/1 ISA	AMR with TV-out
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2S, 1P, USP, PS/2	UDMA/66
Video		
Audio	ESS ES1373	
Comments		

MS 6195

Item	Description	Notes
Form Factor	ATX	
CPU	Athlon	Slot A
Chipset	AMD 751/756	
BIOS	Award	
Bus	6 PCI/1 ISA	AMR with TV-out
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2S, 1P, USP, PS/2	UDMA/66
Video	AGP	2x
Audio		
Comments		Fast memory performance

MINT data

Rebadges Biostars.

Mirage

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1	M54PS		

MiTAC

(800) 756 2888
www.mitac.mic.com.tw

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1	PH 4500AM or LH 4077C/D	9C-00	PH 5400V
2C-00	PH 4500AU		

LH 4077D

Digicom? AT&T 1455?

Mitsuba

www.mitsuba.com

Mitsubishi

www.mitsubishi-computers.com
Division closed

MLE

(800) 780 3486

Motorola

www.mcg.mot.com

MSI

See MicroStar International

M-Technology

www.mtiusa.com Rise

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1	R 407	A-00	R 526
1-00	R 526	AC	R 651 (Rise)/R 533
2-00	R 418	AC	R 525/R 528WP
2C	R 418	AC-00	R 533/R552
3C-00	R 418	BC	R 525
4C-00	R 418	CC	R533
9C	M 549	CC-00	R 534G
9C-00	R 526/R 534(WP)/R-581a	HC	R525

PCI-486

Item	Description	Notes
Form Factor		
CPU	486	Check JP48 for correct voltage
Speeds (MHz)		
Chipset	SiS	
BIOS	Award Flash	
Bus	3 PCI/4 ISA	
Memory (Mb)		8 30-pin sockets, 2 72-pin
Cache (K)	256	64K chips
I/O	2S, 1P, Floppy	

R407

Jumper	*Position*	*Function*
BK SW	1-2	Suspend
JP44	1-2	VL bus 0 wait state
	2-3	VL bus 1 wait state
JP45	1-2	VL bus <=33 MHz
	2-3	VL bus >33 MHz
JP50	1-2	Normal
	2-3	Discharge CMOS
JP60	On	Doze mode
JP61	On	Suspend mode
JP62	On	CGA
	Off	Mono

Intel CPU

P24T not recommended, but set as P24D and cut one end of resisitor R24

Junper	DX/2/4	486SX	P24D
JP1	Open	Open	Open
JP2	3-4	3-4	1-2
JP3	Open	Open	2-3
JP4	2-3	2-3	1-2

Junper	DX/2/4	486SX	P24D
JP5	2-3	2-3	1-2
JP6	1-2	1-2	1-2
JP7	2-3	2-3	2-3
JP8	3-4	Open	3-4
JP9	1-2,3-4	2-3	1-2,3-4
JP10	3-4	3-4	1-2,3-4
JP11	4-5	4-5	4-5
JP12	Open	Open	Open
JP13	Open	Open	1-2
JP14	Open	Open	1-2
JP15	1-2=2.5x (DX4) 2-3=2x (DX4) Open=3x (DX4)	Open	Open
JP16	1-2	1-2	1-2

AMD CPU

Junper	DX, DX/2 DX4-133	DX4/100 DX4/120	DX4/100 V8B DX4/120 V8B	DX4 SV8B	x5-133 x5-160
JP1	Open	Open	Open	Open	Open
JP2	3-4	3-4	1-2,3-4	1-2,3-4	1-2,3-4
JP3	Open	Open	2-3	2-3	2-3
JP4	2-3	2-3	1-2	1-2	1-2
JP5	2-3	2-3	1-2	1-2	1-2
JP6	1-2	1-2	1-2	1-2	1-2
JP7	2-3	2-3	2-3	2-3	2-3
JP8	3-4	3-4	3-4	3-4	3-4
JP9	1-2,3-4	1-2,3-4	1-2,3-4	1-2,3-4	1-2,3-4
JP10	3-4	3-4	1-2,3-4	1-2,3-4	1-2,3-4
JP11	4-5	4-5	4-5	4-5	4-5
JP12	Open	Open	Open	Open	Open
JP13	2-3	Open	1-2	1-2	1-2
JP14	Open	Open	1-2	1-2	1-2
JP15	Open	Open	Open	Open	2-3
JP16	1-2	1-2	1-2	1-2	1-2

Cyrix CPU

Junper	DX, DX/2 DX4 (5v)	DX, DX/2 DX4 (345v)	5x86-100 5x86-120	5x86 GP	x5-133
JP1	2-3	2-3	Open	Open	Open
JP2	2-3	2-3,4-5	1-2,3-4	1-2,3-4	1-2,3-4
JP3	Open	Open	2-3	2-3	2-3
JP4	2-3	2-3	2-3	2-3	2-3
JP5	1-2	1-2	1-2	1-2	1-2
JP6	2-3	2-3	1-2	1-2	1-2
JP7	1-2	1-2	2-3	2-3	2-3
JP8	3-4	3-4	3-4	3-4	3-4
JP9	1-2,3-4	1-2,3-4	1-2,3-4	1-2,3-4	1-2,3-4
JP10	2-3	2-3	1-2,3-4	1-2,3-4	1-2,3-4

Jumper	DX, DX/2 DX4 (5v)	DX, DX/2 DX4 (345v)	5x86-100 5x86-120	5x86 GP	x5-133
JP11	2-3	2-3	4-5	4-5	4-5
JP12	Open	Open	Open	Open	Open
JP13	Open	Open	Open	1-2	Open
JP14	Open	Open	1-2	1-2	1-2
JP15	Open	Open	Open	Open	2-3
JP16	1-2	1-2	1-2	1-2	1-2

System Speed

Speed	JP25	JP38	JP40
25 MHz	Short	Open	Short
33 MHz	Short	Short	Open
40 MHz	Open	Short	Short
50 MHz	Open	Open	Open

R418

Jumper	*Position*	*Function*
JP51	Open	Colour display
	Short	Mono display
JP49	1-2	Retain CMOS data
	2-3	Clear CMOS

Intel CPU

Jumper	DX, DX/2, DX4	486SX	P24T	P24D
JP12	2-3	2-3	1-2	1-2
JP13	2-3	Open	1-2	2-3
JP14	2-3	2-3	2-3	2-3
JP15	Open	Open	1-2	Open
JP16	3-4	3-4	3-4	1-2,3-4
JP17	3-4	3-4	1-2	1-2
JP18	2-3	Open	Open	1-2
JP19	Open	Open	Open	Open
JP20	Open	Open	Open	1-2
JP21	Open	Open	1-2 or 3-4	Open
JP22	1-2,3-4	2-3	1-2,3-4	1-2,3-4
JP23	4-5	4-5	1-2	4-5
JP24	Open	Open	Open	2-3

AMD CPU

Jumper	DX, DX/2, DX4 DX4-133 (V8T)	DX4/100 (V8T) DX4/120 (V8T)	DX4/100 (V8B) DX4/120 (V8B)	x5-133 x5-160
JP12	2-3	2-3	1-2	1-2
JP13	2-3	2-3	2-3	2-3
JP14	2-3	2-3	2-3	2-3

Junper	DX, DX/2, DX4 DX4-133 (V8T)	DX4/100 (V8T) DX4/120 (V8T)	DX4/100 (V8B) DX4/120 (V8B)	x5-133 x5-160
JP15	Open	Open	Open	Open
JP16	3-4	3-4	1-2,3-4	1-2,3-4
JP17	3-4	3-4	1-2,3-4	1-2,3-4
JP18	2-3	Open	1-2	1-2
JP19	Open	Open	Open	2-3
JP20	Open	Open	1-2	1-2
JP21	Open	Open	Open	Open
JP22	1-2,3-4	1-2,3-4	1-2,3-4	1-2,3-4
JP23	4-5	4-5	4-5	4-5
JP24	Open	Open	2-3	2-3

Cyrix CPU

Junper	DX, DX/2 DX4 (5v)	DX, DX/2 DX4 (3.45v)	5x86-100 5x86-120	5x86-133
JP12	2-3	2-3	2-3	2-3
JP13	2-3	2-3	2-3	2-3
JP14	1-2	1-2	2-3	2-3
JP15	2-3	2-3	Open	Open
JP16	2-3	2-3	1-2,3-4	1-2,3-4
JP17	2-3	2-3,4-5	1-2,3-4	1-2,3-4
JP18	Open	Open	1-2	1-2
JP19	Open	Open	Open	2-3
JP20	Open	Open	1-2	1-2
JP21	Open	Open	Open	Open
JP22	1-2,3-4	1-2,3-4	1-2,3-4	1-2,3-4
JP23	2-3	2-3	4-5	4-5
JP24	Open	Open	2-3	2-3

CPU Voltage

9 o’clock of CPU. If no JP48, board is 5v only.

Voltage	JP42	JP43	JP44	JP45	JP46	JP48
3.3	Short	Open	Open	Open	Open	Open
3.45	Open	Short	Open	Open	Open	Open
3.6	Open	Open	Short	Open	Open	Open
3.75	Open	Open	Open	Short	Open	Open
3.9	Open	Open	Open	Open	Short	Open
5	Open	Open	Open	Open	Open	1-2,3-4 Sh

System Speed

11 o’clock of CPU

Speed	JP25	JP38	JP39	JP40
25 MHz	1-2	Open	Open	Open
33 MHz	1-2	Short	Short	Open
40 MHz	1-2	Short	Open	Open
50 MHz	2-3	Open	Short	Open

R526

Item	Description	Notes
Form Factor		
CPU	Pentium	Socket 7
Chipset	SiS 551X	
BIOS	Award 4.50pg or AMI	
Bus	3 PCI/4 ISA	
Memory (Mb)	128	30- or 72-pin sockets
Cache (K)	256	Pipelined burst. 1 Mb standard SRAM
I/O		Up to Mode 4 IDE.

R527

Item	Description	Notes
Form Factor		
CPU	Pentium	Socket 7
Speeds (MHz)		
Chipset	SiS	
BIOS	Award 4.50pg or AMI	
Bus	3 PCI/4 ISA	
Memory (Mb)	128	30- or 72-pin sockets
Cache (K)	256	Pipelined burst. 1 Mb standard SRAM
I/O		Up to Mode 4 IDE.

R528

Item	Description	Notes
Form Factor		
CPU	Pentium	Socket 7
Speeds (MHz)		
Chipset	Intel 82430HX	
BIOS		
Bus		

R529

Item	Description	Notes
Form Factor		
CPU	Pentium	Socket 7
Speeds (MHz)		
Chipset	Intel 82430VX	
BIOS		
Comments		

R 533

Intel 82430VX chipset – settings below not complete!

Switch	Position			Function
JP3-5	**JP3**	**JP4**	**JP5**	**Host bus speed**
	Open	Close	Open	66 MHz
JP19-21	**JP19**	**JP20**	**JP21**	**CPU multiplier**
	Open	Open	Open	3.5x
	Open	Close	Open	3x
	Close	Close	Open	2.5x
	Close	Close	Open	2x

R 534

Mustang, with SiS 5571 chipset – settings below not complete!

Switch	Position			Function
JP10-12	**JP10**	**JP11**	**JP12**	**Host bus speed**
	Close	Close	Open	66 MHz
	Open	Open	Open	75 MHz
JP18,19	**JP18**	**JP19**		**CPU multiplier**
	Open	Open		3.5x
	Open	Close		3x
	Close	Close		2.5x
	Close	Open		2x
JP26	1-2,3-4 close			2.4v core CPU voltage
	1-2 close			2.7v
	1-2,3-4 open			2.8v
JP27	1-2,3-4 close			3.3v CPU I/O voltage
	1-2 close			3.45v
	1-2,3-4 open			3.5v

R 534F/G

Mustang, with SiS 5571 chipset – settings below not complete! See 534 for voltage?

Switch	Position				Function
JP10-12	**JP9**	**JP10**	**JP11**	**JP12**	**Host bus speed**
	Open	Open	Close	Close	66 MHz
	Close	Close	Open	Open	75 MHz
JP18,19	**JP18**	**JP19**			**CPU multiplier**
	Open	Open			3.5x
	Open	Close			3x
	Close	Close			2.5x
	Close	Open			2x

R 540

Mustang, with Intel 430TX chipset

Switch	Position			Function
SW2	**1**	**2**	**3**	**Multiplier**
1-3	Off	Off	On	1.5x
	On	Off	Off	2x
	On	On	Off	2.5x
	Off	On	Off	3x
	Off	Off	Off	3.5x
	On	Off	On	4x

Switch	*Position*			*Function*
	On	On	On	4.5x
SW2	**4**	**5**	**6**	**Host bus**
4-6	On	On	Off	55 MHz
	On	Off	Off	60 MHz
	Off	Off	Off	66 MHz
	Off	On	Off	75 MHz
JP8-9	JP8	JP9		Host bus speed
	Open	Open		66 MHz
	Open	Close		75 MHz

R543

Mustang GX

Item	Description	Notes
Form Factor	AT	4 layer
CPU	Cyrix GX86	
Speeds (MHz)	120/133/150	
Chipset	Cyrix Cx5510	
Bus	2 PCI/3 ISA	
Memory (Mb)	8-128 Mb	FPM/EDO. 4 72-pin SIMMs.
I/O	2S, 1P, Floppy, 2 IDE, PS/2	
Video	Onboard	
Audio	Soundblaster compatible	Optional soundcard

Jumper	*Position*	*Function*
JP1	1-2	Normal
	2-3	Clear CMOS
JP49		

R 557

MIG, with Intel 430TX chipset

Jumper	*Position*			*Function*
JP1-3	**JP1**	**JP2**	**JP3**	**Multiplier**
	Open	Close	Close	2.5x
	Open	Close	Open	3x
	Open	Open	Open	3.5x
JP7	1-2,3-4,5-6 open			Split Rail CPU
JP8-9	**JP8**	**JP9**		**Host bus speed**
	Open	Open		66 MHz
	Open	Close		75 MHz

R 581A

Mustang-AGP. SIS 5591/5595 chipset

Jumper	*Position*			*Function*		
JP1-3	**JP1**	**JP2**	**JP3**	**Host**	**AGP**	**PCI**
	1-2	1-2	2-3	83.3	64	32
	2-3	1-2	2-3	75	64	32

Jumper	*Position*			*Function*		
	1-2	2-3	1-2	75	75	37.5
	2-3	2-3	1-2	68.5	68.5	34.3
	1-2	2-3	2-3	66.7	66.7	33.4
	2-3	2-3	2-3	60	60	30
JP8-10	**JP8**	**JP9**	**JP10**	**Multiplier**		
	Open	Open	Open	1.5x		
	Close	Open	Open	2x		
	Close	Close	Open	2.5x		
	Open	Close	Open	3x		
	Open	Open	Open	3.5x		
	Close	Open	Close	4x		
	Close	Close	Close	4.5x		
	Open	Close	Close	5x		

MTI

See M-Technology
www.mtiusa.com

Mustek

(510) 475 5730

Mycomp

Taiwan Mycomp Corp
www.mtl.mynix.com
See Mynix Technology or TMC

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C-00	AI5TV		

Mylex

www.mylex.com

Northgate/Mylex 80486 EISA motherboard with BIOS version 6.04q is not compatible with **emm386.exe**. The newest revision is 6.15, which is compatible.

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
2-B3	MPXS486		

MAE 486

Jumper	*Position*	*Function*
J1	In*	Cache enabled
	Out	Disabled
J2	1-2*	33 MHz CPU
	2-3	25 MHz CPU
J15		Reserved
J16		Reserved

Memory	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12
1 Mb	Out	Out	Out	Out	Out	2-3	Out	1-2	1-2	1-2
2 Mb	1-2	1-2	1-2	1-2	Out	1-2	Out	1-2	1-2	2-3
4 Mb	Out	Out	Out	Out	Out	1-2	2-3	1-2	1-2	2-3
8 Mb	1-2	1-2	1-2	1-2	Out	1-2	1-2	2-3	1-2	2-3
16 Mb	Out	Out	Out	Out	2-3	1-2	1-2	2-3	1-2	2-3
32 Mb	1-2	1-2	1-2	1-2	1-2	1-2	1-2	2-3	2-3	2-3

MDE 486

Jumper	*Position*				*Function*
JP1	Out				Mono display
	In*				Colour display
JP7,11-13	**JP7**	**JP11**	**JP12**	**JP13**	**Cache memory**
	Out	Out	Out	Out	64K*
	In	In	In	In	256K
JP8-10	**JP8**	**JP9**	**JP10**		**CPU**
	Out	2-3	Out		486SX
	2-3	1-2	In		487SX
	1-2	1-2	In		486DX
JP14-17	**JP14**	**JP15**	**JP16**	**JP17**	**CPU Speed**
	2-3	1-2	2-3	1-2	20 MHz
	2-3	2-3	1-2	2-3	25 MHz
	2-3	1-2	1-2	2-3	33 MHz
	1-2	2-3	1-2	2-3	50 MHz (not MSI 486)
JP18	Out*				AT CLK (ISA Bus Clock)
	In				AT CLK (ISA Bus Clock) 50 MHz (not MSI 486)
JP19	1-2				LPT2 IRQ5
	2-3*				LPT1 IRQ7
JP20	1-2*				Enable all I/O ports
	2-3				Disable
JP21	1-2				Reset CMOS
	2-3*				Internal battery
	Out				External battery

MDI 486

As for MDE 486

MNE 486

Jumper	*Position*	*Function*
J1		Reserved
J2		Reserved
J13		Reserved
J15		Reserved
J16		Reserved
J20		Reserved
J17	1-2	COM1 IRQ4
	2-3	COM2 IRQ3
J18	1-2	LPT1 IRQ5
	2-3	LPT2 IRQ7
J19	1-2	Enable I/O subsystem
	2-3	Disable

Memory	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12
1 Mb	Out	Out	Out	Out	Out	2-3	Out	1-2	1-2	1-2
2 Mb	1-2	1-2	1-2	1-2	Out	1-2	Out	1-2	1-2	2-3
4 Mb	Out	Out	Out	Out	Out	1-2	2-3	1-2	1-2	2-3
8 Mb	1-2	1-2	1-2	1-2	Out	1-2	1-2	2-3	1-2	2-3
16 Mb	Out	Out	Out	Out	2-3	1-2	1-2	2-3	1-2	2-3
32 Mb	1-2	1-2	1-2	1-2	1-2	1-2	1-2	2-3	2-3	2-3

MPXS486

Possibly Chaintech

MSI 486

As for MDE 486

MTI 386

Jumper	*Position*	*Function*
JP1	1-2*	Colour display
	2-3	Mono
JP2	2-3	2nd port is LPT1
JP4	1-2*	Enable I/O peripherals
JP5	1-2	32Kx8 SRAM
	2-3*	32K/64K cache

MTX 386

Jumper	*Position*	*Function*
JP1	2-3	LPT1 IRQ5

Jumper	*Position*	*Function*
JP2	1-2*	Colour display
	2-3	Mono
JP3	1-2*	Enable I/O peripherals
	2-3	Disable

MWS 386

Jumper	*Position*			*Function*		
SW1	On			32-bit memory card in Slot 8		
	Off			Not installed		
SW2-4	**SW2**	**SW3**	**SW4**	**Total Memory**		
	Off	On	On	1 Mb		
	Off	Off	On	2 Mb		
	Off	On	Off	4 Mb		
	On	Off	Off	8 Mb		
SW4	On			256K DRAMs		
	Off			1 Mb DRAMs		
SW5	On			EGA BIOS at C000		
	Off			EGA BIOS at E000		
SW6	On			No 80387		
	Off			80387 installed		
SW7	On			System boots at 8 MHz		
	Off			System boots at 16,20,25 MHz		
SW8	On			BIOS uses colour display at POST		
	Off			BIOS uses mono display at POST		
J25	**Bus speed**? (MHz)			**386/16**	**386/20**	**386/25**
	1-2			5.33	6.67	8.33
	2-3			4	5	6.25
	3-4			4	5	6.25
	4-5*			4	10	12.5
J26	1-2			128K EPROM		
	2-3*			256K EPROM		

MXA 386

Jumper	*Position*			*Function*
S1-3	**S1**	**S2**	**S3**	**Total Memory**
	Off	On	Off	1 Mb
	On	On	Off	2 Mb
	Off	Off	On	4 Mb
	On	Off	On	8 Mb
	Off	On	On	16 Mb
	On	On	On	32 Mb
S4	On			No cache 0C0000-0CFFFF
	Off*			Cache 0C0000-0CFFFF enabled
S5	On*			No cache 0D0000-0DFFFF
	Off			Cache 0D0000-0DFFFF enabled
S6	On			No cache 0E0000-0FFFFF
	Off*			Cache 0E0000-0FFFFF enabled
S7	On			No ISA bus memory
	Off*			ISA bus memory
S8	On*			No 80387

Jumper	Position	Function
	Off	80387 installed
S9	On	Colour display
	Off*	Mono display
S10	On*	Cache enabled
	Off	Disabled
J1-4		Reserved

MXS 386

Jumper	Position		Function
SW1	**S1**	**S2**	**Memory**
S1-2	Off	Off	100 ns FPM 4 page active
	Off	On	100 ns FPM 1 page active
	On	Off	100ns non-FPM
	On	On	120ns non-FPM
SW3	Off		Disable serial port
S1	On*		Enable
S2	Off		Disable parallel port
	On*		Enable
S3	Off*		Serial port is COM1
	On		Serial port is COM2
S4	Off*		Parallel port is LPT1
	On		Parallel port is LPT2
S5	Off		IRQ3 disabled
	On		IRQ3 enabled
S6	Off		IRQ4 disabled
	On		IRQ4 enabled
J6	1-2		512K EPROM
	2-3*		256K EPROM
J8	Out*		Mono display
	In		Colour display
J10	1-2		LPT1 IRQ7
	2-3		LPT2 IRQ5

Notes

N

NEC

APC IV 286

Jumper	*Position*	*Function*
22H1	In	Determines RAS and ALE signals earlier.
S1, 6-7	Out	Normal
S2 5-8,4-9	4-9,3-10	8-bit I/O, 4 waits
S3 3-10,2-11	4-9,2-11	3 wait I/O cycle for device at 000-0FF
	5-8,3-10	2 wait I/O cycle for device at 000-0FF
S4, 1-12	In	No wait memory cycle
	Out	1 wait (normal)
S5 (18K2)	1-4	256Kx1 in Bank 0 (512K)
	2-3	256Kx1 in Bank 0, 64Kx1 in Bank 1 (640K)
	None	256Kx1 in Bank 0, 256Kx1 in Bank 1 (1 Mb)
S6 (5N2)	3-6,4-5	0E(FE) – Reserved on I/O channel
		0F(FF) – Location 7K, 7M enable
	1-8,2-7	0E(0F) - Location 7K, 7M enable
		0F(FF) – Compatible ROM enable
S7 (6N1)	2-3,1-8	27128
	4-5,3-6	27256
S10(14D)	1,2,3,8,9	Reserved
	4	Enable Parallel
	5	Enable serial CH1
	6	Enable serial CH2
	7	Ch1=COM1, CH2=COM2 (Off=reversed)

Jumper	*Position*	*Function*
S8(4N1)	3-2	EPROM ROM Type
	2-1	MASK ROM Type
S9(10)	On	Colour display
	Off	Mono
S11A	1	RS232 receive enable
	8	RS232 transmit enable
S11B	Off	Reserved
P10	1-2	16 MHz CPU
	1-3	11.7647 MHz CPU
	1-4	20 MHz CPU

PM1 286

Jumper	*Position*	*Function*
22J2	Out	ALE and RAS asserted normally
	In	Early
15K2	2-3	256Kx1 in Bank 0 (512K)
	1-4	256Kx1 in Bank 0, 64Kx1 in Bank 1 (640K)
	None	256Kx1 in Bank 0, 256Kx1 in Bank 1 (1 Mb)
14G1	1-2	EPROM
	2-3	MASK ROM
2G1	1-2	27256
	2-3	27128
20D1	2-3	Normal floppy
	1-2	Special floppy

SW14A

Switch	*Position*	*Function*
S1		Reserved
S2	On	Enable LPT1
S3	On	Enable COM1
S4	On	Enable COM2
S5	On	Reserved
S6	On	Enable floppy
S7	On	Secondary floppy controller I/O address
	Off*	Primary floppy controller I/O address
S8	On	Colour display
	Off	Mono

SW14B

Switch	*Position*			*Function*
S1-3	**S1**	**S2**	**S3**	**System ID**
	Off	On	On	APC IV Power mate 1
	On	On	On	APC IV/APC IV E
	On	Off	On	APC IV Power Mate 2
S4				Reserved
S5	On			Reserved – test Mode
S6	On			IBM Compatible ROM
	Off			Not used (selects APC Mode ROM)

PM 286+

Switch 1

Switch	*Position*	*Function*
1	On	8 MHz 80287
	Off	10 MHz 80287
2	On	Enable video
3	On	Enable COM1
4	On	Serial port COM1 3F8h
	Off	Serial port COM2 2F8h
5	On	Enable LPT1
6	On	Enable floppy
7	On	Primary floppy controller I/O address
	Off*	Secondary floppy controller I/O address
8	On	Colour display
	Off	Mono
9	Off	Reserved
10	On	Enable Mouse

Jumper	*Position*		*Function*
S1	1-2		Serial port IRQ3
	2-3		Serial port IRQ4
S2	1-2		Enable power-on password
	2-3		Disable
S3,5	**S3**	**S5**	**ROM Type**
	2-3	2-3	27C256
	1-2	1-2	27C512
S4	1-2		512K base memory
	2-3		640K base memory
S6	1-2		Standard display
	2-3		Extended mode with additional oscillator
S7	Out		Reserved
S8,9	**S8**	**S9**	**RTC**
	1-2	1-2	MC146818
	2-3	2-3	DS1287

PM1 286+

Jumper	*Position*	*Function*
20H2	1-2	500/250/300/150/125 Kbps floppy transfer rate
	2-3	500/250/125 Kbps
12J2	1-2	27128
	2-3	27256
12J3	1-2	MASK ROM
	2-3	EPROM

SW16C1

Switch	*Position*	*Function*
1	On	8 MHz clock

Switch	Position	Function
	Off	12 MHz clock
2	On	Enable LPT1
3	On	Enable COM1
4	On	Enable COM2
5	Off	Reserved
6	On	Enable floppy
7	On	Secondary floppy controller I/O address
	Off*	Disable system board floppy
8	On	Colour display
	Off	Mono

SW16B2

Jumper	Position	Function
S1	Off	Reserved
S2	On	Reserved
S3	Off	Reserved
S4	On	Reserved
S5	On	Test mode off
	Off	Test mode on
S6	On	Reserved

PM 386

Jumper	Position	Function
14L2	1-2	CPU address pipeline mode
	2-3	CPU address non-pipeline mode

SW1

Switch	Position			Function
01-3	01	02	03	Unit ID
	On	On	Off	Default
04	Off			Reserved
05	On			Test mode off
	Off			Test mode on
06	On			0 wait state
	Off			1 wait state

SW2

Switch	Position	Function
01	On	Colour display
	Off	Mono
02	On	Floppy secondary address
	Off	Floppy Primary address
03	On	Enable floppy
04	On	Enable COM2
05	On	Enable COM1
06	On	Enable LPT1

Switch	*Position*	*Function*
07	On	Enable maths coprocessor
08	On	80387
	Off	80287
09	Off	Reserved
10	Off	Reserved

PM1 386/33e

Jumper	*Position*	*Function*
2N1	In	Test Mode on
	Out	Test Mode off
12C3	In	Enable pipeline mode
	Out	Disable pipeline mode
12C2	In	385 reserve 1 pin is tied low
	Out	385 reserve 1 pin is tied high
10B1	1-2	385 READY output to CPU delayed till end of posted write cycle on 385 local bus
	2-3	385 READY output to CPU transparent to CPU
16F1	In	Insert 3 BCLK (16-bit cycles) or 11 BCLK (8-bit cycles) between back-back ISA I/O cycles from the CPU for I/O recovery time.
	Out	Insert 1 BCLK between back-back ISA 8/16-bit I/O cycles from the CPU for I/O recovery time.
13G1	1-2	25 MHz CPU speed
	2-3	33 MHz CPU speed
10H1	1-2	Enable password
9M1	In	Enable manufacturing switch
3E1	1-2	500/250/300/150/125 Kbps floppy transfer rate
	2-3	500/250/125 Kbps
16C2	1-2	MMRTO input tied low
	2-3	MMRTO input tied high
16C3	1-2	MMRT1 input tied low
	2-3	MMRT1 input tied high
16C4	1-2	MMWT input tied low
	2-3	MMWT input tied high

SW1

Switch	*Position*	*Function*
S1	On	Enable LPT1
S2	On	Enable COM1
S3	On	Enable COM2
S4	On	Enable floppy
S5	On	Select second drive B
	Off	First drive A
S6	On	Enable 80387
S7	On	Base memory 0-512K
	Off*	Base memory 0-640K
S8	On	Enable PS/2 mouse
S9	On	Colour display
	Off	Mono
S10	On	Reserved

PM 386sx

SW115G

Switch	Position	Function
1	On	Colour display
	Off	Mono
2	On	First diskette A
	Off	First diskette B
3	On	Enable diskette controller
4	On	Serial port is COM1
	Off	Serial port is COM2
5	On	Enable serial port
6	On	Enable LPT1
7	On	Enable maths coprocessor
8	On	Enable integrated VGA
9	On	0-512K
	Off	0-640K
10	On	Enable PS/2 mouse

Switch	Position	Function
S1	1-2	Non-pipeline mode
	2-3	Pipeline mode
S2	1-2	Enable security lock
S3	1-2	Serial port has COM1 IRQ
	2-3	Serial port has COM2 IRQ
S4	In	Enable reset
S5	Out	Reserved
S6	1-2	RTC battery backup
	2-3	RTC backup Vcc 5v
S7	1-2	Power good MC 146818
	2-3	Power good DS 1287
11L2	Out	Test mode off
	In	Test mode on

PM 386sx 16i

SW1

Switch	Position	Function
S1	On	Disable onboard video
S2	On	Disable floppy
S3	On	Disable password
S4	On	Prevent password reprogramming

SW2

Switch	Position	Function
	Out	Test mode off

PM 386sx 20

SW14F

Switch	*Position*	*Function*
1	On	Colour display
	Off	Mono
2	On	First diskette A
	Off	First diskette B
3	On	Enable diskette controller
4	On	Serial port is COM1
	Off	Serial port is COM2
5	On	Enable serial port
6	On	Enable LPT1
7	On	Enable KB controller D1 command intercept
8	On	Enable integrated VGA
9	On	0-512K
	Off	0-640K
10	On	Enable PS/2 mouse

Jumper	*Position*	*Function*
J1	1-2	Disable password
	2-3	Enable
J2	1-2	Enable IDE
	2-3	Disable
J3	1-2	Serial port has COM2 IRQ
	2-3	Serial port has COM1 IRQ
J5	Out	Reserved
J7	1-2	27C512 ROM BIOS
	2-3	27C256 ROM BIOS
J8	1-2	Disable VGA
10K2	Out	Test mode off
	In	Test mode on

PM 386sx 20vi

As for PM386 16I

PM 386sx 33i

As for PM386 16I except:

Switch	*Position*	*Function*
JP7	1-2	LPT1 IRQ5
	2-3	LPT1 IRQ7

PM 486-20e

Jumper	*Position*	*Function*
3F1	1-2	Disable password
11B5	Out	Disable I/O recovery

Jumper	*Position*	*Function*
15A1	Out	VGA adapter not installed
15C3	1-2,5-6	LPT1=IRQ7, LPT2 IRQ5
	2-3,4-5	LPT1=IRQ5, LPT2 IRQ7
15K1	Out	Disable manufacturing loop jumper
17H1	1-2	Enable write data to Flash ROM
18F1	1-2	27C256 (28F256) BIOS ROM
	2-3	27C512 (28F512) BIOS ROM
10A1	Out	Test mode off
	In	Test mode on
15A2	1-2	Processor board normal operation
	2-3	Test mode
15A3	1-2	Normal operation
	2-3	Test mode

PM 486-33e

As for PM 486-20e

PM 486-50e

As for PM 486-20e

PM 486sx 25i

As for PM386 16I except:

Switch	*Position*	*Function*
JP7	1-2	LPT1 IRQ5
	2-3	LPT1 IRQ7
JP9	1-2	SX/DX2
	2-3	DX

PM 486DX 33i

As for PM 486sx 25i

PM 486DX 50i

As for PM 486sx 25i

NewStar Engineering

www.computersources.com.hk//newstar

Newtech International

SMT boards?

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
BC-00	P55VX3		

Nexcom

Niagara SMD

www.niagaratech.com

NMC Peripherals Europe

www.nmc-pe.de

Novell

286A

Jumper	*Position*				*Function*
J3,8	**J3**	**J8**			
					Enables SW1-1 (Wait/No wait)
					Disables SW1-1 (Wait only)
J4	In				Enable LPT1
J5	In				Enable COM1
J6	In				Enable COM2
J7	In				64K RAM
	Out				256K RAM
J11-14	**J11**	**J12**	**J13**	**J14**	**Boot ROM size**
	In	Out	In	Out	64K
	Out	In	Out	In	256K
J33	In				6 MHz CPU
	Out				8 MHz CPU
J38	1-2				Ignore power good
	2-3				Enable power good
J39	1-2				External battery
	2-3				internal battery

SW1

Switch	*Position*	*Function*
S1	On	No wait state

Switch	Position	Function
	Off	Wait state
S2		Reset
S3	M	Mono display
	C	Colour

286B

SW1

Switch	Position	Function
S1	On	256K RAM chips
	Off	64K RAM chips
S2	On	Enable 512-640K
S3	On	Memory Bank 2 enabled
S4	On	PC compatible keyboard
	Off	AT compatible keyboard
S5	On	Serial port is console monitor
	Off	Keyboard/monitor as console
S6	On	Serial port is COM1
	Off	Serial port is COM3
S7	On	Parallel port is LPT2
	Off	Parallel port is LPT4
S8	On	Colour display
	Off	Mono
E2	In	Reserved
J32	In	Reserved

386A

SW1

Jumper	Position	Function
S1	On	COM1 disabled
S2	On	COM2 disabled
S3	On	Parallel port disabled
S4	On	Parallel port is LPT2
	Off	Parallel port is LPT1
S5	On	COM1 IRQ4 (S6 & 7 off)
	Off	Deselect
S6	On	COM1 IRQ3 (S5 & 8 off)
	Off	Deselect
S7	On	COM2 IRQ4 (S5 & 8 off)
	Off	Deselect
S8	On	COM2 IRQ3 (S6 & 7 off)
	Off	Deselect
S9	On	Parallel port IRQ7 (S10 off)
	Off	Deselect
S10	On	Parallel port IRQ5 (S9 off)
	Off	Deselect

Switch	*Position*	*Function*
W3	2-3	Reserved
W4	2-3	Reserved
W8		Reserved
W12		Reserved
J13		Reserved
J14		Reserved

NTC Technologies

See Ozzo

Notes

O

Ocean

Ocean Office Automation
www.ocean-usa.com/ocean
See Octek

Octek

Ocean Office Automation
www.oceanhk.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0-00	Bison VI PCI	9C-00	Rhino 15
1-00	Hippo 12 VIP	AC-00	Rhino 12+
9C	Rhino 6	DC	Rhino 6VX
9C	Rhino 9		

Olivetti

CP 486

JP1	Disable system password

M21

SW Bank 0

Switch	Position				Function
1-4	**1**	**2**	**3**	**4**	**Memory**
	Off	On	On	On	128K
	On	Off	On	On	256K
	Off	Off	On	On	384/256K on m'b + 128K exp
	On	On	Off	On	512/256K on m'b + 256K exp
	Off	On	Off	On	640/256K on m'b + 384K exp
	On	On	On	Off	512k in bank 0
	Off	On	On	Off	640/512K in bk 0 + 128K bk 1
	Off	On	Off	Off	640/128K in bk 0 + 512K bk 1
5	Off				Coprocessor installed
6	Off				8250 ACE asynchronous installed
7					Reserved
8	On				RAM Bank 0
	Off				RAM Bank 0 & 1

SW Bank 1

Jumper	Position		Function
1	On		360K floppies
	Off		720K floppies
2	On		800ns startup speed
	Off		250ns startup speed
3	On		HDU ROM code on motherboard
	Off		HDU ROM code on controller
4	On		Scroll display
	Off		Slow scroll video
5,6	**5**	**6**	**Video adapter**
	Off	Off	Mono 80x25
	Off	On	CGA 40 x 25
	On	Off	CGA 80 x 25
	On	On	EGA (1.43 BIOS only)
7,8	**7**	**8**	**Floppies**
	On	On	1 drive
	Off	On	2 drives

M24

SW Bank 0

Switch	Position				Function
1-4	**1**	**2**	**3**	**4**	**Memory**

Switch	*Position*				*Function*
	Off	On	On	On	128K/64K DRAMs
	On	Off	On	On	256K/64K DRAMs
	Off	Off	On	On	384/256K on m'b + 128K exp
	On	On	On	Off	512K in bk 0 on m'b
	On	On	Off	On	512/256K on m'b + 256K exp
	Off	On	Off	On	640/256K on m'b + 384K exp
	Off	On	On	Off	640/512K in bk 0 + 128K bk 1
	Off	On	Off	Off	640/128K in bk 0 + 512K bk 1
4	Off				256K DRAMs used
5	Off				8087 installed
6	Off				8250 ACE asynchronous installed
7					Reserved
8	On				2732 EPROM
	Off				2764 EPROM

SW Bank 1

Jumper	*Position*		*Function*
1	On		48 tpi floppies (320K)
	Off		96 tpi floppies (1.2 Mb)
2	On		Slow start up for MFD
	Off		Fast start up for MFD
3	On		HDU ROM code on motherboard
	Off		HDU ROM code on controller
4	On		Standard display controller
	Off		Non-standard display controller
5,6	**5**	**6**	**Video adapter**
	Off	Off	Mono
	Off	On	CGA 40 x 25
	On	Off	CGA 80 x 25
7,8	**7**	**8**	**Floppies**
	On	On	1 drive
	Off	On	2 drives

Jumper	*Position*	*Function*
B	1-2	8 MHz floppy controller
	2-3	4 MHz floppy controller
G	Out	Enable floppy controller
H	1	8 MHz 8087
	2	10 MHz 8087

M24SP

As for M21, except:

Jumper	*Position*	*Function*
B	1-2	8 MHz floppy controller
	2-3	4 MHz floppy controller
C,E	In	Production Test
	Out	Normal
G	Out	Enable floppy controller
H	1	8 MHz 8087

Jumper	Position	Function
	2	10 MHz 8087

M240

SW A

Jumper	Position		Function
S1,2	**S1**	**S2**	**Memory size**
	On	On	Disabled
	On	Off	256K
	Off	On	512K
	Off	Off	640K
S3	On		EGC present
S4,5	**S4**	**S5**	**Mini floppies**
	On	On	1
	Off	On	2
	On	Off	3
	Off	Off	4
S6,7	**S6**	**S7**	**Display type**
	On	On	EGA, INS or CRT not there
	Off	On	Colour 40x25
	On	Off	Colour 80x25
	Off	Off	Mono
8	On		No coprocessor
	Off		Coprocessor installed

SW B

Jumper	Position	Function
1	On	720K floppy
	Off	1.44 Mb floppy
2	On	5.25" floppy as A
	Off	3.5" floppy as A
3	On	5.25" floppy as B
	Off	3.5" floppy as B
4	On	Floppy enabled
5	On	BIOS HD on system
	Off	BIOS HD on controller or no HD
6	On	OGC controller installed
	Off	Other video (CGA etc)
7	On	Serial enabled
8	On	Parallel enabled
JP1	1-2	360K floppy disk change signal enabled
JP2	2-3	720K, 1.2, 1.44 Mb floppy disk change signal enabled
JP3	Out	Factory testing only
JP4	In	Calibration of system board disk drive
JP5	Out	Factory testing only
JP6	Out	Factory testing only
JP7	In	Normal operations
JP8	Out	Disable BIOS

Jumper	*Position*	*Function*
JP9	In	Reserved

M28

Jumper	*Position*			*Function*
JU1	1-16			512K on system board
	2-15			2764/27128 User EPROM
	3-14			27256 User EPROM
	4-13			27128 BIOS EPROM
	5-12			27256 BIOS EPROM
	6-11			Enable parallel port
	7-10			Disable serial port
JU2	1-16,4-13			5.33 MHz coprocessor
	2-15,3-14			8 MHz coprocessor
	5-12			Video adapter only
	6-11			Video adapter + EGC
	5-12,6-11			External video adapter
JU3	1-8			Reserved
	2-7			Colour display (Out=mono)
	3-6			Reserved
	4-5			Reserved
JU4,5	**JU4**	**JU5**		
	In	In		Production
	Out	Out		Test
JU6-8	**JU6**	**JU7**	**JU8**	**CPU Wait State**
	In	Out	Out	4
	Out	In	Out	5
	Out	In	In	6

M280

Jumper	*Position*	*Function*
JU1	1-16	512K on system board
	2-15	2764/27128 User EPROM
	3-14	27256 User EPROM
	4-13	27128 BIOS EPROM
	5-12	27256 BIOS EPROM
	6-11	Enable parallel port
	7-10	Disable serial port
	8-9	Reserved – always out
JU2	1,2,3,4	12 MHz 80287 (Out for 8 MHz)
	5-6	Flicker matrix video (Out=Dual port PGC or OEC video)
	7	External system clock (Out=24 MHz)
	8	80287 3 wait state (Out=10)
JU3-1	Out	Disable burn-in
	In	Enable
2	Out	Mono display
	In	Colour
3	Out	32 MHz clock disconnected
	In	Connected
4	Out	Reserved
JU4	Out	14 MHz clock disconnected

Jumper	*Position*	*Function*
	In	Connected
JU5	Out	1.8 MHz clock disconnected
	In	Connected
JU6	Out	8 MHz system clock
	In	12 MHz system clock
JU7	Out	12 MHz system clock
	In	8 MHz system clock
JU8	In	MC146818 and RAM
JU9	Out	MC146818 clock
	In	Non-volatile RAM
JU10,11,12	Out	8 MHz 80287
	In	12 MHz 80287

M290

Processor board

One version

Jumper	*Position*		*Function*
S1,2	**S1**	**S2**	**Memory**
	On	On	512K
	On	Off	1 Mb
	Off	On	2 Mb
	Off	Off	2 Mb + 256K
S3	On		OEC/OVC adapter
	Off*		PGC/other adapter
S4	On		Burn-in
	Off		Normal
P1	1-2		256-512K RAM module
	2-3		1 Mb RAM module
P2	Off		Reserved
P3	Off		Reserved

Another version

Jumper	*Position*	*Function*
1	On	OEC is secondary video controller
	Off*	OEC is primary video controller
2	On*	Colour
	Off	Mono
3	On*	Reserved – leave On
4	On	CGA emulation primary mode
	Off*	EGA emulation primary mode
5	On	CGA mode only
	Off*	EGA/CGA mode
6	Off*	Reserved – leave Off

M250

Jumper	Position		Function
P1,2	**P1**	**P2**	**SIMM type**
	In	Out	256x9, 512x9 (Bank 0)
	Out	Out	256x9, 512x9 (Bank 0&1)
	In	In	1 Mbx9 (Bank 0)
	Out	In	Reserved
P6	1-2		40 Mb HD
	2-3		20 Mb HD
P8	In*		Battery connected
	Out		Not connected

M250E

Jumper	Position		Function
P1,2	**P1**	**P2**	**SIMM type**
	1-2	1-2	1 Mb, no SIMM
	2-3	2-3	2 Mb, 2 512K SIMM
	3-4	3-4	4 Mb, 2 512K SIMM + 2 1 Mb
P6	1-2		1:1 HD interleave
	2-3		1:3 HD interleave
P8	In		Battery connected
	Out		Not connected
P9	In		16 MHz floppy
	Out		1.2 Mb floppy
P10	In		HD not installed
P11	In		Disable serial port
P12	1-2		Enable VGA
	2-3		Disable
P15	In		Selectable hysteresis
	Out		Normal hysteresis
P20	In		187ns precomp
	Out		125ns precomp

M300

Processor board

Jumper	Position		Function
JP1,2	**JP1**	**JP2**	
	In	Out	100ns DRAM
	In	In	120ns DRAM
	Out	Out	100ns FPM, 4 DRAM pages active
	Out	In	100ns FPM, 1 DRAM page active
JP3	In		Normal
	Out		Reserved
JP5	In		Normal
	Out		Reserved
JP6	1-2		A20GATE signal activated through keyboard controller
	2-3		A20GATE signal activated in fast mode (through chipset)
JP4,7-8,10	All 1-2		For 82335B
	All 2-3		For 82335A
JP9	In		Video adapters, BIOS on board
	Out		Video adapters, no BIOS on board

Jumper	*Position*	*Function*
JP11	In	Enable IRQ12 for mouse
	Out	Disable

M380T

Jumper	*Position*	*Function*
W010	In	14 MHz clock
A05BB	In	32 MHz clock
W1131	In	24 MHz clock
K0539	In	1.8 MHz clock
W07FD	In	Test burn-in mode
	Out	Normal operation
W07FQ	In	PGC or OEC video controller
	Out	Others
F01LQ	In	80387 uses external oscillator on system board F01L3
	Out	Uses system oscillator
Z12LU	1-2,5-6	Normal floppy operation

M380/XP1

As for M380T

M380/XP3

As for M380T

M380/XP4

As for M380T

M380/XP5

Jumper	*Position*		*Function*
JPR1,2	**JPR1**	**JPR2**	**82385 clock**
	1-2	2-3	25 MHz
	2-3	1-2	33 MHz
JPR4	2-3		Enable 12-16 Mb RAM as cache
	1-2		12-16 Mb RAM managed by I/O controller
	None		Disabled
JP1,2	**JP1**	**JP2**	**Processor speed**
	In	In	16 or 20 MHz
	Out	In	25 MHz (not used)
	In	Out	33 MHz
	Out	Out	40 MHz (not used)
JP3,4	**JP3**	**JP4**	**Bank (memory type)**
	In	In	0 (1 Mbx9 – 4 Mb)
	Out	In	0 & 1 (Mbx9 – 8 Mb)
	In	Out	0 (16 Mbx9 – 16 Mb)
	Out	Out	0 & 1 (4 Mbx9 – 32 Mb)
JP5	In		Enable system board RAM

Jumper	*Position*		*Function*
JP6	In		Enable coprocessor clock
	Out		System clock
JP7	In		386 pipeline operating mode
	Out		Non-pipeline
JP8	In		System serial port clock
	Out		External serial port clock
JP9,10	**JP9**	**JP10**	**EPROM**
	In	Out	256K
	Out	In	512K
JP11,12	**JP11**	**JP12**	**Compatibility**
	Out	Out	Compaq
	In	In	IBM

M380/XP7

As for M380/XP5

M380/XP9

As for M380/XP5, except:

Jumper	*Position*	*Function*
JPR3	2-3	Enable IRQ12 for mouse
	1-2	I/O disabled/enabled
	None	Disabled

M486 ESDI

Jumper	*Position*	*Function*
JP1		Disable system password

M486 SCSI

Jumper	*Position*	*Function*
JP1		Disable system password

P500 P4.1

Jumper	*Position*		*Function*
JP01	In		1 memory bank
	Out		2 memory banks
JP2,3	**JP2**	**JP3**	
	1-2	1-2	Enable RAS 0 (Bank 0)
	2-3	2-3	Enable RAS 1 (Banks 0&1)
JP5	1-2		1Mb SIMMs
	2-3		256K SIMMs
JP10	In		Disable power-up password
	Out		Normal

P500 P5

As for P500 P4.1

P750

Jumper	*Position*	*Function*
J3	In	Disable system password, restore default configuration
	Out	Normal

Opti

3486L

Jumper	*Position*				*Function*
P4	1-2				Double phase clock, 386 mode
	2-3				Single phase clock, 486 mode
P12-14	**P12**	**P13**	**P14**		**CPU**
	1-2	1-2	Close		486DX-25/33/50, DX2
	2-3	Open	Close		486SX-20/25
	1-2	2-3	Close		487SX-20/25
P25,33,100	P25	P33	P100		CPU Type
	1-2	Close	2-3		486 mode
	2-3	Open	1-2		386 mode
P28	On				Cyrix CX486DLC-33/40
	Off				Intel 386DX-33, AMD386DX-40
P30-32,P97	**P30**	**P31**	**P32**	**P97**	**Frequency** (MHz) if AV9107-03 clock chip is in U09.
	Off	On	On	Off	20
	On	Off	On	Off	25
	On	On	Off	Off	33.33
	Off	Off	On	Off	40
	Off	On	On	On	40
	On	Off	On	On	50
	On	On	Off	On	66.66
	Off	Off	On	On	80
P39	On				33 MHz 386
	Off				40 MHz 386
					486 speed is set in BIOS (CLK/6, etc)

Z386S

Jumper	*Position*	*Function*
JP1	1-2	Discharge CMOS
	2-3	Normal
JP2	Open	Colour
	Close	Mono
S1	Open	Turbo (JP3 is LED)
	Close	Normal
S2		Reset

Opus

PC IV 286

Jumper	*Position*			*Function*
W11	2-3			HD normal operation
	1-2			Old type HD (CP342)
W12				HD LED
W14	In			Enable floppies
W15,16	**W15**	**W16**		**Serial port**
	In	In		Enable COM1
	Out	Out		Enable COM3
	Out	In		Disable COM1
	In	Out		Disable COM3
W17,18	**W17**	**W18**		**Serial port**
	In	In		Enable COM2
	Out	Out		Enable COM4
	Out	In		Disable COM2
	In	Out		Disable COM4
W13,19, 20	**W13**	**W19**	**W20**	**Parallel port**
	1-2	In	In	Enable LPT1
	2-3	Out	Out	Enable LPT2
		Out	In	Disable LPT1
		In	Out	Disable LPT2
W21	In			Enable onboard HD
W22	In			Enable game port
W23	Out			Mono display
	In			Colour
W24	1-2			External battery
	2-3			Onboard battery
W25	1-2			Power fail detect circuit
	2-3			External power good
J9				For AA batteries

PC V 386

Jumper	*Position*	*Function*
JP1	In	CGA, EGA, VGA
	Out	MDA, HDC, Mono
J3	In	Onboard battery
	Out	External battery
JP8	2-3	Enable pipelined mode
JP10	1-2	80387 installed
	2-3	Not installed
JP11	In	Weitek 3167 installed
	Out	Not installed

PC VII 40

Jumper	*Position*	*Function*
JP1	In	CGA, EGA, VGA
	Out	MDA, HDC, Mono
JP2	1-2	Onboard battery
	2-3	Clear CMOS
	Out	External battery at J10
JP3	Out	CPU clock divided by 6 (OSCIN/6)
	In	CPU clock divided by 8 (OSCIN/8)
JP9	1-2	RA12 32K cache
		RA13 64K cache
	2-3	RA14 128K cache
		RA15 256K cache
JP12		HD LED

Panther 386sx

Jumper	*Position*			*Function*
JP1	1-2			Colour display
	2-3			Mono
JP2-4	**JP2**	**JP3**	**JP4**	**Turbo pin**
	In	Out	Out	8042 Turbo pin=27
	Out	In	Out	8042 Turbo pin=24
	Out	In	In	8042 Turbo pin=23
JP5	In			24mA bus driver
	Out			12mA bus driver
JP7	1-2			IRQ3 for mouse
JP8	1-2			IRQ4 for mouse
JP9	1-2			IRQ5 for mouse
JP10	1-2			IRQ2 for mouse
JP11	1-2			Enable mouse
JP12	1-2			Enable floppy
JP13	1-2			Enable onboard HD
JP14	1-2			Enable COM1
	2-3			Disable
JP15	1-2			Enable COM2
	2-3			Disable
JP16	1-2			Enable LPT1
JP17	1-2			Floppy primary address 3F1
	2-3			Floppy secondary address 371
JP18	1-2			HD primary address 1F0
	2-3			HD secondary address 170
JP19	1-2			COM1 primary I/O address 3F8
	2-3			COM1 secondary I/O address 3E8
JP20	1-2			COM2 primary I/O address 2F8
	2-3			COM2 secondary I/O address 2E8
JP21	1-2			LPT primary I/O address 378
	2-3			LPT secondary address 278
JP23	In			Clear CMOS
	Out			Normal

Powerstation 486

Jumper	*Position*	*Function*
JP1	1-2	Clear CMOS
	2-3	Onboard battery
	Out	External battery at J4
JP2	In	CGA, EGA, VGA display
	Out	Mono
JP3	In	Enable floppy
JP4,5	In	Enable HD
JP6	In	ATCLK=CLKIN/6
	Out	ATCLK=CLKIN/4
W2	1-2	50 MHz CPU, single frequency
	2-3	20,25,33 MHz CPU, double frequency

Notes

P

Packard Bell

286X

Jumper	*Position*		*Function*
J7	1-2		Enable COM1
	3-4		Enable COM2
J14	In		RAM 0 wait state
	Out		RAM 1 wait state
J15	In		256Kx9 RAM
	Out		1Mbx9 RAM
J16	In		Disable 384K relocation
	Out		Enable
J17,18	**J17**	**J18**	**Parallel port**
	1-2	2-3	LPT1 IRQ7
	2-3	1-2	LPT2 IRQ5
J20			Keylock
J21	In		Enable floppy
J22	In		Colour display
	Out		Mono
J23	In		Enable HD

386SX

16-bit HD controller automatically disables IDE.

Jumper	*Position*	*Function*
W3	1-2	Mono display
	2-3	Colour
W4	1-2	Disable floppy
	2-3	Enable
W11	1-2	Disable onboard VGA
	2-3	Enable
W12	1-2	Disable IDE LED
	2-3	Enable
W16	In	Enable PS/2 mouse port

386X

Jumper	*Position*		*Function*
J7	1-2		Enable COM1
	3-4		Enable COM2
J11,21	**J11**	**J21**	**Parallel port**
	1-2	2-3	LPT1 IRQ7
	2-3	1-2	LPT2 IRQ5
J12	In		Colour display
	Out		Mono
J14,15	**J14**	**J15**	**DRAM**
	1-2	1-2	100ns, FPM, 4 page, 0 ws
	2-3	1-2	100ns, FPM, 1 page, 0 ws
	1-2	2-3	100ns, 1 ws
	2-3	2-3	100ns, 1 ws
J18			Front panel connector
J19	In		Enable floppy
J20	In		Enable HD
J23			Keylock
J24	In		Enable PS/2 mouse port (v5 boards only)

486ES

Jumper	*Position*			*Function*
J11	2-3			Enable onboard VGA
	1-2			Disable
J12	In			Colour display
	Out			Mono
J13	1-2			LPT IRQ7
	2-3			LPT IRQ5
J14	In			Password Override
	Out			Clear password
J16	In			Enable I/O
	Out			Disable
J17	1-2			Boot from Boot block
	2-3			Normal
J22	In			VGA IRQ Enable
	Out			
J23, 25	**J23**	**J25**	**J26**	**CPU Speed**
26	In	Out	Out	20 MHz

Jumper	*Position*				*Function*
	Out	In	In		25/40MHz
J24	In				Enable battery
	Out				Disable
J27	In				Enable Mouse
	Out				Disable
J28					External Battery
J29					Reserved
J30-33	**J30**	**J31**	**J32**	**J33**	**Cache Size**
	Out	1-2	1-2	1-2	32K
	In	2-3	2-3	2-3	128/512K
J34,40	J34	J40			CPU Type
	1-2,3-4	1-2,5-6			486DX/487SX/Overdrive
	5-6				
	5-6	3-4			486SX (U48)
J37	In				Lock keyboard
	Out				Unlock
J39	1-2				Onboard Speaker
	2-3				Auxiliary
J41	In				Disable onboard RAM
	Out				Enable

486I

See Packmate486-25

486R/T

Jumper	*Position*	*Function*
JMP1	1-2	Enable floppy
	2-3	Disable
JMP2	1-2	Colour display
	2-3	Mono
JMP3	1-2	Enable IDE
	2-3	Disable
J4		Reset
J9		HD LED

486SX-20

Jumper	*Position*	*Function*
J11	In	Enable modem
J12	In	Enable mouse
J13	1-2	Disable VGA
	2-3	Enable
J14	1-2	Enable COM3
	2-3	Enable COM1
J15	1-2	Enable COM4
	2-3	Enable COM2
J16	1-2	Enable LPT2
	2-3	Enable LPT1
J18	1-2	LPT IRQ5

Jumper	*Position*	*Function*
	2-3	LPT IRQ7
J19	In	Interlaced VGA
	Out	Non-interlaced VGA
J20	1-2	HD secondary address
	2-3	HD primary address
J22	1-2	Floppy secondary address
	2-3	Floppy primary address
J23		Auxiliary fan
J26	1-2	External speaker
	2-3	Onboard
J27	5-6	486
	3-4	486SX
	1-2	487
J28	3-4	No cache (NC)
	1-2	Cache (C)
J29		Front panel
J30		Keylock

720

Something to do with AST? (Similar jumper labels to Bravo MS 5100).

Jumper	*Position*	*Function*
J4L1A	1-2	Password enabled
	2-3	Password disabled
	2-4	Normal
	5-6	Clear CMOS
J4L1B	1-2	Allow access to setup
	2-3	Denied
J4L1C	1-2,5-6	66 MHz host bus speed
	2-3,4-5	60 MHz
	2-3,5-6	50 MHz
J4L1D	1-2,4-5	1.5x CPU clock
	2-3,4-5	2x
	2-3,5-6	2.5x
	1-2,5-6	3x
J6A2	1-2	Standard voltage (3.3v)
	2-3	VRE (3.6v)
J6C2	1-2,4-5	2 PCI slots on riser
J4G1?	2-3,5-6	2 PCI slots on riser
J6C2	1-2,4-5	Normal
	2-3,5-6	Recovery Mode

Force 486-25

As for 486R/T

IS-VT286

Jumper	*Position*	*Function*
J1		Reset
J2	1-2	1Mb (512/512)

Jumper	Position				Function
	2-3				512 or 640K
J7	1-2				Colour display
	2-3				Mono
J12	1-2				Low system clock
	2-3				High system clock
SW1	**S1**	**S2**	**S3**	**S4**	**ROM size**
S1-4	On	On	Off	Off	128K/chip (4)
	Off	Off	On	On	256K/chip (2)

Packmate 486/25

Jumper	Position	Function
E2-E3		256K EPROM
E3-E4		512K EPROM
E5-E6		Enable password
E6-E7		Disable

PB 100

Jumper	Position	Function
Jfdc	1-2	Enable floppy
Jhdc	1-2	Enable IDE
Jc13	1-2	Modem COM1
	2-3	Modem COM3
Jc24	1-2	Serial port is COM2
	2-3	Serial port is COM4
Jlps	1-2	Parallel port is LPT1
	2-3	Parallel port is LPT2
Jirq	1-2	LPT IRQ7
	2-3	LPT IRQ5
Jvrq	In	VGA IRQ9
	Out	No interrupt
Jmrq	In	Mouse IRQ12
	Out	No interrupt
Jvgas	1-2	Disable VGA
	2-3	Enable VGA
Jgams	1-2	Enable game port
	2-3	Disable
Jvd	In	Colour display
	Out	Mono

PB 1000

Jumper	Position		Function
S1	On		Colour display
	Off		Mono
S2	On		256K BIOS EPROM
	Off		128K BIOS EPROM
S3,4	**S3**	**S4**	**System speed**
	On	On	10 MHz CPU
	Off	On	8 MHz CPU

Jumper	Position		Function
	Off	Off	5 MHz CPU
S5	On		Primary floppy address 3Fh
	Off		Secondary floppy address 37h
S6	Off		Reserved
S7	On		Reserved
S8	On		Reserved

PB 22/23

Jumper	Position	Function
J11	In	Enable modem
J12	In	Enable mouse
J13	1-2	Enable VGA
	2-3	Disable
J14	1-2	Enable COM1
	2-3	Enable COM3
J15	1-2	Enable COM2
	2-3	Enable COM4
J16	1-2	Enable LPT1
	2-3	Enable LPT2
J18	1-2	LPT IRQ7
	2-3	LPT IRQ5
J19	In	Interlaced VGA
	Out	Non-interlaced VGA
J20	1-2	HD primary address
	2-3	HD secondary address
J22	1-2	Floppy primary address
	2-3	Floppy secondary address
J23		Auxiliary fan
J26	1-2	External speaker
	2-3	Onboard
J27	5-6	486
	3-4	486SX
	1-2	487
J28	3-4	No cache (NC)
	1-2	Cache (C)
J29		Front panel
J30		Keylock

PB 25/33

Jumper	Position	Function
Jfdc	1-2	Enable floppy
Jhdc	1-2	Enable IDE
Jc1s	1-2	Enable COM1
	2-3	Disable
Jc2s	1-2	Enable COM2
	2-3	Disable
Jlps	1-2	Parallel port is LPT1
	2-3	Parallel port is LPT2
Jirq	1-2	LPT IRQ7

Jumper	*Position*	*Function*
	2-3	LPT IRQ5
Jpipe	Out	Non-pipeline mode (In is reserved)
Jrom	1-2	512K ROM (Out=256K)
Jvd	2-3	Colour display
	1-2	Mono

PB 286

Jumper	*Position*				*Function*
S1,2	**S1**	**S2**			**Memory size**
	Off	Off			256K
	Off	On			512K
	On	Off			640K
	On	On			640+384K
S3,4	**S3**	**S4**			**System clock**
	Off	Off			High speed
	Off	On			Middle speed
	On	Off			Low speed
	On	On			Low speed
S5					Reserved
S6					Reserved
S7	On				Colour display
	Off				Mono
S8	On				10 MHz 80287
	Off				4.77 MHz 80287
SW2	**S1**	**S2**	**S3**	**S4**	**ROM size**
S1-2	On	On	Off	Off	128K/chip (4)
	Off	Off	On	On	256K/chip (2)

PB 286B

Jumper	*Position*	*Function*
JP1	In	Colour display
	Out	Mono
JPF	In	Disable floppy
	Out	Enable

PB 300

Jumper	*Position*	*Function*
Jfdc	1-2	Enable floppy
Jhdc	1-2	Enable IDE
Jc13	1-2	Modem COM1
	2-3	Modem COM3
Jc24	1-2	Serial port is COM2
	2-3	Serial port is COM4
Jlps	1-2	Parallel port is LPT1
	2-3	Parallel port is LPT2
Jirq	1-2	LPT IRQ5
	2-3	LPT IRQ7
Jvrq	In	VGA IRQ9

Jumper	Position	Function
	Out	No interrupt
Jmrq	In	Mouse IRQ12
	Out	No interrupt
Jvgas	1-2	Enable VGA
	2-3	Disable
Jgams	1-2	Diisable game port
	2-3	Enable
Jvd	In	Colour display
	Out	Mono
Jpip	In	Pipelined 386
	Out	Non-pipelined

PB 301A-B2

Jumper	Position	Function
Jfdc	1-2	Floppy primary address
	2-3	Floppy secondary address
Jhdc	1-2	IDE primary address
	2-3	IDE secondary address
Jc13	1-2	Modem COM1
	2-3	Modem COM3
Jc24	1-2	Serial port is COM2
	2-3	Serial port is COM4
Jlps	1-2	Parallel port is LPT1
	2-3	Parallel port is LPT2
Jirq	1-2	LPT IRQ5
	2-3	LPT IRQ7
Jinlc	In	Interlaced monitor
	Out	Non-interlaced
Jmrq	In	Enable mouse port
	Out	Disable
Jvgas	1-2	Enable VGA
	2-3	Disable
Jgams	1-2	Diisable game port
	2-3	Enable
Jvd	1-2	Mono display
	2-3	Colour
Jpip	In	Pipelined 386
	Out	Non-pipelined
Jspks	1-2	Enable internal speaker
	2-3	Disable
Jbts	In	Enable external battery
	out	Disable

PB 301B-B2

As for PB 301A-B2

PB 301C-C1

As for PB 301A-B2

PB 320

As for PB 300

PB 386CDM-1

As for PB 301A-B2

PB 386-16/20 Supreme

Old

Jumper	*Position*	*Function*
JMP1	1-2	Colour display
	2-3	Mono
JMP2	1-2	Disable coprocessor
	2-3	Enable

New

Jumper	*Position*	*Function*
JMP1	1-2	Colour display
	2-3	Mono
JMP2	1-2	80387
	3-4	No 80387
	5-6	80287
JMP3	1-2	256K EPROM
	2-3	512K EPROM
JMP4	1-2	Disable aux IOCS16
	2-3	Enable

PB 386-25 Rev D

Same as Samsung SD 820

Jumper	*Function*
E1-E2, E4-E5	100ns SIMMs
E7-8, E10-11	256K SIMMs
E8-9, E11-12	1 Mb SIMMs
E13-14	Enable LPT1
E14-15	Disable
E16-17	Leading edge printer acknowledge
E17-18	Trailing edge printer acknowledge
E19-20	Enable LPT2
E20-21	Disable
E22-23	Enable COM1
E23-24	Disable
E25-26	Enable COM2
E26-27	Disable
E28-29	Maths copro installed
E29-30	Not installed

Jumper		*Function*
E34-35		Enable keyboard reset
E35-36		Disable
E37-38		Unix system
E38-39		Non-Unix
E41-42		Colour display
E40-41		Mono
E53-54	**E55-56**	**SIMM Type**
Out	In	Static column
In	In	FPM
Out	Out	Standard RAS/CAS
E57-58		64K ROM
E58-59		128K ROM
E60-62	**E61-63**	**Total RAM**
Out	Out	1 Mb
Out	In	2 Mb
In	Out	4 Mb
In	In	8 Mb

PB 386-25 Rev F

Jumper	*Function*
E2-3	Leading edge printer acknowledge
E3-4	Trailing edge printer acknowledge
E5-6	Enable LPT1
E6-7	Disable LPT1
E8-9	Enable LPT2
E9-10	Disable
E11-12	Enable COM1
E12-13	Disable
E14-15	Enable COM2
E15-16	Disable
E18-19	Colour display
E17-18	Mono
E23-24	64K ROM
E24-25	128K ROM
E35-36, E30-31, E33-34, E39-40	1 Mb RAM
E32-33, E35-36, E39-40, E30-31	2 Mb RAM
E33-34, E36-37, E38-39, E29-30	4 Mb RAM
E32-33, E36-37, E38-39, E29-30	8 Mb RAM
E42-43, E44-45	Static column RAM
E42-43, E45-46	FPM
E41-42, E44-45	Standard RAS/CAS
E47-48	Onboard RAM 100ns
E48-49	Onboard RAM 85ns

PB 386-33

Same as Samsung SD 830

Jumper		*Function*
E2-4	**E3-5**	**RAM Type**
Out	Out	RAS/CAS

Jumper		*Function*
In	In	FPM
Out	In	Static column
E6-8	**E7-9**	**Total RAM**
Out	Out	1 Mb
Out	In	2 Mb
In	Out	4 Mb
In	In	8 Mb
E16-18, E17-19		256K SIMMs
E18-20, E19-20		1 Mb SIMMs
E25-26		Enable LPT1
E26-27		Disable LPT1
E28-29		Enable LPT2
E29-30		Disable
E31-32		Enable COM1
E32-33		Disable
E34-35		Enable COM2
E35-36		Disable
E37-38		Mono display
E38-39		Colour
E40-41		Enable keyboard reset
E41-42		Disable
E43-44		Maths copro installed
E44-45		Not installed
E46-47		Leading edge printer acknowledge
E47-48		Trailing edge printer acknowledge
E49-50		64K EPROM
E50-51		128K EPROM

PB 400DX-33

Jumper	*Position*	*Function*
J8	In	Enable onboard battery
	Out	External battery
J10	1-2	Enable onboard VGA
	2-3	Disable
J12	1-2	Disable game port
	2-3	Enable
J14	In	Normal VGA
	Out	Enable VESA
J16	In	Colour display
	Out	Mono
J17	In	Enable PS/2 mouse port
J18	1-2	Enable COM1
	2-3	Enable COM3
J20	1-2	Enable COM2
	2-3	Enable COM4
J22	1-2	Enable LPT1
	2-3	Enable LPT2
J23	1-2	LPT IRQ7
	2-3	LPT IRQ5
J24	1-2	IDE primary address
	2-3	IDE secondary address

Jumper	*Position*	*Function*
J26	1-2	Floppy primary address
	2-3	Floppy secondary address
J29	1-2	Onboard buzzer
	2-3	External speaker
J30	3-4	486SX
	1-2,5-6,7-8	486DX/DX2
	1-2,5-6,9-10	487SX, P23T, P24T
J31	In	Upgrade CPU in U74
	Out	No upgrade CPU
J34	In	486DX2
	Out	No DX2
J35	1-2,3-4	16 MHz CPU
	3-4	20 MHz CPU
	1-2	25 MHz CPU
	None	33 MHz CPU
J36	None	64K cache
	1-2,5-6,7-8	128K cache
	1-2,3-45-6,9-19	256K cache

PB 400DX2-50

As for PB 400DX-33

PB 400SX-20

As for PB 400DX-33

PB 400SX-25

As for PB 400DX-33

PB 410

Jumper	*Position*			*Function*
J11	1-2			Disable VGA
J12	Short			Colour
	Open			Mono
J13	1-2			LPT IRQ7
	2-3			LPT IRQ5
J15	Short			Enable game port
	Open			Disable
J16	Short			Enable I/O
J17	1-2			Normal
	2-3			Boot Block
J22	Short			Enable VGA IRQ9
J23-26	**J23**	**J25**	**J26**	**CPU speed**
	Short	Open	Open	20 MHz
	Open	Short	Short	25 MHz
	Open	Short	Open	33 MHz
	Open	Open	Short	40 MHz
J24	Short			Enable onboard battery

Jumper	*Position*				*Function*
J27	Short				Enable mouse port
J28					External battery connector
J29	Short				CPU > 33 MHz
	Open				CPU <= 33 MHz
J30-33	**J30**	**J31**	**J32**	**J33**	**Cache**
	Open	1-2	1-2	1-2	32K
	Short	2-3	2-3	1-2	128K
	Short	2-3	2-3	2-3	512K
J34,40	**J34**	**J40**			**CPU type**
	1-2,5-6	1-2,5-6			486DX, ODPR
	1-2,5-6	3-4			487SX, POD
	5-6	3-4			486SX
	3-4	1-2,5-6			No upgrade CPU

PB 420(T)

As for PB 410

PB 430

Jumper	*Position*				*Function*
J11	1-2				Disable VGA
J12	Short				Colour
	Open				Mono
J13	1-2				LPT IRQ7
	2-3				LPT IRQ5
J16	Short				Enable I/O
J17	1-2				Normal
	2-3				Boot Block
J22	Short				Enable VGA IRQ9
J23-26	**J23**	**J25**	**J26**		**CPU speed**
	Short	Open	Open		20 MHz
	Open	Short	Short		25 MHz
	Open	Short	Open		33 MHz
	Open	Open	Short		40 MHz
J24	Short				Enable onboard battery
J27	Short				Enable mouse port
J28					External battery connector
J30-33	**J30**	**J31**	**J32**	**J33**	**Cache**
	Open	1-2	1-2	1-2	32K
	Short	2-3	2-3	1-2	128K
	Short	2-3	2-3	2-3	512K
J34,40	**J34**	**J40**			**CPU type**
	1-2,5-6	1-2,5-6			486DX, ODPR
	1-2,5-6	3-4			487SX, POD
	5-6	3-4			486SX
	3-4	1-2,5-6			No upgrade CPU

PB 440(T)

As for PB 430

PB 450

Jumper	Position		Function
J8 Jcol	In		Colour display
	Out		Mono
J9 Jvirq	In		Enable video IRQ 9
	Out		Disable
J10 Jpwdclr	In		Clear password
J11 Jgams	In		Enable game port
J15 Jdack	**J15**	**J16**	**ECP DMA**
J16 Jdrq	1-2	1-2	Channel 1
	2-3	2-3	Channel 3
J17 Jbbe	1-2		Boot block
	2-3		Normal
J18 Jpare	1-2		Enable parity
	2-3		Disable
J19 Jvgae	1-2		Disable VGA
J20 Jio	1-2		Disable I/O
J25 Jsel	1-2		25 MHz CPU
	2-3		33 MHz CPU
J26 Jcsize	Any		No cache
	Open		128K
	1-2,3-4		512K
J31	1-2,3-4		486DX, P24T
	5-6		486SX
J36 Jspk	Open		External speaker
	3-4		Internal speaker
J37 Jobmd	Open		Enable memory
J39 Jacf	Open		All other
	Close		Alternate CPU
J40 Jacd	1-2		No SMM
	1-2,3-4		With SMM
	2-3		All other
J41 Jace	1-2		No SMM
	1-2,3-4		With SMM
	2-3		All other

PB 470

Same as Zenith Z-Station 510

Jumper	Position	Function
J8 Jpwdclr	In	Clear password
J9 Jcol	In	Colour display
	Out	Mono
J12 Jirq9	In	Enable video IRQ 9
J13 Jio	1-2	Disable I/O
J14 Jbte	1-2	Boot block
	2-3	Normal
J15 Jvgae	1-2	Disable VGA
J16 Jpare	1-2	Enable parity
	2-3	Disable
J23 Jca2/3	Any	No cache
J25 Jcal7/2	1-2	128K

Jumper	*Position*		*Function*
	2-3		256K
	1-2		512K
J24Jcsize	Any		No cache
	None		128K
	Open		256K
	1-2,3-4		512K
J27dack	**J27**	**J28**	**ECP DMA**
J28drq	1-2	1-2	Channel 1
	2-3	2-3	Channel 3
J30 Jeride	1-2		Enable (?)
	2-3		Disable
J31 Jbte	Closed		Enable onboard battery
J32 Jsel	1-2		25 MHz CPU
	2-3		33 MHz CPU
J33 Jsx	5-6		SX CPU
	1-2,3-4		Others
J34 Jret	1-2		Reserved
	2-3		All CPUs
J35 Jdev	Closed		Enable
J36 J(3.3v)	1-2,3-4		3.3v CPU
	3-5,4-6		5v CPU
J37 Jmul	None		x3 CPU
	3-4		x2 CPU
	1-2		Other
J40 Jspk	Open		External speaker
	3-4		Internal speaker

PB 500

Jumper	*Position*		*Function*
S1	On		Serial port is COM2
	Off		Serial port is COM1
S2	On		Parallel port is LPT2
	Off		Parallel port is LPT1
S3,4	**S3**	**S4**	**Video Type**
	On	On	Auto select
	Off	Off	80x25 mono
	Off	On	80x25 colour
	On	Off	40x25 colour
J6	Out		2764/27128/27256
	1-2		2764/27128/27256/27512

PB 520

Jumper	*Position*	*Function*
J7A1	4-5	66 MHz (not used)
	5-6	60 MHz
J1G2		Turbo switch
J12H1	1-2	Recovery
	3-4	Normal
	5-6	Program Flash
	7-8	Write protect

Jumper	*Position*	*Function*
J13H1	1-2	Normal
	3-4	Clear CMOS
	5-6	Enable password
	7-8	Disable
J13H3	1-2	Mono
	3-4	Colour
	5-6	Enable setup
	7-8	Disable

PB 520R

Jumper	*Position*	*Function*
J13		Not used
J14	1-2	66 MHz (not used)
	2-3	60 MHz
J15	1-2	Mono display
	2-3	Colour
J16	1-2	Normal
	2-3	Clear password
J17	1-2	Flash boot block recovery mode
	2-3	Normal
J18	1-2	Flash write enable
	2-3	Flash write protect
J19	1-2	Clear CMOS
	2-3	Normal
J20	1-2	Enable CMOS setup

PB 55

Switch	*Position*	*Function*
JP2		Reserved
JP3	In	Colour display
	Out	Mono
JP4		Reserved
JP5	In	Enable PS/2 mouse
JP7	In	60Hz V/37.8KHz H
	Out	56Hz V/35.2KHz H
JP8	In	Multi-sync monitor
	Out	PS/2 or other monitor
JP9	In	PS/2 VGA video BIOS
	Out	AT VGA video BIOS
JP10		Reserved
JP11		Reserved
JP12	In	Enable VGA
	Out	Disable VGA
JP14	In	Clear CMOS
	Out	Normal
JP15	1-2	Internal speaker
	2-3	External speaker
JP30	In	Centronics printer port
	Out	PS/2 (bidirectional) printer port

PB 540

Switch	Position	Function
J1J1 (75/90)		Reserved
J1J2 (75/90)		Reserved
J1H1 (RCVR)	1-2	Flash boot block recovery mode
	2-3	Normal
J1H2 (PRG)	1-2	Flash write enabled
	2-3	Flash write protected
J1H3 (SETUP)	1-2	Enable CMOS setup
	2-3	Disable
J1H4 (PED)	1-2	Normal
	2-3	Clear password
J1H5 (MO/CLR)	1-2	Mono
	2-3	Colour
J1H6 (CMOS)	1-2	Normal
	2-3	Clear CMOS
J9N1	1-2	3.45v CPU
	2-3	3.3v CPU

PB 550

As for PB 540

PB 560

As for PB 540

PB 570

Switch	Position	Function
1	On	Reserved
2	On	60 or 66 MHz
	Off	50 MHz
3	On	Disable password
	Off	Enable
4	On	Clear CMOS
	Off	Normal
5	On	Disable setup
	Off	Enable
6	On	CPU 2x
	Off	CPU 1.5x
7	On	60 MHz
	Off	50 or 66 MHz
8	On	66 MHz
	Off	50 or 60 MHz
J5A2	1-2	Normal
	2-3	BIOS recovery
J13J1	1-2	CPU voltage VR
	2-3	CPU voltage VRE

PB 580

As for PB 570

PB 590

As for PB 570

PB 600

Jumper	*Position*	*Function*
J8	In	Clear password
	Out	Normal
J9	In	Quick boot
	Out	Normal
J14	1-2	Boot block
	2-3	Normal
J15	1-2	Disable onboard I/O
	2-3	Enable
J16	1-2	Parity check disable (if no onboard memory)
	2-3	Enable
J17	In	Standard power supply
	Out	With Standby
J18	1-2	ECP DRQ Channel 1
	2-3	ECP DRQ Channel 3
J19	1-2	ECP DACK Channel 1
	2-3	ECP DACK Channel 3
J19	1-2	CPU VR voltage (3.3v)
	2-3	CPU VRE voltage (3.45v)
J29	In	Onboard lithium battery
	Out	External
J30	In	60/66 MHz host bus frequency
	Out	50 MHz host bus frequency
J31	In	66 MHz host bus frequency
	Out	50/60 MHz host bus frequency
J32	In	CPU multiplier 2x
	Out	CPU multiplier 1.5x
J37	In	Onboard speaker
	Out	External speaker

PB 630

As for PB 650

PB 640

Same as Z-Station Campus

Jumper	*Position*	*Function*
J5J1	1-2,4-5	50 MHz Host bus speed
	1-2,5-6	50 MHz Host bus speed
	2-3,4-5	66 MHz host bus speed

Jumper	*Position*	*Function*
J5J2	1-2,4-5	1.5x CPU
	2-3,4-5	2x CPU
	2-3,5-6	2.5x CPU
J5K2	1-2	Normal
	2-3	Clear CMOS
	4-5	Password enabled
	5-6	Clear password
J9C1	1-2	Normal
	2-3	Boot block recovery
J4K1	1-2	1/3 PCI CLK
	2-3	¼ PCI CLK
	4-5	Enable access to CMOS
	5-6	Deny access to CMOS
J6A2	1-2	Standard CPU voltage (3.3v)
	2-3	VRE

PB 650

As for PB 570

PB 660

As for PB 640

PB 680

Same as ZDS Cheetah

PB 686

Jumper	*Position*		*Function*
JP1	1-2		128K piggy-back board always on
	2-3		System sees only 512K RAM
JP2	1-2		Mono display
	2-3		Colour display
JP5	In		640K RAM
	Out		1 Mb RAM (not on 1 Mb motherboard)
JP24,33	**JP24**	**JP33**	**Serial port**
	1-3,2-4	1-3,2-4	DB25=COM1, DB9=COM2
	1-3,2-4	1-3,2-4	DB25=COM2, DB9=COM1
	2-4	1-3	DB25=COM1, DB9 disabled
	1-2	1-2	DB25=COM2, DB9 disabled
	3-4	3-4	DB9=COM1, DB25 disabled
	1-3	2-4	DB9=COM2, DB25 disabled

PB 800/900 Rev C/D

Jumper	*Position*	*Function*
COLOR/MONO	1-2	Colour display
	2-3	Mono

Jumper	*Position*	*Function*
J19	1-2	80287-8
	3-4	80287-10 (with 30-32 MHz crystal at U17)

PB 88

Processor board

Jumper	*Position*		*Function*
S1	Off		Reserved (test)
S2	On		Maths copro not installed
	Off		Installed
S3	Off		Reserved
S4	Off		Reserved
S5,6	**S5**	**S6**	**Display type**
	Off	On	Low res graphics
	On	Off	High res graphics
	Off	Off	Mono
S7,8	**S7**	**S8**	**Diskette drives**
	On	On	1 floppy
	On	Off	2 floppies

PB 8810

As for PB 500.

PB VX 588

Jumper	*Position*		*Function*
S1	Off		Reserved (On=test)
S2	On		Maths copro not installed
	Off		Installed
S3,4	**S3**	**S4**	Total RAM
	On	On	256K
	Off	On	512K
	On	Off	576K
	Off	Off	640K
S5,6	**S5**	**S6**	Display type
	Off	Off	Mono
	Off	On	40x25 colour
	On	Off	80x25 colour
	On	On	EGA
S7	On		1 floppy
	Off		2 floppies
S8	On		8 MHz
	Off		5.5 MHz
S9	On		Enable video
S10	On		Enable serial port
S11	On		Enable parallel port
S12	On		Enable floppy

PB VX 88

As for PBVX 588 except:

Jumper	Position		Function
S3,4	**S3**	**S4**	**Total RAM**
	On	On	256K
	Off	On	512K
	On	Off	Reserved
	Off	Off	640K
S5,6	**S5**	**S6**	**Display type**
	Off	Off	Mono
	Off	On	40x25 colour
	On	Off	80x25 colour
	On	On	Reserved
S8	On		Fast mode
	Off		Slow mode

Spectria

Jumper	Position	Function
J8	Close	Colour
	Open	Mono
J9	Close	Enable VGA IRQ9
J10	Close	Clear password
J15,16	1-2	DMA Channel 1
	2-3	DMA Channel 2
J17	1-2	Protected Boot Block
	2-3	Normal
J18	1-2	Enable parity
	2-3	Disable
J19	1-2	Disable Video
	2-3	Enable
J20	1-2	Disable I/O
	2-3	Enable
J25	1-2	25 MHz CPU
	2-3	33 MHz CPU
J26	Open	128K
	Closed	512K
J28	1-2	Reserved
	2-3	All CPUs
J29	Open	3x CPU
Not Rev D	2-3	2x CPU
	1-2	Other multiplier
J30	3-4	External battery
J31	5-6	SX
	1-2,3-4	All others
J32	3-5,4-6	5v CPU (3.3v not supported)
J39		Only on Rev G board – do not change (Std/Alt CPU)
J40		Only on Rev G board – do not change (CPU SMI)
J41		Only on Rev G board – do not change (SMIACT)

Victory

Jumper	*Position*	*Function*
W3	1-2	Mono display
	2-3	Colour
W4	1-2	Disable floppy
	2-3	Enable
W9	1-2	80C287-12
	2-3	80287-6
W11	1-2	Disable video
	2-3	Enable
W12	1-2	Disable HD LED
	2-3	Enable
W16	In	Enable PS/2 mouse port
	Out	Disable

Palit

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	PCI54IT		

Panrix

Slot A

Made by anonymous famous manufacturer

Item	Description	Notes
Form Factor	ATX	
CPU	Athlon	Slot A
Speeds (MHz)		
Chipset	AMD 750	
BIOS		
Bus	5 PCI/1 ISA	UDMA/66
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2 EIDE, floppy	
Video		AGP
Performance		
Comments		

Palmax

Pantex

Rebadges Biostars.

PC Chips

Hsing Tech Enterprises
www.pcchips.com
www.protac.com/files/index.html – Europe.

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1-00	M 529	H-01	80486VIP
AC-00	M 577		

i430VX

Jumper	*Position*			*Function*
JP1	In			Clear CMOS
	Out			Normal
JP2	1-2			PCI Clock/4
	2-3			PCI Clock/3
JP3	1-2			12v Flash ROM
	2-3			5v Flash ROM
JP4	1-2			2 Mb Flash ROM
	2-3			1 Mb Flash ROM
JP5A,B	3.3/5v			Voltage Selector
JP6A-C	**A**	**B**	**C**	**CPU Speed**
	2-3	2-3	1-2	50 MHz
	1-2	2-3	2-3	55 MHz
	2-3	1-2	1-2	60 MHz
	1-2	2-3	1-2	66 MHz
	1-2	1-2	1-2	75 MHz
JP7A,B	**A**	**B**		**CPU Internal Clock**
	In	Out		2x (Intel/Cyrix)
	Out	Out		1.5x (Intel/AMD)
	In	In		2.5x (Intel)
	Out	In		3x (Intel)
JP8	1-2			256K cache
	2-3			512K cache
JP9	A			3.5v CPU

Jumper	Position	Function
	B	2.9v
	C	2.8v
	D	2.7v
	E	3.3v
	None	2.5v
JP10	1-2	RTC Chip select - Default

80486VIP

Jumper	Position		Function
JP2	1-2		12v Flash ROM
	2-3		5v Flash ROM
JP3A-C	JP3C		25 MHz CPU
	JP3A,B,C		33 MHz
	JP3B,C		40 MHz
	JP3A		50 MHz
J4	3-4		Discharge CMOS
JP7-12	JP7, 8A 2-3, 9A 2-3, 10A3-4, 10C 1-2 3-4, JP12A 1-2, JP12B 1-2		486DX/DX2
	JP6, JP8A 1-2, JP9A 1-2, JP9B 1-2 3-4, JP9C 3-4, JP10A 3-4, JP10B 1-2 3-4, JP10C 1-2 3-4, JP14 2-3 4-5, JP12A 1-2, JP12B 1-2		AMD X5-133, Cyrix 5x86, AMD enh 486 DX2/DX4
	JP8B 1-2, JP9A 1-2, JP9B 1-2, JP9C 2-3, JP10A 3-4, JP10B 2-3, JP10C 1-2 3-4, JP11 2-3, JP14 1-2 3-4, JP12A 2-3, JP12B 1-2		Cyrix/IBM/Ti/SGS DX/DX2/DX4
	JP8A 1-2, JP9A 1-2, JP9B 1-2 3-4, JP9C 3-4, JP10A 3-4, JP10B 2-3, JP10C 1-2 3-4, JP14 2-3 4-5, JP12A 1-2, JP12B 1-2		P24D
	JP7, JP8A 2-3, JP9A 2-3, JP10A 3-4, JP10C 1-2 3-4, JP12A 1-2, JP12B 1-2		AMD DX2/DX$
	JP8A 2-3, JP9A 1-2, JP9B 1-2, JP10A 3-4, JP10B 1-2, JP10C 1-2 3-4, JP14 2-3 4-5, JP12A 1-2, JP12B 1-2		DX4-SL
	JP 13, JP8A 1-2, JP9A 1-2, JP9B 1-2 3-4, JP 9C 3-4, JP10A 3-4, JP10B 1-2 3-4, JP10C 1-2 3-4, JP14 2-3 4-5, JP12A 2-3, JP12B 1-2		Cyrix/IBM/SGS DX4-100 (Intel pinout)
JP5 A-D	**5A-D**	**JP4**	**CPU Voltage**
JP4	1-2	In	3.3
	1-2	Out	4
	2-3	In	5
JP6	On		2x CPU Intel, 5x Cyrix, 4xAMD
	Off		3x CPU
JP8A	1-2		2x AMD DX4
	2-3		3x AMD DX4

M 506

Jumper	Position		Function
JP1,2	1-2		LPT DMA1
	2-3		LPT DMA3
JP3	1-2		AT bus CPU/6
	2-3		AT bus CPU/8
JP4	In		12v Flash ROM
	Out		5v Flash ROM
JP5	**A**	**B**	**CPU Speed**
	In	In	50 MHz

Jumper	Position		Function
	Out	In	60 MHz
	In	Out	66 MHz
JP6	1-2		3.5v VRE
	2-3		3.3v STD/VR
JP9	1-2		256K cache
	2-3		512K cache
JP10	1-2		5v SRAM
	2-3		3.3v SRAM
JP11	**A**	**B**	**Clock Multiplier**
	In	Out	2x
	Out	Out	1.5x
	In	In	2.5x
	Out	In	3x

M 529

Same as Elpina/Amptron PM 7400 v1.0. Comes from Hsin Tech

M 559

Jumper	Position					Function
JP3	Out					Enable Sound pro
	In					Disable
JP4	In					Special Microphone
	Out					Normal
J5	1-2					Normal
	2-3					Clear CMOS
JP6	**A**	**B**	**C**	**D**	**E**	**CPU Core Voltage**
	In	Out	Out	Out	Out	3.5v
	Out	In	Out	Out	Out	3.3v
	Out	Out	In	Out	Out	3.2v
	Out	Out	Out	In	Out	2.9v
	Out	Out	Out	Out	In	2.8v
	Out	Out	Out	Out	Out	2.5v
JP8	1-2					12v Flash ROM
	2-3					5v Flash ROM

M 570 v3.0

Item	Description	Notes
Form Factor	AT	
CPU	Pentium	Socket 7
Speeds (MHz)		
Chipset		100 MHz bus speed
Bus	3 PCI/2 ISA	
Memory (Mb)		DIMM sockets
I/O	2S, 1P, USP, PS/2	UDMA 3
Video		AGP

Jumper	*Position*				*Function*
JP2	1-2				Normal
	2-3				Clear CMOS
JP3	1-2				5v DIMMs
	2-3				3.3v DIMMs
JP5	**A**	**B**	**C**	**D**	**CPU Multiplier**
	1-2	1-2		1-2	1.5/3.5x
	2-3	2-3		1-2	2.5x
	2-3	1-2	2-3	1-2	4x
	1-2	2-3	2-3	1-2	5x
	2-3	1-2		1-2	2x
	1-2	2-3		1-2	3x
	2-3	2-3	2-3	1-2	4.5x
	1-2	1-2	2-3	1-2	5.5x
JP6	**A**	**B**	**C**		**CPU Frequency**
	2-3	2-3	2-3		60 MHz
	2-3	1-2	2-3		68 MHz
	1-2	2-3	1-2		83 MHz
	1-2	2-3	2-3		66 MHz
	2-3	2-3	1-2		75 MHz
JP7	**A**	**B**	**C**	**D**	**CPU Core Voltage**
	Out	In	Out	In	2v
	Out	In	In	In	2.4v
	Out	In	Out	Out	2.8v
	Out	In	In	Out	3.2v
	In	In	Out	In	2.1v
	In	In	In	In	2.5v
	In	In	Out	Out	2.9v
	In	In	In	Out	3.3v
	Out	Out	Out	In	2.2v
	Out	Out	In	In	2.6v
	Out	Out	Out	Out	3v
	Out	Out	In	Out	3.4v
	In	Out	Out	In	2.3v
	In	Out	In	In	2.7v
	In	Out	Out	Out	3.1v
	In	Out	In	Out	3.5v

M 571 v1.3

Item	Description	Notes
Form Factor	AT	
CPU	Pentium	Socket 7
Speeds (MHz)		
Chipset		100 MHz bus speed
BIOS		
Bus	4 PCI/4 ISA	
Memory (Mb)		2 DIMM sockets, 4 72-pin
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video		

Jumper	*Position*					*Function*
JP2	1-2					Normal
	2-3					Clear CMOS
JP3	1-2					Disable Internal VGA
	2-3					Enable
JP4	5v					5v DIMMs
	3.3v					3.3v DIMMs
JP5	**A**	**B**	**C**			**CPU Frequency**
	2-3	2-3	2-3			50 MHz
	1-2	2-3	2-3			55 MHz
	2-3	2-3	1-2			60 MHz
	2-3	1-2	2-3			66 MHz
	1-2	2-3	1-2			75 MHz
JP5D	1-2					PCI CPUCLK/2
	2-3					33 MHz
JP6	**A**	**B**	**C**	**D**	**E**	**CPU Core Voltage**
	Out	Out	Out	Out	Out	2.5v
	Out	Out	Out	Out	In	2.8v
	Out	Out	Out	In	Out	2.9v
	Out	Out	In	Out	Out	3.2v
	Out	In	Out	Out	Out	3.3v
	In	Out	Out	Out	Out	3.5v
JP7	**A**	**B**				**CPU Internal Clock**
	1-2	1-2				1.5x/3.5x
	2-3	1-2				2x
	2-3	2-3				2.5x
	1-2	2-3				3x
JP8A,B	2-3					P54C (Single Voltage)
	1-2					P55C (Dual Voltage)

M 575 v1.1

Item	Description	Notes
Form Factor	AT	
CPU	Pentium	Socket 7
Speeds (MHz)		
Chipset		100 MHz bus speed
BIOS		
Bus	4 PCI/3 ISA	
Memory (Mb)		3 DIMM sockets, 4 72-pin
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video		
Audio		

Jumper	*Position*	*Function*
JP1	1-2	Normal
	2-3	Clear CMOS
JP3	1-2	P55C (Dual Voltage)
	2-3	P54C (Single Voltage)

Jumper	*Position*						*Function*
JP5	**A**	**B**					**CPU Internal Clock**
	1-2	1-2					1.5x/3.5x
	2-3	1-2					2x
	2-3	2-3					2.5x
	1-2	2-3					3x
JP6	**A**	**B**	**C**	**D**	**E**	**F**	**CPU Core Voltage**
	Out	Out	Out	Out	Out	In	2.5v
	Out	Out	In	Out	Out	In	3.2v
	Out	Out	Out	Out	Out	Out	2.2v
	Out	Out	Out	Out	In	In	2.8v
	Out	In	Out	Out	Out	In	3.3v
	Out	Out	Out	In	Out	In	2.9v
	In	Out	Out	Out	Out	In	3.5v
JP7	**A**	**B**					**CPU External Speed**
	In	In					60 MHz
	Out	In					66 MHz
	In	Out					75 MHz
	Out	Out					83 MHz
JP9	Out						Enable Sound Pro
	In						Disable

MB-5770

Item	Description	Notes
Form Factor	AT	
CPU	Pentium	Socket 7
Speeds (MHz)	90-350 MHz	
Chipset	TX AGP Pro PC100	100 MHz bus speed
BIOS		
Bus	3 PCI/2 ISA	
Memory (Mb)		3 DIMM sockets, 2 72-pin
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video		AGP
Audio	3D Sound Pro	

MB-5900

Item	Description	Notes
Form Factor	AT	
CPU	Pentium	Socket 7
Speeds (MHz)	90-350 MHz	
Chipset	PC100 TX Pro	100 MHz bus speed
BIOS		
Bus	3 PCI/2 ISA	
Memory (Mb)		2 DIMM sockets, 2 72-pin
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video	4 Mb AGP 3D	AGP
Audio	3D Sound Pro	

MB-7170

Item	Description	Notes
Form Factor	AT	
CPU	Pentium II/Celeron	
Speeds (MHz)	233-333 MHz	Celeron up to 300 MHz
Chipset	440EX/LX	
BIOS		
Bus	3 PCI/2 ISA	
Memory (Mb)		2 DIMM sockets, 2 72-pin
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video	4 Mb AGP 3D	AGP
Audio	3D Sound Pro	

MB-7290

Item	Description	Notes
Form Factor	AT	
CPU	Pentium II	Slot 1
Speeds (MHz)	233-450 MHz	Celeron 266-300 MHz
Chipset	PC100 based BXcel	100 MHz bus speed
BIOS		
Bus	3 PCI/2 ISA	
Memory (Mb)		3 DIMM sockets
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video		AGP
Audio	3D Sound	

MB-7300

Item	Description	Notes
Form Factor	Micro ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	233-400 MHz	Celeron 266-333 MHz
Chipset	PC100 BXpert	100 MHz bus speed
BIOS		
Bus	3 PCI/2 ISA	
Memory (Mb)		3 DIMM sockets
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video	8 Mb AGP 3D	AGP
Audio	3D Sound Aureal	

MB-7470

Item	Description	Notes
Form Factor	AT	

Item	Description	Notes
CPU	Pentium II	Slot 1
Speeds (MHz)	233-450 MHz	Celeron 266-300 MHz
Chipset	PC100 BX Pro	100 MHz bus speed
BIOS		
Bus	3 PCI/2 ISA	
Memory (Mb)		3 DIMM sockets
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video	3D AGP	64 bit 4 Mb Frame Buffer
Audio	3D Sound	

MB-7610

Item	Description	Notes
Form Factor	Micro ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	233-500 MHz	Celeron 266-333 MHz
Chipset	440 BX	100 MHz bus speed
BIOS		
Bus	3 PCI/1 ISA	
Memory (Mb)		3 DIMM sockets
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video		AGP
Audio	3D Sound Aureal	

Triton Board (unidentified)

Jumper	*Position*						*Function*
JP1	1-2						Normal
	2-3						Clear CMOS
JP3	1-2						P55C (Dual Voltage)
	2-3						P54C (Single Voltage)
JP5	**A**	**B**					**CPU Internal Clock**
	1-2	1-2					1.5x/3.5x
	2-3	1-2					2x
	2-3	2-3					2.5x
	1-2	2-3					3x
JP6	**A**	**B**	**C**	**D**	**E**	**F**	**CPU Core Voltage**
	Out	Out	Out	Out	Out	In	2.5v
	Out	Out	In	Out	Out	In	3.2v
	Out	Out	Out	Out	Out	Out	2.2v
	Out	Out	Out	Out	In	In	2.8v
	Out	In	Out	Out	Out	In	3.3v
	Out	Out	Out	In	Out	In	2.9v
	In	Out	Out	Out	Out	In	3.5v
JP7	**A**	**B**					**CPU External Speed**
	In	In					60 MHz
	Out	In					66 MHz

Jumper	Position		Function
	In	Out	75 MHz
	Out	Out	83 MHz
JP9	Out		Enable Sound Pro
	In		Disable

PC Master

See PC Ware

PC Max

See PC Ware

PC Partner

See Vtech Computer Systems Ltd
www.pcpartner.com

PC Quest

See PC Ware

PC Ware

www.pcware.com

Pine Technology

www.pineusa.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	TL-LX01	AC-00	PT 730A/B

PT 319A

386sx

Jumper	Position	Function
JP1	Closed*	Colour display

Jumper	*Position*	*Function*
	Open	Mono
JP3	1-2*	387SX clock synchronous (CLK2)
	2-3	387SX clock asynchronous (OSC2)
		If CPU and copro are same speed, connect JP3 1-2. otherwise, 2-3 with another oscillator.
JP5	Closed	Turbo speed
	Open	Low speed

PT-429G

NetWare compatible 486

Jumper	*Position*					*Function*
JP1	Short					Onboard battery connect
JP2	1-2*					External power good
	2-3					Internal power good
JP3	1-2*					Normal VGA
	2-3					Power 9000 VGA
JP4	1-2					Enable Cx487s * MCA3 only for Master Mode
	2-3*					Normal 3 VESA Master
JP5	1-2*					No CPURDY# Delay 1-T state (50 MHz VESA)
	2-3					Delay 1-T state (50 MHz VESA)
JP6	1-2*					No PADS# Delay 1-T state (50 MHz VESA)
	2-3					Delay 1-T state (50 MHz VESA)
JP7	Open*					Enable CPU test logic
	Close					Disable
JP9-11,30	**JP9**	**JP10**	**JP11**	**JP30**		**Clock speed** (AvaSem AV9107-05 at U34)
		On	Off	2-3		25 MHz
		Off	On	2-3		33 MHz*
		Off	Off	2-3		40 MHz
		On	Off	1-2		50 MHz
	JP9	**JP10**	**JP11**	**JP30**		**Clock speed** (Chrontel CH9007E at U35)
	On	On	On			25 MHz
	On	On	Off			33 MHz*
	On	Off	On			40 MHz
	Off	Off	Off			50 MHz
	JP9	**JP10**	**JP11**	**JP30**		**Clock speed** (MX 8315 at U28)
	Off	Off	On			25 MHz
	On	On	On			33 MHz*
	Off	On	On			40 MHz
	On	Off	Off			50 MHz
JP12	Open					CPU speed <=33 MHz (for VL bus)
	Close					CPU speed >33 MHz
JP13-17	**JP13**	**JP14**	**JP15**	**JP16**	**JP17**	**Cache size**
	Open	2-3	Open	Open	Open	32K
	Open	1-2	Open	Short	Open	64K
	2-3	2-3	Open	Short	Short	128K
	1-2	1-2	Short	Short	Short	256K*
JP18,19	**JP18**	**JP19**				**CPU type**
	2-3	Open				486SX
	1-2,3-4	1-2				486DX/DX2*
	1-2,3-4	2-3				P24N/P24T
JP20	Open*					0 VESA wait state

Jumper	*Position*		*Function*
	Short		1 VESA wait state
JP21	1-2		Bank 0 30-pin SIMM
	2-3		Bank 2 30-pin SIMM
JP22,23	**JP22**	**JP23**	**72-pin SIMM5**
	1-2	2-3	Bank 0
	Off	Off	Bank 1
	JP22	**JP23**	**72-pin SIMM5**
	1-2	2-3	Bank 0 & 1
	1-2	2-3	Bank 1 & 2
JP24,25	**JP24**	**JP25**	**72-pin SIMM6**
	1-2	2-3	Bank 1
	Off	Off	Bank 2
	JP24	**JP25**	**72-pin SIMM6**
	1-2	2-3	Bank 1 & 2
	1-2	2-3	Bank 2 & 3
JP32	1		Green AUX #2 connector output #1
	2		Green AUX #2 connector output #2
GJ1	Open		Normal
	Close		Enable Green Function
GJ3	1-2		AMI Megakey keyboard BIOS
	2-3		Phoenix Multikey keyboard BIOS

Pionex Computers

Rebadges Biostars.

Powertech

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
HC	MB 532	LC	MB 533
KC	MB 533		

Premio

Formerly CompuTrend
www.premiopc.com

President Technology

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
A-00/01	P54SA(B)		

Pride

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	Freeway II	0C	Freeway II
AC	Freeway VX		

Freeway II

Freetech Board

Freeway II+

Really a Freetech P586F62T - same as Genoa Turbo Express 586HX v T1B

Freeway VX

Really a Freetech something-or-other.

Prime

Vision Top?

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	VT 586VX	FC	VT 586VX
EC-00	VT 586VXB v2.4G	GC-00	VT 586 VXB

Procomp

See also Compower

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C-00	AL B586v1.1		

Pronix

(714) 990 8858
See Epox

Proside

Mpact
www.mpactworld.com

Proteam

Protech

Notes

Q

QDI

Quality Design Innovation
www.qdigrp.com
www.qdi.se

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1-00	VIP 596P93 v2.0	CC	P51437/250A v2.1 BIOS
2-00	P5S5480P3	CC	P51430HX-T2 Frontier
9C	P61440FX	DC	P51430TX Titanium 1B
9C-00	P51430TX-250/Titanium 1	GC	P51430TX
AC	P51437/250A		

Advance 3

Item	Description	Notes
Form Factor	ATX	
CPU		Socket 7
Speeds (MHz)	66-100	
Chipset	MPV3	
BIOS	Award	
Bus	1 PCI/1 ISA	

Item	Description	Notes
Memory (Mb)	256 Mb	
I/O	2S, 1P, USP, PS/2	
Video		AGP
Performance		

Advance 5/133(E)

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	66-133	
Chipset	Apollo Pro	
BIOS	Award 4.51 PG	
Bus	4 PCI/3 ISA	
Memory (Mb)	512 SDRAM 768 EDO	3 DIMM sockets
I/O	The usual	Supports LS-120
Video	AGP	2x
Comments		PCI 2.2 compliant

Jumper	*Position*			*Function*
JAV	Closed			BIOS cannot be overwritten
	Open			BIOS can be flashed
JCC	1-2			Clear CMOS
	2-3			Normal
JKB	1-2			Enable keyboard password power-on(set also in BIOS)
	2-3			Disable
JFSB1,2	**JFSB1**	**JFSB2**	**JCLK**	**CPU FSB** (Overclocking)
JCLK	Close	Close	1-2	66/100 Auto
	Open	Close	1-2	100
	-	Open	2-3	133

Brilliant 1(S)

Jumperless

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	66-100	4.5 x CPU clock
Chipset	440 BX	
BIOS	Award 4.51 PG	
Bus	4 PCI/3 ISA	100 MHz
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2S, 1P, USP, PS/2	UDMA 3
Video		AGP
Performance		Average

Geniux 4

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Xeon	SMP Slot 2
Cache		
Chipset	Intel 440GX	
BIOS		
Bus	6 PCI/1 ISA	UDMA/33
Memory (Mb)	2 Gb	4 DIMM sockets
I/O	2 EIDE, floppy USB, IR, Intel 82558 LAN	Adaptec AIC 7890AB
Video		AGP 2x
Performance		
Comments		

Legend IV

Item	Description	Notes
Form Factor	ATX	
CPU	2 Pentium II	Slot 1
Speeds (MHz)		
Chipset		
BIOS		
Bus	4 PCI/3 ISA	1 slot can be extended for RAID
Memory (Mb)	512	SDRAM. 4 DIMM sockets
Cache (K)		
I/O	EIDE, floppy, AIC 7880P SCSI, 10Base T	Narrow and Wide SCSIO
Video		AGP
Performance		Fast

Legend V

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	66-100	
Chipset	BX	
BIOS	Award 4.51 PG	
Bus	4 PCI/3 ISA	
Memory (Mb)	384 SDRAM 768 EDO	3 DIMM sockets
Comments		JP6 clears the CMOS

Legend VII

Item	Description	Notes
Form Factor	Baby AT	
CPU		Socket 370
Speeds (MHz)	66	

Item	Description	Notes
Chipset	LX	
BIOS	Award 4.51 PG	
Bus	3 PCI/2 ISA	
Memory (Mb)	256	
Comments		

Legend VIII

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	66-100	
Chipset	BX	
BIOS	Award 4.51 PG	
Bus	4 PCI/3 ISA	
Memory (Mb)	384 SDRAM 768 EDO	3 DIMM sockets
Comments		

Superb 1

Item	Description	Notes
Form Factor	Micro ATX	
CPU	Pentium/K6	Super Socket 7
Cache	512 Kb	
Chipset	SiS 530	
BIOS		
Bus	3 PCI/2 ISA	UDMA/66
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	2 EIDE, floppy USB, IR	
Video		AGP 2x
Audio	Crystal C54235	
Comments		

Titanium 1B

Item	Description	Notes
Form Factor	AT	
CPU	Pentium	Socket 7. AMD, Cyrix and Intel
Speeds (MHz)		
Chipset		
BIOS		
Bus		
Memory (Mb)		
Performance		
Problems		
Comments		Good board. Overclocks nicely with Windows '95, though Flight Sim 98 doesn't like it.

P51430HX-T2 Frontier

Item	Description	Notes
Form Factor	AT	
CPU	Pentium	
Speeds (MHz)	200	
Chipset	Intel 430HX	
BIOS	Award	
Bus	4 PCI/4 ISA	
Memory (Mb)	8-256	FPM, EDO & BEDO. ECC. 4 x 72-pin SIMMs.
Cache (K)	512	
I/O	2S, 1P, floppy, 2 EIDE, PS/2, USB, IR	

Jumper	*Position*				*Function*
JP6	**JP6**	**JP10**	**JP11**	**JP16**	**System Clock**
JP10,11	Out	In	In	Out	50 MHz
JP16	Out	Out	Out	Out	55 MHz
	1-2	In	Out	In	60 MHz
	2-3	Out	In	In	66 MHz
JP7,26	**JP7**	**JP26**			**CPU voltage**
	In	In			3.5v (single)
	In	Out			3.3v (single)
	Out	In			3.5v (double)
	Out	Out			3.3v (double)
JP14,15	**JP14**	**JP15**			**Clock Multiplier**
	2-3	2-3			1.5x
	2-3	1-2			2x
	1-2	1-2			2.5x
	1-2	2-3			3x
JP21	Out				2.5v Core
	1-2				2.7v
	2-3				2.9v
JP22	In				Hardware Green (stop clock)
	Out				Normal
JP23	1-2				Reserved
JP24	2-3				Reserved
JC	In				Clear CMOS
	Out				Normal

P61440FX

Item	Description	Notes
Form Factor	AT	
CPU	Pentium Pro	
Speeds (MHz)	150-200	
Chipset	Intel 440FX	
BIOS	Award	
Bus	4 PCI/4 ISA	
Memory (Mb)	8-256	FPM, EDO & BEDO. ECC. 4 x 72-pin SIMMs.
I/O	2S, 1P, floppy, 2 EIDE, PS/2, USB, IR	

Jumper	*Position*				*Function*
JP3-6	**JP3**	**JP4**	**JP5**	**JP6**	**System Clock**
	In	Out	In	Out	60 MHz*
	Out	In	Out	In	66 MHz
JP9	1-2				Clear CMOS
	2-3*				Normal
JP14-17	**JP14**	**JP15**	**JP16**	**JP17**	**CPU clock multiplier**
	In	In	In	In	2x
	Out	In	In	In	2.5x
	In	In	Out	In	3x
	Out	In	Out	In	3.5x
	In	Out	In	In	4x
JP23-26	**JP23**	**JP24**	**JP25**	**JP26**	**CPU voltage**
	Close	Close	Close	Close	3.5v
	Close	Close	Close	Open	3.4v
	Close	Close	Open	Close	3.3v
	Close	Close	Open	Open	3.2v
	Close	Open	Close	Close	3.1v
	Close	Open	Close	Open	3v
	Close	Open	Open	Close	2.9v
	Close	Open	Open	Open	2.8v
	Open	Close	Close	Close	2.7v
	Open	Close	Close	Open	2.6v
	Open	Close	Open	Close	2.5v
	Open	Close	Open	Open	2.4v
	Open	Open	Close	Close	2.3v
	Open	Open	Close	Open	2.2v
	Open	Open	open	Close	2.1v

Winnex 1

Item	Description	Notes
Form Factor	Micro ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	66-100	
Chipset	Intel 810	
BIOS	Award 4.51 PG	
Bus	3 PCI/1 AMR	
Memory (Mb)		2 DIMM sockets
Sound		On board
Video	AGP	On board
Comments		PCI 2.2 compliant

Jumper	*Position*	*Function*
JAV	Closed	BIOS cannot be overwritten
	Open	BIOS can be flashed
JCC	1-2	Clear CMOS
	2-3	Normal
JSD	1-2	Disable on-board audio
	2-3	Enable
JKB	1-2	Enable keyboard password power-on(set also in BIOS)

Jumper	*Position*		*Function*
	2-3		Disable
JSB	Open		Disconnect PCI 3.3VSB
	Closed		Connect (use for AMR card)
JFS0,1	**JFS0**	**JFS1**	**CPU FSB** (Overclocking)
	2-3	2-3	66 MHz
	Open	2-3	100 MHz
	Open	1-2	133 MHz
	1-2	2-3	Auto

QTC

(714) 258-4500

P54TS

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	75-200	
Chipset	Triton	
BIOS		
Bus	3 PCI/4 ISA	
Memory (Mb)		FPM/EDO. 4 72-pin sockets
Cache (K)		Normal/pipelined burst
I/O		Adaptec AIC7870 SCSI

Quanta

Quantex

Rebadges Biostars.

MBD-4MB2

See Biostar 8433 UUD.

MBD-4PB2

See Biostar 8433 UUD.

Notes

R

Rectron

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0C-00	RT 4S3	1-01	Terminator 80486PCI

RT 4S3

Same as Kaimei KM-S4-1 PCI rev 5.1 or Azza 4SIG

RedFox

Fordlian?

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C-00	5ATXB rev B		

Rise Computer Inc

www.rise.com.tw
See also MTech

Robotech

GMB-486UNL

Jumper	*Position*	*Function*				
JP1	In*	Colour display				
	Out	Mono				
JP2	1-2	Discharge CMOS				
	2-3*	Normal				
JP4	1-2,4-5,6-7	486DX/DX2				
	2-3,4-5,6-7	487SX				
	5-6	486SX				
JP6,7,9,11	**Cache size**	**JP6**	**JP7**	**JP9**	**JP11**	
	32K	Open	Open	Open	2-3	
	64K	Open	Short	Open	1-2	
	128K	Open	Short	Short	1-2,3-4	
	256K	Short	Short	Short	1-2,4-5	
JP19	In	>33 MHz System speed (VL bus)				
	Out	<=33 MHz System speed (VL bus)				
JP20	In	VL Bus 1 wait state				
	Out	VL Bus 0 wait state				
JP29-31	**System Speed**	**JP29**	**JP30**	**JP31**		
	25 MHz	In	Out	In		
	33 MHz	In	In	Out		
	40 MHz	Out	Out	In		
	50 MHz	Out	In	Out		
JP40-42	**Master/Slave**	**JP40**	**JP41**	**JP42**	**JP44**	**JP45**
44,45	PAL/GAL installed	Out	Out	Out	1-2	2-3
	Not installed	In	In	In	2-3	2-3
JP43	1-2	Normal VL Bus clock speed (same as CPU)				
	2-3*	VL Bus clock speed same phase as U4800				

RSAptek

S

S & D

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
AC	P6ALXA		

Samsung

DM286-12

Deskmaster. Motherboard/BIOS from Microfive.

Jumper	*Position*	*Function*
W2	On	Colour display
	Off	Mono
W3	On	Enable VGA
	Off	Disable

DM 386-33n

Jumper	*Position*	*Function*
NPU	1-2	Maths copro not installed
	2-3	Installed
SNA	In]Out	Enable cache pipeline mode
		Disable
NP1	In	Disable POST input
	Out	Enable POST input
ONBAT	In	Onboard battery
	Out	External battery
IRQ4	In	COM1 IRQ4
IRQ3	In	COM2 IRQ3
IRQ12	In	Enable mouse IRQ12
	Out	Disable
IRQ9	In	Enable VGA IRQ9
	Out	Disable
CRT	In	Colour display
	Out	Mono

SW1

Switch	*Position*			*Function*
S1-3	**1**	**2**	**3**	**VGA**
	On	On	Off	Enable
	Off	Off	On	Disable
S4	On			Enable write buffer mode
	Off			Disable
S5	On			16-bit mode
	Off			8-bit mode
S6	On			PS/2 VGA
	Off			PC/AT Video
S7	On			Older multi-frequency monitors
	Off			Standard PS/2 compatible

DM 386s-16

Switches as for DM386-33n

MFC 6000

Motherboard/BIOS from Microfive.

Switch	*Position*	*Function*
S1	On	256K RAM chips
	Off	64K RAM chips
S2	On	640K
	Off	512K
S3		Reserved
S4	On	PC compatible keyboard
	Off	AT compatible keyboard
S5	On	COM1 as default system console

Switch	*Position*	*Function*
	Off	Monitor/keyboard as console
S6	On	10 MHz
	Off	8 MHz
S7		Reserved
S8	On	Colour display
	Off	Mono

PCT 286

Jumper	*Position*		*Function*
J5	On		Enable mono display
	Off		Disable
J4,13	**J4**	**J13**	**Video**
	Off	Off	Onboard or add-in mono
	Off	On	Add-on CGA or EGA
	On	Off	Not used
	On	On	Onboard CGA
J23,29	On		Parallel port as LPT2, IRQ5
	Off		Disable
J3,22	On		Parallel port as LPT1, IRQ7
	Off		Disable
J38,25	On		Serial port as COM2, IRQ3
	Off		Disable
J2,24	On		Serial port as COM1, IRQ4
	Off		Disable
J14	On		XT keyboard
	Off		AT keyboard
J15	Off		Disable maintenance mode
	On		Enable

S300

Switch	*Position*		*Function*
JP4,7			Reserved
S1	On		Normal
	Off		Loop POST
S2	On		Coprocessor installed
	Off		Not installed
S3,4			Reserved
S5,6	**S5**	**S6**	**Display**
	On	On	EGA
	Off	On	Colour 40x25
	On	Off	Colour 80x25
	Off	Off	Mono
S7,8	**S7**	**S8**	**Floppies**
	On	On	1 drive
	Off	Off	2 drives

S500

Switch	*Position*	*Function*
JP1	On	Enable parallel port
JP3	On	Enable serial port
JP4	On	Enable COM2
JP5	On	Floppy secondary address
	Off	Floppy primary address
JP6,9	On	Enable floppy
JP7	On	Dual speed drive
	Off	Single speed
JP8	On	Precomp 187ns
	Off	125 ns
JP10,11	1-2	High state RAM size
	2-3	Low state
JP13	1-2	DMA operating clock=DMA clock
	2-3	DMA operating clock=SYS clock
JP14	On	512K
	Off	640K
JP16	2-3	10/8 MHz keyboard selectable
	1-2	10 MHz
	All out	8 MHz
SW1	Up	Colour display
	Down	Mono

S5200

Jumper	*Position*		*Function*		
SW1	Off		Enable floppy		
SW2	Off		Enable SCSI		
SW3	Off		Enable serial port		
SW4	Off		Serial port as COM1		
	On		COM2		
SW5	Off		Parallel port as LPT1		
	On		LPT2		
SW6	Off		Colour display		
	On		Mono		
SW7	Off		Primary address 2B0-2B7h		
	On		Secondary address 170-177h		
SW8,9	**SW8**	**SW9**	**Bank 0**	**Bank 1**	**RAM Type**
	On	On	4 Mb	1 Mb	1 Mb
	On	Off	2 Mb	1 Mb	None
	Off	On	1 Mb	256K	256K
	Off	Off	512K	256K	None
SW10			Reserved		

S800

Switch	*Position*	*Function*
JMP1	In	Pipelined mode
	Out	Non-pipelined
JMP2,3	In	Maths copro enabled
	Out	Not enabled
S1	On	Enable HD

Switch	*Position*	*Function*
S2,3	On	Double density floppies
	Off	High density
S4	On	Disable floppy
	Off	Enable floppy
S5	On	Enable COM1
S6	On	Enable COM2
S7	On	Enable LPT1
S8	On	Colour display
	Off	Mono

SD700

Jumper	*Position*		*Function*
NPX	1-2		386SX not installed
	2-3		Installed
JP1,8	**JP1**	**JP8**	**Serial port**
	3-4	7-8	9-pin is COM1
	1-2	7-8	25-pin is COM2
	7-8	7-8	9-pin is COM2
	5-6	7-8	25-pin is COM1
	11-12		Parallel port is LPT1
		1-2	Parallel port is LPT2
JP2	In		512K EPROM
	Out		256K EPROM
JP3,7	**JP3**	**JP7**	**HD Type**
	Off	On	Miniscribe old version
	On	Off	Any other
JP6	Out		Enable IDE
	In		Other HD controller
JP8	3-4		Disable parallel port
	5-6		Disable 9-pin serial port
	9-10		Diasble 25-pin serial port
JP10	Out		Mono display
	In		Colour

SD820

As for Packard Bell PB 386-25 Rev D

SD830

As for Packard Bell PB 386-33

SM 386/33T

Jumper	*Position*	*Function*
P1	1-2	64K cache
	2-3	128K
P2	In	80387 installed
	Out	Weitek installed

Jumper	*Position*	*Function*
P3	In	512K EPROM
	Out	256K
P11	In	Feature enabled
	Out	Test only
P12	Out	Page violation
	In	Test only
P16	A	Mouse installed
	B	Not installed
P17	A	Floppy enabled
	B	HD enabled

SM 486/25TE

Jumper	*Position*	*Function*
J1	1-2	Enable external cache
	Out	Disable
J2	1-2	33 MHz
	2-3	25 MHz
J15	1-2	Disable I/O recovery delay
	2-3	Enable
J16	1-2	Always
	2-3	Reserved

	1 Mb	2 Mb	4 Mb	8 Mb	16 Mb	32 Mb
J3	Out	1-2	Out	1-2	Out	1-2
J4	Out	1-2	Out	1-2	Out	1-2
J5	Out	1-2	Out	1-2	Out	1-2
J6	Out	1-2	Out	1-2	Out	1-2
J7	Out	Out	Out	1-2	2-3	1-2
J8	2-3	1-2	1-2	1-2	1-2	1-2
J9	Out	Out	2-3	1-2	1-2	1-2
J10	1-2	1-2	1-2	2-3	2-3	2-3
J11	1-2	1-2	1-2	1-2	1-2	2-3
J12	1-2	2-3	2-3	2-3	2-3	2-3

SM 486/33TE

As for SM 486/25TE

SPC 3000

Processor board

Switch	*Position*		*Function*
S1			POST
S2	On		Coprocessor not installed
	Off		Installed
S3			Reserved
S4			Reserved
S5,6	**S5**	**S6**	**Video**
	Off	On	Low Res graphics

Switch	Position		Function
	On	Off	High Res graphics
	Off	Off	Mono
	On	On	Auto
S7,8	**S7**	**S8**	**Floppies**
	On	On	1 drive
	Off	On	2 drives

SPC 3000V

Switch	Position		Function
S1	Off		Serial port is COM1
	On		Serial port is COM2
S2	Off		Parallel port is LPT1
	On		Parallel port is LPT2
S3,4	**S3**	**S4**	**Video Type**
	On	Off	40x25 colour
	Off	On	80x25 colour
	Off	Off	80x25 Mono
	On	On	Disable

SPC 6100

Jumper	Position	Function
JP1		Reserved
JP2	1-2	Mono display
	2-3	Colour
JP3	In	Disable 2nd 256K of main board RAM
	Out	Enable
JP5	In	640K main board RAM
	Out	1 Mb
JP23	1-2	Enable LPT1
	2-3	Enable LPT2
JP24	1-2	25-pin serial port is COM2
	1-3	9-pin serial port is COM2
	2-4	25-pin serial port is COM1
	3-4	9-pin serial port is COM1
JP27	1-3	Enable LPT2
	2-4	Enable LPT1
JP33	1-2	25-pin serial port is COM2
	1-3	25-pin serial port is COM1
	2-4	9-pin serial port is COM2
	3-4	9-pin serial port is COM1

SPC 6500

Processor board

Jumper	Position	Function
CN2	A-C	Mono display
	B-C	Colour
CN5		Reserved
CN6		Speaker

Jumper	Position	Function
CN8,9	A-C	5.4 MHz maths copro enabled
	C-B	8 MHz
CN10		Daughter board connector
CN13	A-C	6 MHz
	B-C	10 MHz

Sam-Tec

www.computersources.com.hk/samtec

San-Li

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	SL-586V	CC	SP-P2LXC
BC	SL-586V+/VPXT3 vC		

SL-586V

Acorp 586VX?

SL 586V+

Acorp 5VX32 ver B

San Carlos Computers

Rebadges Biostars.

SBC

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	PC 560		

Seanix

www.seanix.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0-00	S 895 Rev 2.A		

See-thru Data Systems

www.seethru.com

Shuttle

Holco
(408) 945 1480
www.spacewalker.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1	HOT 523	CC	HOT 541
1-00	HOT 433 non PS/2	EC-00	HOT 565
9C	HOT 553/555/603	IC	HOT 557 v1.5
9C-00	HOT 539C rev2	HC-00	HOT 569
AC	HOT 541/617	KC	HOT 555A
BC	HOT 555/557 v1.32		

HOT-419

486 VL Bus
CPU setting also uses resistor pack on JPA, B and C. Align pin 1 of resistor to mark on board.

Jumper	*Position*				*Function*
JP10-11	**JP10**	**JP11**	**JP13**	**JP50**	**Cache size**
13,50	Open	Open	2-3	Open	64K (8Kx8)
	Open	Short	1-2	Open	128K (32Kx8)
	Short	Short	2-3	Open	256K (32Kx8 double bank)
	Short	Short	1-2	Open	256K (64Kx8 single bank)
	Short	Short	1-2	Short	512K (128Kx8)
JP21-23	**JP21**	**JP22**	**JP23**		**System clock**
	2-3	2-3	1-2		20 MHz

Jumper	*Position*			*Function*
	1-2	2-3	1-2	25 MHz
	2-3	1-2	2-3	33 MHz
	1-2	2-3	1-2	40 MHz
	2-3	1-2	1-2	50 MHz
	Open	2-3	2-3	25 MHz (DX4, P24T)
	2-3	Open	2-3	33 MHz (DX4, P24T)
	2-3	Open	Open	50 MHz (DX4, P24T)
JPA-C	Set resistors			486DX/DX2
	Set resistors			486SX, UMC U5-S
	Resistors + JP44,45,46			486DX/DX2/DX4 S, AM486 Enh
	Resistors + JP44,45,46			486SX-S
	Resistors + JP44,45,46			P24D (DX2 w/b)
	Resistors + JP44,45,46			P24T
	Set resistors			Am486DX/DX2/DX4
	Resistors + JP48			Cyrix 486S
	Resistors + JP48			Cyrix 486DX/DX2
JP30	Short			Colour display
	Open			Mono
JP33	Open			VESA bus high speed write 0 WS
	Short			VESA bus high speed write 1 WS
JP34	Close			VL Bus speed >33 MHz
	Open			VL Bus speed <=33 MHz
JP36	2-3			Normal
	1-2			Delay CPU ADS# signal
JP53	1-2			Reserved
JP55,69	**JP55**	**JP69**		**CPU RDY# signal delay**
	1-2,3-4	Open		33/50 MHz with fast VL bus devices
	2-3	Short		33/50 MHz with slow VL bus devices
JP58	Open			P24T cache w/t
	Close			P24T cache w/b
JP59	Open			P24D cache w/t
	Close			P24D cache w/b
JP60-62	**JP60-62**	**JP70-72**		**Memory modes**
70-72	Short	2-3		2 VESA master slots (J20 + another)
	Open	1-2		1 VESA master slot (J20 is slave)
JP63				Power management indicator
JP64,73	**JP64**	**JP73**		**CPU voltage**
	1-3,2-4	N/A		5v
	3-5,2-6	1-2		3.3v
	3-5,2-6	Open		3.45v
	3-5,2-6	2-3		4v
JP65	2-3			CPU 3x (DX4)
	1-2			CPU 2x (DX4)
JP67	Close			reserved
JP68				EPMI connector (power save)
JP74	2-3			Reserved
JP77	2-3			Reserved
JP79	1-2			Reserved

HOT-433P

486 PCI

Jumper	*Position*				*Function*
JP1-3	**JP1**	**JP2**	**JP3**		**System clock**
	2-3	2-3	1-2		25 MHz
	1-2	1-2	1-2		33 MHz
	2-3	1-2	1-2		40 MHz
	1-2	2-3	2-3		50 MHz
JP8	1-2				12v Flash ROM
	2-3 or Open				5v
JP11-14	**JP11**	**JP12**	**JP13**	**JP14**	**Cache Size**
			2-3		128K
			1-2	1-2	256K (Double bank)
		1-2	2-3	1-2	256K (Single Bank)
	1-2	1-2	2-3	1-2,3-4	512K (Single Bank)
		2-3	1-2	1-2,3-4	512K (Double Bank)
	2-3	2-3	1-2	1-2,3-4,5-6	1 Mb
JP15,16	**JP9**	**JP15**	**JP16**		**CPU Voltage**
		1-2	1-2		5v
	1-2	2-3	2-3		3.3v
	3-4	2-3	2-3		3.45v
	5-6	2-3	2-3		3.6v
	7-8	2-3	2-3		4v
JP17-32	JP10 1-2 2-4, JP19 1-2, JP25 1-2, JP28 1-2 3-4, JP30 3-4				486DX/DX2
	JP10 1-2 2-4, JP19 1-2, JP25 1-2, JP28 2-3, JP30 3-4				486SX
	JP10 1-2 2-4, JP17 1-2, JP19 3-4, JP20 2-3 4-5, JP21 1-2, JP25 2-3, JP28 2-3				486SX-S
	JP10 1-2 2-4, JP17 1-2, JP19 3-4, JP20 2-3 4-5, JP21 1-2, JP25 2-3, JP28 1-2 3-4, JP30 3-4				DX/DX2/DX4-S
	JP10 1-2 2-4, JP17 1-2, JP19 3-4, JP20 2-3 4-5, JP21 1-2, JP 22 In, JP23 In, JP25 2-3, JP28 1-2 3-4, JP30 3-4, JP31 In, JP32 In				P24D
	JP10 1-2 2-4, JP17 1-2, JP19 3-4 5-6, JP20 2-3 4-5, JP21 1-2, JP25 2-3, JP27 2-3, JP30 2-3				P24T
	JP10 1-2 2-4, JP17 1-2, JP19 3-4, JP20 2-3 4-5, JP21 1-2, JP25 2-3				AM486DX/DX2/DX4 (NV8T, SV8T)
	JP10 1-2 2-4, JP17 1-2, JP19 3-4, JP20 2-3 4-5, JP21 1-2, JP25 2-3				Am486DX4 enh (SV8B) Am5x86-P75 (X5-133)
	JP10 1-2 2-4, JP17 1-2, JP19 3-4, JP20 2-3 4-5, JP21 1-2, JP22 In, JP23 In, JP24 2-3, JP25 2-3, JP28 1-2 3-4, JP30 3-4, JP31 In, JP32 In				Cyrix 5x86
	JP10 1-3 4-6, JP17 2-3, JP19 3-4, JP20 1-2 3-4, JP21 1-2, JP25 2-3, JP26 2-3, JP27 1-2, JP28 1-2 3-4, JP29 2-3, JP30 3-4				Cyrix Cx486DX/DX2/DX4
	JP10 1-3 4-6, JP17 2-3, JP19 3-4, JP20 1-2 3-4, JP21 1-2, JP25 2-3, JP26 2-3, JP27 1-2, JP28 2-3, JP29 1-2				Cyrix Cx486S (M6)
	JP10 1-3 4-6, JP19 1-2, JP21 2-3, JP25 2-3, JP26 1-2, JP27 2-3, JP28 2-3, JP29 3-4, JP30 1-2 3-4				UMC 486S U5
JP18	None				3:1 Core-Bus ratio
	2-3				2:1 (4:1 X5-133)
JP24	1-2				P24D WT cache
	2-3				P24D WB cache
	None				Other CPU

HOT-555A

Jumper	*Position*				*Function*
JP18	1-2				12v Flash EPROM
	2-3				5v Flash EPROM
JP33-4	JP33	JP34	JP39	JP43	**Single CPU voltage** (VIO=Vcore)
JP39,JP43	None	In	None	1-2	2-8v
	None	In	2-4	1-2	2.9v

Jumper	*Position*				*Function*
	None	In	3-4	1-2	3.1v
	None	In	1-3	1-2	3.3v
	None	In	1-2,2-4	1-2	3.5v
JP33-4	JP33	JP34	JP39	JP43	**Dual CPU voltage** (VIO, Vcore separate)
JP39,JP43	3.4,5-6	Out	None		2-8v (Vcore)
	3-4,5-6	Out	2-4		2.9v (Vcore)
	3-4,5-6	Out	3-4		3.1v (Vcore)
	3-4,5-6	Out		1-2	3.3v (VIO)
	3-4,5-6	Out		2-4	3.4v (VIO)
	33 1-2 (open) & 44 (shut) reserved				
JP45	In				Normal CMOS
	Out				Clear CMOS

HOT 569

Same as Acusharp Excalibur TX 1569

HOT-661V

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	
Speeds (MHz)	333	
Chipset	Via Apollo	
BIOS	Award 4.51PG	NCR SCSI
Bus	4 PCI/3 ISA	
Memory (Mb)		4 banks SDRAM
Cache (K)		
I/O		
Video		AGP

Jumper	*Position*		*Function*
J17	1-2		12v Flash EPROM
	2-3		5v Flash EPROM
JP19			Clear CMOS
JP37	1-2,3-4,5-6,7-8		2x CPU Clock Ratio
	1-2,3-4,5-6		2.5x CPU Clock Ratio
	1-2,5-6,7-8		3x CPU Clock Ratio
	1-2,5-6		3.5x CPU Clock Ratio
	3-4,5-6,7-8		4x CPU Clock Ratio
	3-4,5-6		4.5x CPU Clock Ratio
	5-6,7-8		5x CPU Clock Ratio
JP38	**JP38**	**JP44**	**Keyboard/PS2 mouse power-on**
	1-2,4-5	2-3	Disabled
	2-3,5-6	1-2	Enabled
	2-3,4-5	1-2	Mouse only
	1-2,5-6	2-3	Keyboard only
JP39	1-2,3-4,5-6		50 MHz CPU Host Clock
	5-6		66 MHz CPU Host Clock

Jumper	Position	Function
	3-4,5-6	75 MHz CPU Host Clock
	1-2,5-6	83 MHz CPU Host Clock
	None	100 MHz CPU Host Clock
	1-2,3-4	103 MHz CPU Host Clock
JP45		Overspeeds 66-100 MHz bus speed (disregards CPU)

Silicon Star Intl

See Abit.

SMT

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C-00	TX3	CC	5TA
BC	5TA		

Soltek

Now EPoX
www.soltek.com.tw

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	82440FX (Ppro)	CC	SL 54P5/U5
9C	SL 54P5	EC	SL 56D5/D!
AC-01	SL-54T5	FC	SL 66B

SL54P2/P5

Jumper	Position		Function
SW1	**S1**	**S2**	**Clock Multiplier**
S1-2,5	Off	Off	1.5x
	On	Off	2x
	On	On	2.5x
	Off	On	3x
	Off	Off	3.5x
	On	Off	4x
	On	On	4.5x

Jumper	*Position*		*Function*
	Off	On	5x
	Off	Off	5.5x
S3-4	**S3**	**S4**	**Host bus speed**
	On	Off	60 MHz
	Off	Off	66 MHz
S5	On		AMD K6 CPU
S6	On		AT Power Supply
	Off		ATX
JP7	1-2		Clear CMOS
	2-3		Normal
JP14	Open		2v CPU
	1-2		2.1v
	3-4		2.2v
	1-2,3-4		2.3v
	5-6		2.4v
	1-2,5-6		2.5v
	3-4,5-6		2.6v
	1-2,3-4,5-6		2.7v
	7-8		2.8v
	1-2,7-8		2.9v
	3-4,7-8		3v
	1-2,3-4,7-8		3.1v
	5-6,7-8		3.2v
	1-2,5-6,7-8		3.3v
	3-4,5-6,7-8		3.4v
	1-2,3-4,5-6,7-8		3.5v
JP15	1-2		Non-Intel Flash or normal
	2-3		Intel Flash
J1	1-4		HD
	6-10		IR
	12-13		Power
	14-15		Sleep
J2	1-4		Speaker
	5-6		Reset
	8-10		Power LED
	11-12		Keylock
	14-15		Turbo LED

Sowah Research

www.sowah.com
Spear Motherboard?

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
FC-00	SR-M504		

SR-M504

Spear Motherboard SM-M504?

Soyo

(818) 330 1712
www.soyo.co.uk
www.soyo.com.tw
www.soyo.nl

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1	25M/N/P/Q/R/R2	AC	5TF
1-00	30 A/B/C Serial or 030F2	BC-00	5BT5
1-00	025N2	GC-00	5VD2/D5
2-00	4S A2/A5	HC	5TA2
3	25J/K/L	IC	5VA
9	4SA W2/W5	LC	5TC2
9C	5TF0/2/5	PC	5TE2/5TCU
9C-00	5VA2 or 4SA W2/W5	QC	5TA2

VL Bus 486

Jumper	*Position*				*Function*
JP4-6	**JP4**	**JP5**	**JP6**		**CPU clock**
	Open	Open	Close		25 MHz
	Close	Close	Close		33 MHz
	Open	Close	Close		40 MHz
	Close	Open	Open		50 MHz
JP9,10	**JP7**	**JP8**	**JP9**	**JP10**	**Cache size**
	On	On	2-3	2-3	256K (2 banks SRAM)
	On	On	1-2,3-4	1-2	256K (1 bank SRAM)
	Off	On	1-2	1-2	128K
	Off	Off	Open	2-3	64K
JP14-16,23	**JP14**	**JP15**	**JP16**	**JP23**	**CPU voltage**
	1-2	1-2	1-2	Close	3.3v
	1-2	1-2	1-2	Open	3.45v
	2-3	2-3	2-3	Open	5v
JP21	Close				VESA clock >33 MHz
	Open				VESA clock <=33 MHz
JP22	Close				VESA 1 wait state
	Open				VESA 0 wait state
JP30	Close*				Output clock speed select

CPU (Blue)	JP11	JP12	JP13	JP17	JP18	JP19
486SX	-	2-3	2-3	-	-	-
DX/DX2	-	2-3	1-2,3-4	1-2	-	-
DX/SL	1-2	1-2	1-2,3-4	1-2	5-6	1-2,3-4
P24D	1-2,4-5	1-2,4-5	1-2,3-4	1-2	3-4,5-6	1-2,3-4
P24T	1-2	1-2	1-2,3-4	2-3	5-6	1-2,3-4
Cyrix M6	1-2,3-4,5-6*	1-2,3-4,5-6	2-3	-	2-3,4-5	2-3,4-5
Cyrix M7	1-2,3-4,5-6*	1-2,3-4,5-6	1-2,3-4	1-2	2-3,4-5	2-3
AMD DXL	2-3	2-3	1-2,3-4	1-2,3-4	1-2	-
UMC 486	2-3	2-3	2-3	3-4	1-2	-

* is for double clock. For P24C, as for DX-SL plus JP20 Open for 3x, 1-2 for 2.5x, 2-3 for 2x

SY-D61BA(2)

Item	Description	Notes
Form Factor	ATX	
CPU	Dual Pentium II	Slot 1
Speeds (MHz)		
Chipset	82440BX	133 MHz bus speed
BIOS	Award	
Bus	4 PCI/2 ISA	
Memory (Mb)	1024	4 DIMM sockets
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3. Adaptec 7880 UW SCSI
Video	AGP	
Audio		

SY-D61GA

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Xeon	SMP Slot 2
Cache		
Chipset	Intel 82440GX	
BIOS		
Bus	6 PCI	100
Memory (Mb)	2 Gb	4 DIMM sockets
I/O	2 EIDE, floppy USB, IR, Intel 82558 LAN	Adaptec AIC-7890AB
Video	AGP	2x
Performance		
Comments		

SY-25J/K/L

486 VESA

Jumper	*Position*	*Function*
JP3	In	Colour
	Out	Mono
JP4	In	8 MHz (standby) mode
	Out	Full speed

Jumper	*Position*			*Function*
JP5	1-2			Retain CMOS data
	2-3			Discharge CMOS
JP6				Green switch. Pin 1 is GRD.
JP9,10,13	**JP9**	**JP10**	**JP13**	**Cache size**
	2-3	N/A	1-2	64K
	2-3	1-2	2-3	128K
	1-2	2-3	2-3	256K (2 banks SRAM)
	1-2	2-3	2-3	256K (1 bank SRAM)
JP29-31	**JP29**	**JP30**	**JP31**	**CPU external speed** (red jumpers)
	In	Out	In	25 MHz
	Out	In	In	33 MHz
	In	Out	Out	40 MHz
	Out	In	Out	50 MHz
JP24	1-3,2-4			5v
	3-5,4-6			3.45v
JP35-37	All 1-2			Bank 0=30 pin SIMMs
	All 2-3			Bank 0=72 pin SIMMs

CPU (Blue)	JP1	JP2	JP11	JP12	JP14	JP15	JP16	JP18	JP19	JP20	JP21	JP22	JP23
486SX	2-3	1-2	3-4	2-3	2-3	-	-	2-3	4-5	-	1-2	-	-
DX/S1/4,ODP	2-3	1-2	3-4	2-3	3-4	2-3	-	2-3	4-5	-	1-2	-	-
Cyrix S/DX (M7)	1-2	2-3	2-3	1-2	1-2,3-4	2-3	-	2-3	2-3	-	-	2-3	2-3
AMD DX2/80	2-3	1-2	3-4	2-3	1-2,3-4	2-3	-	2-3	4-5	2-3	1-2	-	-
AMD DX4/100	2-3	1-2	3-4	2-3	1-2,3-4	2-3	-	2-3	4-5	1-2	1-2	-	-
P24T	2-3	1-2	3-4	2-3	1-2,3-4	1-2	-	2-3	1-2	-	-	1-2	1-2
P24D	1-2	1-2	1-2,3-4	2-3	1-2,3-4	2-3	In	1-2	4-5	2-3	2-3	1-2	-
DX4 (P24C)**	2-3	1-2	3-4	2-3	1-2,3-4	2-3	-	2-3	4-5	-	1-2	-	-

**JP27 and 34 always in except for DX4 (P24C) which has JP34 out.

SY-25 Q/R, T Serial

486 VESA

Jumper	*Position*				*Function*
J20	2-3*				Retain CMOS data
	3-4				Discharge CMOS
	1-4				External battery
JP4-6	**JP4**	**JP5**	**JP6**		**CPU external speed** (red jumpers)
	Out	Out	In		25 MHz
	In	In	In		33 MHz
	Out	In	In		40 MHz
	In	Out	Out		50 MHz
	JP14	**JP15**	**JP16**	**JP27**	**CPU voltage**
	1-2	1-2	1-2	1-2	3.45v
	1-2	1-2	1-2	2-3	3.6v
	1-2	1-2	1-2	5-6	4v
	2-3	2-3	2-3	None	5v
JP9,10	**JP9**	**JP10**			**Cache size**
	2-3	2-3			256K (2 banks SRAM)
	1-2,3-4	1-2			256K (1 bank SRAM)

CPU (Blue)	JP11	JP12	JP13	JP17	JP18	JP19	JP20	JP26
486SX	-	2-3	2-3	-	-	-	-	
DX/DX2	-	2-3	1-2,3-4	1-2	-	-	-	
DX/SL,DX4,ODP	1-2	1-2	1-2,3-4	1-2	5-6	1-2,3-4	-	-
P24T (OD)	1-2	1-2	1-2,3-4	2-3	5-6	1-2,3-4	-	-
DX4	1-2	1-2	1-2,3-4	1-2	5-6	1-2,3-4	-	-
P24D	1-2,4-5	1-2,4-5	1-2,3-4	1-2	3-4,5-6	1-2,3-4	-	-
AMD DXL/2	2-3	2-3	1-2,3-4	1-2,3-4	1-2	-	-	-
AMD DX2	-	2-3	1-2,3-4	1-2	-	-	-	In
AMD DX4	-	2-3	1-2,3-4	1-2	-	-	-	-
Cyrix DX/DX2	1-2,3-4	1-2,3-4,5-6	1-2,3-4	1-2	2-3,4-5	2-3	-	-
UMC U5S	2-3	2-3	2-3	3-4	1-2	-	-	-

SY-5BT5

Item	Description	Notes
Form Factor	Baby AT	
CPU	Pentium	Socket 7
Chipset	430 TX	75 MHz bus speed
Bus	4 PCI/3 ISA	
Memory (Mb)		2 DIMM sockets, 2 72-pin
Cache (K)	512K	
I/O	2S, 1P, USB, PS/2	UDMA 3

SY-5EAS5

Item	Description	Notes
Form Factor	Baby AT	
CPU	Pentium	Socket 7
Speeds (MHz)		
Chipset	Eteq 6618	
BIOS	Award	
Bus	3 PCI/4 ISA	66
Memory (Mb)	512	
Cache (K)	1 Mb	
I/O	2S, 1P, USB, PS/2	UDMA 3

SY-5ED5/M

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium	Socket 7
Speeds (MHz)	266	
Chipset	Eteq 6628	VIA Apollo VP3 under licence
Bus	5 PCI/2 ISA	75 MHz
Memory (Mb)		3 DIMM sockets, 2 72-pin
Cache (K)	512K/1 Mb	
I/O	2S, 1P, USB, PS/2	UDMA 3
Video		AGP

SY-5EHM

Item	Description	Notes
Form Factor	Baby AT	
CPU	Pentium	Super Socket 7
Speeds (MHz)		
Chipset	Eteq 6638/EQ 82	
BIOS	Award	
Bus	3 PCI/3 ISA	66-100
Memory (Mb)	576 Mb	
Cache (K)	1 Mb	
I/O	2S, 1P, USP, PS/2	UDMA 3
Video	AGP	

SY-5EMA

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium	Super Socket 7
Speeds (MHz)		
Chipset	Eteq 6638 EQ 82C)	124 MHz bus speed
BIOS	Award 4.51PG	
Bus	5 PCI/2 ISA	
Memory (Mb)	512 Mb	2 DIMM sockets, 2 72-pin
Cache (K)	1 Mb	
I/O	2S, 1P, USP, PS/2	UDMA 3
Video		AGP
Problems		Poor documentation
Comments		Cheap, but MSI MS5169 is a better buy

SY-5EMM

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium	Super Socket 7
Speeds (MHz)		
Chipset	Eteq 6638	100 MHz bus speed
BIOS		
Bus	4 PCI/3 ISA	
Memory (Mb)		2 DIMM sockets, 2 72-pin
Cache (K)	1 Mb	
I/O	2S, 1P, USP, PS/2	UDMA 3
Video		AGP

SY-5SSM

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium	Super Socket 7

Item	Description	Notes
BIOS	Award	
Chipset	SiS 530	
Bus	4 PCI/1 ISA	66-83
Memory (Mb)	768	
Cache (K)	1 Mb	
I/O	2S, 1P, USP, PS/2	UDMA 3
Peorformance		Good – just behind Tyan S1590
Video/Sound		AGP/ESS 1938S 3D on board (no slots)

SY-5STM

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium	Super Socket 7
BIOS	Award	
Chipset	SiS 5598	
Bus	2 PCI/2 ISA	66-83
Memory (Mb)	256	
Cache (K)	1 Mb	
I/O	2S, 1P, USP, PS/2	UDMA 3
Peorformance		
Video/Sound		

SY-5T F0/F2/F5 Serial

Item	Description	Notes
Form Factor	AT	
CPU	Pentium MMX	Cyrix 6x86, AMD 5x86. Socket 7.
Speeds (MHz)	75-200	
Chipset		
BIOS	Award PnP Flash	NCR 810 SCSI supported
Bus	4 PCI/4 ISA	
Memory (Mb)	4-512	EDO
Cache (K)	512	256 standard. PB. COAST upgrade.
I/O	2S, 1P, Floppy, 2 EIDE, PS/2	
Comments		Defaults setup for Pentium 100

Jumper	*Position*		*Function*
JP3	In*		EGA/VGA
	Out		Mono
JP4	1-2		Reserved
JP5	In		Clear CMOS data
	Out*		Retain CMOS data
JP6	2-3		Reserved
JP10,11	**JP10**	**JP11**	**Host bus Speed**
	In	In	25 MHz
	Out	Out	27.5 MHz
	In	Out	30 MHz
	Out	In	33 MHz

Jumper	*Position*		*Function*
JP13,14	**JP13**	**JP14**	**Core/Bus Ratio**
	Out*	Out*	3/2 (1.5)
	In	Out	2/1 (2)
	In	In	5/2 (2.5)
	Out	In	3/1 (.33)
JP20	Out*		256K PB cache
	In		512K PB cache (COAST upgrade)
JP22	2-3		Reserved
JP24	2-3		Reserved
JP40	In		Reserved
JP30,31	JP30	JP31	CPU voltage
	In*	Out*	Standard and VR (3.3v + 5%)
	Out	In	VRE (3.45-3.6v)
JPS2	In		Enable PS/2 mouse (IRQ12 available to system)
	Out*		Disable PS/2 mouse (IRQ12 available to system)

SY-5XA5

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium	Socket 7
Speeds (MHz)		
Chipset	430 TX	75 MHz bus speed
BIOS		
Bus	5 PCI/3 ISA	
Memory (Mb)		3 DIMM sockets, 2 72-pin
Cache (K)	512K	
I/O	2S, 1P, USP, PS/2	UDMA 3

SY-6BA+(III/IV)

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III/Celeron	Slot 1
Speeds (MHz)		
Chipset	440BX	
BIOS	Award	
Bus	5 PCI/2 ISA	66-133
Memory (Mb)	1 Gb	4 DIMM sockets PC100
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA/33
Video	AGP	
Performance		Good – near Super Micro P6SBA

SY-6BB

Item	Description	Notes
Form Factor	AT	
CPU	Pentium II	Slot 1

Item	Description	Notes
Speeds (MHz)		
Chipset	440BX	133 MHz bus speed
BIOS		
Bus	3 PCI/3 ISA	
Memory (Mb)		3 DIMM sockets
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3

SY-6BE(+)

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		
Chipset	82440BX	
BIOS	Award	
Bus	4 PCI/3 ISA	66-133
Memory (Mb)	768	3 DIMM sockets
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video	AGP	

SY-6IBM

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		
Chipset	82440BX	
BIOS	Award	
Bus	3 PCI/1 ISA	66-133
Memory (Mb)	768	3 DIMM sockets
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video		

SY-6IZA

Item	Description	Notes
Form Factor	ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		
Chipset	Intel 82440ZX	
BIOS	Award	
Bus	3 PCI	66-133
Memory (Mb)	256 Mb	
I/O	The usual	
Video	AGP	

SY-6KB

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	233-333	
Chipset		
BIOS		
Bus	4 PCI/3 ISA	
Memory (Mb)	512	SDRAM/EDO. 4 DIMM sockets
Cache (K)		
Video		AGP
Performance		Poor
Comments		Poor documentation

SY-6KD

Item	Description	Notes
Form Factor	ATX	
CPU	Dual Pentium II	Slot 1
Speeds (MHz)		
Chipset	440 LX	66/75
BIOS		
Bus	4 PCI/2 ISA	
Memory (Mb)		4 DIMM sockets
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video		AGP

SY-6KE

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		
Chipset	440LX	
BIOS	Award	
Bus	4 PCI/3 ISA	66-100
Memory (Mb)	768	3 DIMM sockets
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video	AGP	

SY-6KL

Item	Description	Notes
Form Factor	AT	
CPU	Pentium II	Slot 1
Speeds (MHz)		

Item	Description	Notes
Chipset	440LX	83 MHz bus speed
BIOS		
Bus	3 PCI/3 ISA	
Memory (Mb)		3 DIMM sockets, 2 72-pin
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video		AGP

SY-6VZA

Item	Description	Notes
Form Factor	ATX	
CPU		Socket 370
Speeds (MHz)		
Chipset	Apollo Pro	
BIOS	Award	
Bus	3 PCI	66-133
Memory (Mb)	512	2 DIMM sockets
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video	AGP	

SY-71WA-F

Item	Description	Notes
Form Factor	ATX	
CPU	Celeron	Socket 370
Speeds (MHz)	500	
Chipset	Intel 810	
BIOS	Award	
Bus	5 PCI	Possibly 1 ISA depends on model
Memory (Mb)	512	3 DIMM sockets PC 100
Cache (K)		
I/O	2S, 1P, USP, PS/2, joystick, audio	UDMA 3

SY-V6BE+

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		
Chipset	Apollo Pro	
BIOS	Award	
Bus	4 PCI/3 ISA	66-133
Memory (Mb)	768	3 DIMM sockets
Cache (K)		
I/O	2S, 1P, USP, PS/2	UDMA 3
Video	AGP	

Spacewalker

See Shuttle

Spear Motherboard

Sowah Research?

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
CC-00	SM-M504		

SM-M504

Sowah Research SR-M504?

Spica

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	P5TX-AT	AC	SC 9700

Spring Circle

(909) 869 5599

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	SP566	AC-00	P561-U03
9C-00	P5C01	BC	ST586/P561-4
AC	ST586/SP564	BC	P571-3

Sukjung

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	SJ-PTM HX		

SuperMicro

www.supermicro.com

370SBA

Item	Description	Notes
Form Factor	ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		66-100
Chipset	Intel 440BX	
BIOS	AMI	
Bus	4 PCI 1 ISA	
Memory (Mb)	768 Mb	
Video		AGP
Comments		

370SLM

Item	Description	Notes
Form Factor	Micro ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		66
Chipset	Intel 440LX	
BIOS	AMI	
Bus	3 PCI	
Memory (Mb)	768 Mb	
Video		AGP
Comments		

370SVM

Item	Description	Notes
Form Factor	Micro ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		66-100
Chipset	Via Apollo +	

Item	Description	Notes
BIOS	Award	
Bus	3 PCI	
Memory (Mb)	768 Mb	
Video		AGP
Comments		

370SWM

Item	Description	Notes
Form Factor	Micro ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		66-133
Chipset	Intel 810	
BIOS	AMI	
Bus	2 PCI	
Memory (Mb)	768 Mb	
Video		AGP
Comments		

PIIISCA(E)

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III	Slot 1
Speeds (MHz)		133 FSB
Chipset	Intel 820	
BIOS	AMI	
Bus	5 PCI 1 AMR	1 each shared. UDMA/66
Memory (Mb)		2 RIMM/2 DIMM sockets E has 3 RIMM sockets
Video		AGP 4x
Comments		Better try a Via Apollo Pro Plus board, or Slot A

PIIISEA

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III	Slot 1
Speeds (MHz)		133 FSB
Chipset	Intel 810E	
BIOS	AMI	
Bus	4 PCI/3 ISA 1 AMR	1 each shared. UDMA/66
Memory (Mb)		2 DIMM sockets
Video		Mediocre
Comments		Via Apollo or 820 is better for performance

P5MMA98

Item	Description	Notes
Form Factor		
CPU		
Speeds (MHz)		
Chipset		
BIOS		
Bus	4 PCI/4 ISA	1 each shared
Memory (Mb)		4 72-pin slots
Problems		Linux can lock up during boot due to keyboard timeout. Recommended Flash ROM update can kill BIOS and board (possibly upgraded now).
Comments		

P55

Item	Description	Notes
Form Factor		
CPU		
Speeds (MHz)	75-180	
Chipset	Triton	
BIOS		
Bus	3 PCI/4 ISA	1 each shared. PCI busmastering. Use triton.exe.
Memory (Mb)	128	FPM/EDO. 4 SIMM sockets.
Cache (K)	512	CWA has asynchronous, CWS has pipelined burst synchronous.
I/O	EIDE Mode 4	
Comments		Cheap

P6DBE

Item	Description	Notes
Form Factor	ATX	
CPU	Dual Pentium II	Slot 1
Speeds (MHz)	233-450	
Chipset	440BX	
BIOS	AMI 2 Mb	
Bus	5 PCI/2 ISA	
Memory (Mb)	1 Gb registered SDRAM	4 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	
Video		AGP
Performance		
Comments		

P6DBS

Item	Description	Notes
Form Factor	ATX	
CPU	Dual Pentium II	Slot 1
Speeds (MHz)	233-450	
Chipset	440BX	

Item	Description	Notes
BIOS	AMI 2 Mb	
Bus	4 PCI/3 ISA	
Memory (Mb)	1 Gb registered SDRAM	4 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	AIC 7895 Dual UW+50 pin. RAIDport II
Video		AGP

P6DGU

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Xeon	SMP Slot 2
Cache		
Chipset	Intel 440GX	
BIOS		
Bus	5 PCI/2 ISA	
Memory (Mb)	2 Gb	4 DIMM sockets
I/O	2 EIDE, floppy USB, IR	Adaptec AIC-7890AB
Video		AGP 2x
Performance		
Comments		

P6DLS

Item	Description	Notes
Form Factor	ATX	
CPU	2 Pentium II	Slot 1
Speeds (MHz)	450	
Chipset	440LX	
BIOS	AMI	
Bus	4 PCI/3 ISA	
Memory (Mb)	512 SDRAM 1 Gb EDO	4 DIMM sockets
Cache (K)		
I/O	UDMA EIDE, floppy, AIC 7880P SCSI	Ultra and Ultrawide ports
Performance		Solid

P6DGH

Item	Description	Notes
Form Factor	AT	
CPU	Dual Pentium II	
Speeds (MHz)	233-450	
Chipset	440GX	
BIOS	AMI 2 Mb	
Bus	9 PCI/2 ISA	
Memory (Mb)	2 Gb	4 DIMM sockets
Cache (K)		

Item	Description	Notes
I/O	2 EIDE, floppy, USB	AIC 7896 Dual Ultra 2. RAIDport III. UDMA
Video		AGP

P6DGU

Item	Description	Notes
Form Factor	ATX	
CPU	Dual Pentium II	Slot 1
Speeds (MHz)	233-450	
Chipset	440GX	
BIOS	AMI 2 Mb	
Bus	5 PCI/2 ISA	
Memory (Mb)	2 Gb	4 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	AIC 7890 U2W+UW+50 pin. RAIDport III
Video		AGP

P6SBA

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	233-450	
Chipset	440BX	
BIOS	AMI WinBIOS 2.5	
Bus	4 PCI/3 ISA	UDMA/33
Memory (Mb)	768 Mb registered SDRAM	3 DIMM sockets
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video		AGP
Performance		Excellent (actually “stunning…” PC Pro)
Comments		Good price

P6SBU

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III/Celeron	Slot 1
Speeds (MHz)	600/400	
Chipset	440BX	
BIOS	AMI 2 Mb	
Bus	4 PCI/3 ISA	
Memory (Mb)	1 Gb registered SDRAM	4 DIMM sockets
Cache (K)		
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	AIC 7890 U2W+UW+50 pin. RAIDport III
Video		AGP
Performance		Competent

P6SBS

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III/Celeron	Slot 1
Speeds (MHz)	600/400	
Chipset	440BX	
BIOS	AMI 2 Mb	
Bus	4 PCI/3 ISA	
Memory (Mb)	1 Gb registered SDRAM	4 DIMM sockets
Cache (K)		
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video		
Performance		

P6SLA

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	233-333	
Chipset	440LX	
BIOS	AMI 2 Mb	
Bus	4 PCI/3 ISA	
Memory (Mb)	768 EDO or 384 SDRAM	3 DIMM sockets
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video		AGP
Performance		Reasonable. 75 MHz bus speed, 6 x multiplier.

P6SWA

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		
Chipset	Intel 810E	
BIOS	AMI 2 Mb	
Bus	4 PCI/3 ISA	UDMA/66
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video		
Performance		

P6SWD

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		

Item	Description	Notes
Chipset	Intel 810DC-100	
BIOS	AMI 2 Mb	
Bus	4 PCI/3 ISA	UDMA/66
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video		
Performance		

S2DGR

Item	Description	Notes
Form Factor	ATX	
CPU	Dual Pentium II/Xeon	
Speeds (MHz)	400-500	
Chipset	440GX	
BIOS	AMI 2 Mb	
Bus	4 PCI/2 ISA	
Memory (Mb)	2 Gb	4 DIMM sockets
I/O	2 EIDE, floppy, USB	AIC 7895 Dual UW+50 pin. RAIDport II. UDMA
Video		AGP

S2DGU

Item	Description	Notes
Form Factor	ATX	
CPU	Dual Pentium II/Xeon	
Speeds (MHz)	400-500	
Chipset	440GX	
BIOS	AMI 2 Mb	
Bus	5 PCI/2 ISA	
Memory (Mb)	2 Gb	4 DIMM sockets
Cache (K)		
I/O	2 EIDE, floppy, USB	AIC 7890 U2W+UW+50 pin. RAIDport III. UDMA
Video		AGP

S2DG2

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Xeon	SMP Slot 2
Cache		
Chipset	Intel 440GX	
BIOS		
Bus	5 PCI/2 ISA	
Memory (Mb)	2 Gb	4 DIMM sockets
I/O	2 EIDE, floppy USB, IR	Adaptec AIC-7896N LVD
Video		AGP 2x
Performance		

S370SED(A)

Item	Description	Notes
Form Factor	Micro-ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		
Chipset	Intel 810E	
BIOS		
Bus	3 PCI (6 for SEA)	UDMA/66
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	2 EIDE, floppy	
Video		
Performance		
Comments		

S370SWD

Item	Description	Notes
Form Factor	Micro-ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		
Chipset	Intel 810DC-100	
BIOS		
Bus	3 PCI	UDMA/66
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	2 EIDE, floppy	
Video		
Performance		
Comments		

S370SW(M)(T)

Item	Description	Notes
Form Factor	Micro-ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		
Chipset	Intel 810L	
BIOS		
Bus	3 PCI, AMR	UDMA/66
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	2 EIDE, floppy, USB, ser, par, joystick, audio	
Video		Embedded AGP
Performance		
Comments		Better boards for power

SuperPower

www.superpower.com.tw

6XV-133

Item	Description	Notes
Form Factor	AT	
CPU	Pentium II	Slot 1
Speeds (MHz)		
Chipset	Via Apollo Pro Plus	
BIOS		
Bus	5 PCI/2 ISA	UDMA/66
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)		
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video		AGP
Comments		Excellent Value

6XW

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		
Chipset	Intel 810E	
BIOS		
Bus	5 PCI	
Memory (Mb)	512 Mb	2 DIMM sockets
Cache (K)		
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video		AMR
Comments		Excellent Value

P2BXA-E

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		8x clock multiplier
Chipset	Intel 440BX	
BIOS		
Bus	5 PCI/2 ISA	UDMA/33
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)		
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video		AGP
Comments		

SP-586TB

Item	Description	Notes
Form Factor	AT	
CPU	Pentium	Socket 7
Speeds (MHz)		
Chipset		
BIOS		
Bus	4 PCI/3 ISA	
Memory (Mb)		4 72-pin, 2 DIMM sockets
Cache (K)		
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video		
Performance		

Jumper	*Position*			*Function*
J1,2	1-2			5v DIMMs
	2-3			12v
JP1	None			3.5/1.5x CPU
	1-2			2x
	1-2,3-4			2.5x
	3-4			3x
	5-6			4x
JP2-4	**JP2**	**JP3**	**JP4**	**Bus speed**
	1-2	1-2	1-2	50 MHz
	2-3	2-3	1-2	60 MHz
	2-3	2-3	2-3	66 MHz
	2-3	1-2	2-3	73 MHz
JP10	2-3			5v Flash ROM
	1-2			12v
JP16	5-6			2.1v Ext CPU
	1-2			2.8v
	1-2,7-8			2.9v
	1-2,3-4			3.2v
	1-2,3-4,5-6			3.3v
	1-2,3-4,5-6,7-8			3.5v

SP-A586B

Item	Description	Notes
Form Factor	AT	
CPU	Pentium	Super Socket 7
Speeds (MHz)		
Chipset	Ali-V M1542/1543	
BIOS	Award Green	
Bus	3 PCI/2 ISA	
Memory (Mb)	768	3 DIMM sockets
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video		AGP
Performance		Reasonable

Jumper	*Position*			*Function*
JB1	None			1.5/3.5x CPU
	1-2			2x
	1-2,3-4			2.5x
	3-4			3x
	1-2,5-6			4x
	1-2,3-4,5-6			4.5x
	3-4,506			5x
	5-6			5.5x
JC1-3	**JC1**	**JC2**	**JC3**	**Bus speed**
	In	In	In	60 MHz
	Out	In	In	66 MHz
	In	In	Out	75 MHz
	Out	In	Out	83 MHz
	In	Out	Out	95 MHz
	Out	Out	Out	100 MHz
JV1	None			2v CPU Core
	1-2			2.1v
	3-4			2.2v
	1-2,3-4			2.3v
	5-6			2.4v
	1-2,5-6			2.5v
	3-4,5-6			2.6v
	1-2,3-4,5-6			2.7v
	7-8			2.8v
	1-2,7-8			2.9v
	3-4,7-8			3v
	1-2,3-4,7-8			3.1v
	5-6,7-8			3.2v
	3-4,5-6,7-8			3.3v
	1-2,3-4,5-6,7-8			3.4v
JV2	In			3.3v
	Out			3.45v
JR1	1-2			5v Flash ROM
	2-3			12v Flash ROM
JBT1	1-2			Normal
	2-3			Clear CMOS

SP-P2BXA

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		
Chipset	440BX	
BIOS	Award 4.51PG	
Bus	4 PCI/3 ISA	
Memory (Mb)	768	3 DIMM sockets
Cache (K)		
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video		AGP
Performance		Below average

Sye

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C-00	5700		

Notes

T

Taemung/Fentech

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	KBT5A-1 or KBT5A-2		

Taiwan Mycomp Corp

See TMC

Taken Corp

www.taken.com.tw

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
2C	PCI 400	AC	PCI 590
9C	PCI 590-2	BC	PCI 597

Tandon

MCS

Jumper	*Position*			*Function*
J6A	In			Security disabled
	Out			Security enabled
J6B,C	**J6B**	**J6C**		**Base Memory**
	Out	Out		640K
	On	Off		512K
	Off	On		256K
J10A,B	**J10A**	**J10B**	**Y5**	**RAM**
Y5	Off	Off	Empty	256K
	Off	Off	Empty	512K
	On	Off	40 MHz	256K
	On	Off	40 MHz	512K
	Off	On	50 MHz	256K
	Off	On	50 MHz	512K

MCS Pro

Jumper	*Position*		*Function*
JP1A,B	**JP1A**	**JP1B**	**Base Memory**
	Out	Out	640K
	Out	In	512K
	In	Out	256K
J1C	In		Security disabled
	Out		Security enabled
JP2	In		Onboard floppy enabled/disabled automatically
	Out		Disabled permanently

PAC 286/8/10 (Type A)

Switch	*Position*	*Function*
1	Off	Reserved
2	On	Disable 512-640K RAM
	Off	Enable
3	On	Disable Data Pac 1 ejection
	Off	Enable
4	On	Disable setup access
	Off	Enable
E1	1-2	Onboard diskette is secondary controller
	2-3	Primary controller

PAC 286/8/10 (Type B)

Switch	*Position*	*Function*
1	Off	Reserved
2	On	Disable 512-640K RAM
	Off	Enable
3	On	Disable Data Pac 1 ejection
4	On	Disable setup access
	Off	Enable
5-8		Reserved
E1	1-2	Onboard diskette is secondary controller
	2-3	Primary controller

PAC 286/12

Switch	*Position*		*Function*	
1,2	**S1**	**S2**	**Base**	**Extended**
	Off	Off	640K	384K
	Off	On	512K	512K
	On	Off	256K	384K
	On	On	256K	512K
3	On		Disable security features	
	Off		Enable	
4	Off		Reserved	
E1	Out		Reserved	
E2	1-2		8 MHz 80287	
	3-4		Reserved	
	5-6		10/12 MHz 80287	

PAC 386sx

Switch	*Position*	*Function*
1	Off	Reserved
2	On	Disable security features
	Off	Enable
3	Off	Reserved
4	On	Disable 512-640K RAM
	Off	Enable
5-8	Off	Reserved
E1	1-2	32K BIOS Chip
	2-3	64K BIOS Chip
E5	Out	Reserved
E6	In	1 Mb (J20-23 256K)
	In	2 Mb (J20-27 256K)
	Out	2 Mb (J20-21 1 Mb)
	Out	4 Mb (J20-23 1 Mb)
	Out	8 Mb (J20-27 1 Mb)
E7	Out	Reserved
E8	Out	Reserved

PAC II

Jumper	*Position*			*Function*
J19	In			Clear CMOS
	Out			Normal
J22C	In			Onboard video is PS/2 VGA mode
	Out			Onboard video is AT VGA mode
J22D	In			Onboard video uses PS/2 VGA timing
	Out			Onboard video uses standard timing
J24	In			Term power to SCSI bus
	Out			Term power from SCSI bus
J35A,B	**J35A**	**J35B**		**Base Memory**
	Out	Out		640K
	Out	In		512K
	In	Out		256K
J35C	In			Security disabled
	Out			Security enabled
J36	1-2			16K BIOS size
	2-3			32K BIOS size
J37	1-2			Enable onboard SCSI
	2-3			Disable
J38	1-2			DataPacII/0 normal ejection
	2-3			Emergency eject
J39	1-2			DataPacII/1 normal ejection
	2-3			Emergency eject
J41 S1-2	Off			Reserved
J41 S3-5	**S3**	**S4**	**S5**	**RME ID**
	On	On	On	0
	Off	On	On	1
	On	Off	On	2
	Off	Off	On	3
	On	On	Off	4
	Off	On	Off	5
	On	Off	Off	6
	Off	Off	Off	7
J41 S6	In			DataPacII/0 normal ejection
	Out			Locked
J41 S7	In			DataPacII/1 normal ejection
	Out			Locked
J45				RTC test point
J48	1-2			BIOS is standard EPROM
	2-3			BIOS is Flash EPROM

PCA 6/8

Switch	*Position*	*Function*
S1-2	Off	Reserved
S3	On	Colour adapter
	Off	Mono
S4-7	Off	Reserved
S8	On	256K chips in Bank 1 (1 Mb)
	Off	64K chips in Bank1 (640K)

PCA 12 (Type A)

Switch	*Position*		*Function*	
J6			Reset/LED	
1,2	**S1**	**S2**	**Base**	**Extended**
	Off	Off	640K	384K
	Off	On	512K	512K
	On	Off	256K	384K
	On	On	256K	512K
3	On		Disable security features	
	Off		Enable	
4	Off		Reserved	
E1	Out		Reserved	
E2	1-2		8 MHz 80287	
	5-6		10/12 MHz 80287	

PCA 12 (Type B)

Switch	*Position*		*Function*	
J9			Speaker	
J10			Reset/LED	
J12			IDE LED	
1,2	**S1**	**S2**	**Base**	**Extended**
	Off	Off	640K	384K
	Off	On	512K	512K
	On	Off	256K	384K
	On	On	256K	512K
3	On		Disable security features	
	Off		Enable	
4	Off		Reserved	
E1	1-2		Reserved	
E2	1-2		8 MHz 80287	
	2-3		10/12 MHz 80287	
E3	1-2		BIOS chip size	

286N (Type A)

Jumper	*Position*	*Function*
W2	1-2	Reserved
W3	1-2	Enable security features
	2-3	Disable
W4	1-2	Disable onboard floppy
	2-3	Enable
W5	1-2	Disable diskette reduced write current
	2-3	Enable
W9	1-2	12 MHz 802C87
	2-3	6 MHz 80287
W11	1-2	Disable onboard VGA
	2-3	Enable
W12	1-2	Disable IDE LED
	2-3	Enable
W15	1-2	Enable IRQ9

Jumper	Position	Function
	2-3	Disable
W16	In	Disable IRQ12
	Out	Enable
W17	In	Disable 512-640K
	Out	Enable

286N (Type B)

Jumper	Position	Function
J2		Reserved
J3		Reserved
J4	In	Enable onboard VGA
	Out	Disable
J5		Reserved
J6	In	Lock keyboard
	Out	Normal
J7		Reset
J8	1-2	Enable security features
	2-3	Disable
J9	In	Disable 512-640K
	Out	Enable
J14		Power LED
J15		HD LED
J16		Internal reset

386N (Type A)

Jumper	Position	Function
JP2	In	Disable 512-640K
	Out	Enable
JP3	In	Disable security features
JP5	In	Disable IRQ12
	Out	Enable
JP6	1-2	Disable onboard floppy
	2-3	Enable
JP7	1-2	Disable onboard IDE
	2-3	Enable
JP8	1-2	Disable diskette reduced write current
	2-3	Enable
JP9	1-2	64K BIOS
	2-3	32K BIOS
JP10	In	Disable IDE LED
	Out	Enable
JP11		Keyswitch/IDE

386N (Type B)

As for 286N (Type B), except J2,3,5 Out.

386N (Type C)

Jumper	*Position*			*Function*				
JP1				Speaker				
JP4A	In			Enable 256-640K				
	Out			Disable				
JP4B	In			Disable security features				
	Out			Enable				
JP5A	Out			Reserved				
JP5B	In			Enable LPT bidirectional mode				
JP10				Battery				
JP12-14	**JP12**	**JP13**	**JP14**	**Mem**	**Fixed**	**Bank 0**	**Bank 1**	**Interleave**
	1-2	1-2	1-2	512K	512			0
	1-2	1-2	1-2	1 Mb	512		256	2
	2-3	2-3	2-3	1.5 Mb	512	256	256	2
	1-2	1-2	1-2	2.5 Mb	512		1 Mb	0
	2-3	2-3	2-3	4 Mb		1 Mb	1 Mb	2
	2-3	2-3	2-3	10 Mb		1 Mb	4 Mb	0
	2-3	2-3	2-3	16 Mb		4 Mb	4 Mb	2
JP18				HD LED				
JP19				Power LED				

386-16/20

Switch	*Position*				*Function*		
1-4	**1**	**2**	**3**	**4**	**Bank1**	**Bank2**	**Total RAM**
	On	On	On	On	256x9		1 Mb
	Off	On	On	On	256x9		1 Mb
	On	Off	On	On	256x9		1 Mb
	Off	Off	On	On	256x9		1 Mb
	On	On	Off	On	256x9	256x9	2 Mb
	Off	On	Off	On	256x9	256x9	2 Mb
	On	Off	Off	On	256x9	256x9	2 Mb
	Off	Off	Off	On	256x9	256x9	2 Mb
	On	On	Off	Off	1Mbx9		4 Mb
	Off	On	On	Off	1Mbx9		4 Mb
	On	Off	On	Off	1Mbx9		4 Mb
	Off	Off	On	Off	1Mbx9		4 Mb
	On	Off	Off	Off	1Mbx9	256x9	5 Mb
	Off	Off	Off	Off	1Mbx9	256x9	5 Mb
	On	On	Off	Off	1Mbx9	1Mbx9	8 Mb
	Off	On	Off	Off	1Mbx9	1Mbx9	8 Mb
5	Off				EGA BIOS Disabled		
	On				Enabled		
6	Off				80387		
	On				80287		
7	Off				Boot high speed		
	On				Normal speed		
8	Off				Mono display		
	On				Colour		

386-25/33

Jumper	*Position*		*Function*
W7,8	**W7**	**W8**	**80387 clock**
	1-2	In	Asynchronous
	2-3*	Out*	Synchronous
W12,13	**W12**	**W13**	**Cache mode**
	In	1-2	Direct mapped
	Out*	2-3*	2-way associative
W22,23			Reserved

Switch	*Position*	*Function*
1	Off	Reserved
2	Off	809387 not installed
	On	Installed
3	Off	Reserved
4	Off	Reserved
5	Off	Reserved
6	Off	Enable security features
	On	Disable
7	Off	Reserved
8	Off	8.25 MHz bus speed
	On	11 MHz bus speed

386/33 (Type E)

Jumper	*Position*	*Function*
JP1	1-2	Enable security
	2-3	Disable
JP2	1-2	LPT1 uses IRQ7
	2-3	LPT2 uses IRQ5
JP3	Out	Reserved
JP4	1-2	Disable I/O peripherals
	2-3	Enable
JP5	1-2	128K cache
	2-3	32/64K cache
J3		COM1
J4		COM2
J8		Speaker
J9		Speed LED
J10		Reset
J11		IDE

Sonia II PCX

BIOS supports up to 4 floppies, but onboard controller only supports 2.

Switch	*Position*	*Function*
S1	On	Disable boot on drive A
	Off	Enable
S2	On	Maths copro installed

Switch	*Position*			*Function*
	Off			Not installed
S3,4,JP1	**S3**	**S4**	**JP1**	**Total RAM**
	On	Off	2-3	128K
	Off	On	2-3	192K
	Off	Off	2-3*	256K
	On	Off	1-2	128K
	Off	On	1-2	384K
	Off	Off	1-2	640K
S5,6	**S5**	**S6**		**Display**
	Off	Off		Mono
	Off	On		Colour 40x25
	On	Off		Colour 80x25
	On	On		None
S7,8	**S7**	**S8**		**Floppies installed**
	Off	Off		1
	Off	On		2
	On	Off		3
	On	Off		4
P2	1-2			Disable LPT1

Sonia III PCX

Jumper	*Position*		*Function*
JP1	In		64K chips in Bank 1 (256K)
	Out		256K chips in Bank 1 (640K)
JP3,4	**JP3**	**JP4**	**Display Type**
	B	B	Mono 80 column
	B	A	Colour 40 column
	A	B	Colour 80 column
	A	A	None
JP5	A		Enable LPT1
	B		Disable

SL (Type A)

Jumper	*Position*	*Function*
JP1	Out	16K ROM BIOS
	In	32K ROM BIOS
JP3		Reserved
JP4		Reserved
JP5	Out	Enable onboard floppy
	In	Disable

SW1

Jumper	*Position*	*Function*
1	Off	Enable security
	On	Disable security
2	Off	SIMMs not installed
	On	SIMMs installed

SW2

Switch	Position	Function
1	Off	Disable COM1
	On	Enable
2	Off	Disable COM2
	On	Enable
3	Off	Disable LPT1
	On	Enable
4	Off	DRAM 1 wait state
	On	DRAM 0 wait state

SL (Type B)

Jumper	Position	Function
E1	2-3	Reserved
E2	1-2	IDE IRQ14 enabled
	2-3	Disabled
E3	2-3	Reserved
E4	2-3	Reserved
E5,6	1-2	IDE secondary address
	2-3	IDE primary address
	Out	Disable IDE (also E2 to 2-3)
E7	2-3	Reserved
E8	1-2	RAM parity checking enabled
	2-3	Disabled

SW1

Reset switch

SW2

Switch	Position		Function
1,2	**1**	**2**	**Memory**
	Off	Off	640K
	Off	On	512K
	On	On	256K
3	Off		Enable security
	On		Disable

SL (Type C)

Jumper	Position	Function
E1	2-3	Reserved
E2	1-2	IDE IRQ14 enabled
	Out	Disabled
E3	2-3	Reserved
E4	2-3	Reserved
E5	1-2	80287 clock divided by 3
	2-3	80287 clock used directly

Jumper	*Position*	*Function*
E6,7	1-2	IDE secondary address
	2-3	IDE primary address
	Out	Disable IDE (also E2 to Out)
E8	1-2	8 MHz clock to 80287
	5-6	10/12 MHz clock to 80287
E9	2-3	Reserved
E10	1-2	RAM parity checking enabled
	2-3	Disabled
E11	2-3	Reserved

SW1

Reset switch

SW2

Switch	*Position*		*Function*
1,2	**1**	**2**	**Memory**
	Off	Off	640K
	Off	On	512K
	On	On	256K
3	Off		Enable security

Tower 386

Switch	*Position*	*Function*
S1	Off	Reserved
S2	Off	Coprocessor not installed
	On	Coprocessor installed
S3	Off	I/O bus speed 8.25 MHz
	On	I/O bus speed 11 MHz
S4	Off	Reserved
S5	Off	Reserved
S6	Off	Security enabled
	On	Disabled
S7	On	Normal operation
S8	Off	Reserved

Jumper	*Position*		*Function*
W9	Off		Non-cacheable region D00000-DFFFF
	On		Non-cacheable region E00000-FFFFFF
W10	Off		Base memory 640K
	On		Base memory 512K (BIOS >3.7 only)
W14,15	**W14**	**W15**	**Cache Mode**
	On	1-2	Direct mapped
	Off	2-3	2-way set associative
W30			Reserved
W98	1-2		256K SIMMs
	2-3		1 Mb SIMMs

Tower 486

Switch	Position		Function
S1,2	**S1**	**S2**	**Memory**
	Off	Off	640K
	Off	On	512K
	On	On	256K
S3	Off		Security enabled
	On		Disabled
S4			Reserved
J7			IDE LED
J8			Battery
J9			Speaker
J10			Reset & LEDs

Tatung

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TCS 4000

Jumper	Position	Function
J1	In	For readjusting WDC 10 MHz VCO frequency after repairs. This is removed when adjusting C38 and replaced afterwards.
J2	1-2	Onboard WDC select disabled
	2-3	Enabled
J3	1-2	Onboard FDC select disabled
	2-3	Enabled
J4		HDD data cable
J5		HDD control cable
J6		External battery
J7	1-2	System clock mode
	2-3	DMA clock mode
J8		Floppy cable
J9		Keyboard
J12		Reset/keylock
J13		HDD LED, Power LED, speaker
J18	1-2	EPROM select mode
	2-3	ROM select mode
J19	1-2	27128 ROM
	2-3	27256 ROM
J20		Special EGA card on main board
J21	1-2	80287 at 10 MHz
	2-3	80287 at 4.77 MHz

SW1

Switch	Position				Function	
S1-4	**S1**	**S2**	**S3**	**S4**	**Drive A**	**Drive B**
	On	On			1.2 Mb	
	On	Off			360K	

Switch	*Position*				*Function*	
	On	On	On	On	1.2 Mb	1.2 Mb
	On	On	Off	Off	1.2 Mb	360K
	Off	Off	On	On	360K	1.2 Mb
	Off	Off	Off	Off	360K	360K
S5-8					Reserved	

SW2

Switch	*Position*	*Function*
1	On	Colour display
	Off	Mono
2	On	640K onboard memory
	Off	512K or 1 Mb onboard memory
3	On	Enable COM1
	Off	Disable
4	On	Enable COM2
	Off	Disable
5	On	Enable LPT1
	Off	Disable
6	On	System clock speed 6(8) MHz
	Off	10 MHz

TCS 7000

Jumper	*Position*				*Function*
J1					Reset
J2	1-2				System board memory 1 Mb
	2-3				512/640K
J7	1-2				Colour display
	2-3				Mono
J10	1-2				0 wait state
	2-3				1 wait state
J12	1-2				Low system clock
	2-3				High system clock
S1-4	**S1**	**S2**	**S3**	**S4**	**ROM select**
	On	On	Off	Off	128K
	Off	Off	On	On	256K

TC Computers

Rebadges Biostars.

Tekram

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Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	P6L40-A4	9C	P5V30-B4 rev 1/P5T30B4

P5M4-M

Item	Description	Notes
Form Factor	Micro ATX	
CPU	Pentium/K6	Super Socket 7
Cache	512 Kb	
Chipset	Via MVP4	
BIOS		
Bus	4 PCI/1 ISA	UDMA/66
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2 EIDE, floppy USB, IR	
Video		
Performance		
Comments		

P6B40-A4

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		
Chipset	440BX	
BIOS	Award 4.51PG	
Bus	4 PCI/3 ISA	
Memory (Mb)	1 Gb	4 DIMM sockets
Cache (K)		
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video		AGP 2x
Performance		Reasonable

P6BX-A

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		
Chipset	440BX	
BIOS		
Bus	5 PCI/2 ISA	UDMA/33
Memory (Mb)	768 Mb	3 DIMM sockets
Cache (K)		
I/O	2S, 1P, EIDE, floppy, 2 USB, 2 PS/2	
Video		AGP 2x
Performance		

TMC

Taiwan Mycomp Company
www.mycomp-tmc.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0	PCI58PL	AC-00	PCI54ST
1-00	PCI48PG/PG4/PAT48PG	CC	PCI541T
9C	PCI541T/P55CIT/PCI54SP	CC-00	PCI54ST
9C	A15TH/VP	DC	PCI541T
AC	PCI541T		

AI5VG+

Item	Description	Notes
Form Factor	Baby AT	
CPU	Pentium/K6 etc	Super Socket 7
Speeds (MHz)		
Chipset	VIA MVP3	
BIOS	Award 4.51PG	
Bus	4 PCI/2 ISA	66-100
Memory (Mb)	768	
Cache (K)	1 Mb	
I/O	2S, 1P, floppy, 2 EIDE, IRDA	UDMA
Video	AGP	
Audio		
Performance		

MI7WBM

Item	Description	Notes
Form Factor	Micro-ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		
Chipset	Intel 810	
BIOS		
Bus	3 PCI, 1 AMR	UDMA/66
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	2 EIDE, floppy, ser, par, PS/2, joystick, audio	
Video		
Performance		
Comments		

PCI48PG4

Item	Description	Notes
CPU	486	P24D
Chipset	Opti	
BIOS	Award or AMI WinBIOS	
Bus	2 PCI/2 ISA/2 VESA	1 PCI/ISA shared.
Memory (Mb)	128	4 slots – all must be used.
Cache (K)	256	
I/O	2S, 1P, Floppy	Opti PCI IDE controller (82C621), SMC for serial/parallel/floppy.

PCI54IT

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	90	
Chipset	Triton	
BIOS	Award	
Bus		PnP 1.0a compliant. Use triton.exe
Memory (Mb)		4 72-pin slots
I/O	2S, 1P, Game, IDE	

PCI54PV3

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	90	
Chipset	Opti Viper	
BIOS	Award	
Bus	3 PCI/4 ISA	
Memory (Mb)		4 72-pin SIMMs
Cache (K)		
I/O	2S, 1P, Floppy, IDE	
Performance		Slower than PCI541T

PCI58PL

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	60/66	
Chipset	Opti	82C822, 82C571, 82C572
BIOS	Award	
Bus	3 PCI/2 ISA/1 VL	1 shared PCI/VL. PCIs busmaster, as does 1 VL.
Memory (Mb)	192	Parity only. 4 30-pin sockets (Bank 0) and 3 72-pin (0, 1 and 2).
Cache (K)	512	256 standard
I/O	None	

PET 48PN

486 EISA + VL Bus

Switch	*Position*				*Function*
RNA/B/C/D	**A1/2**	**B1/2**	**C1/2**	**D1/2**	**Cache Size**
	Closed	Open	Open	Open	64K
	Open	Closed	Open	Open	128K
	Open	Open	Closed	Open	256K
	Open	Open	Open	Closed	512K
RNA/B/C	**A3**	**B3**	**C3**		**CPU**
	Closed	Open	Open		486DX2
	Open	Closed	Open		ODP486SX
	Closed	Open	Open		486DX
	Open	Closed	Open		487SX
	Open	Open	Closed		486SX
RNE1-5	On				30 pin SIMMs first
RNF1-5	On				72-pin SIMMs first
JP2-4	**JP2**	**JP3**	**JP4**		**CPU**
	1-2	1-2	2-3		20 MHz
	1-2	1-2	2-3		25 MHz
	1-2	2-3	2-3		33 MHz
	1-2	1-2	2-3		40 MHz (internal)
	1-2	1-2	2-3		50 MHz (internal)
	2-3	2-3	1-2		50 MHz
	1-2	2-3	2-3		66 MHz (internal)
JP5	Open				Mono Display
	Closed				Colour Display
JP7	Open				Channel Ready Select Normal
	Closed				Channel Ready Select EXRDY signal generated
JP8 & 9	Open				33 MHz VL bus speed
	Closed				50 MHz
W7-10	**W7**	**W8**	**W9**	**W10**	**Clock Source**
	Open	Closed	Open	Open	20 MHz
	Open	Open	Closed	Open	25 MHz
	Closed	Open	Open	Open	33 MHz
	Open	Open	Closed	Open	50 MHz
	Open	Open	Open	Closed	66 MHz
J4					IDE LED
J5	1-4				Speaker
	7-17				Turbo Switch
	9-19				Reset
	10-20				IDE LED

TD6NB SCSI

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)		
Chipset	82440BX	
BIOS	Award 4.51PG	
Bus	5 PCI/2 ISA	66-100
Memory (Mb)	1024	

Item	Description	Notes
Cache (K)		
I/O	2S, 1P, floppy, 2 EIDE, IRDA	UDMA
Video	AGP	

TIVG

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium MMX	6x86/L/MX, K5, K6
Speeds (MHz)	90-233	
Chipset	VIA VP3	
BIOS		
Bus	4 PCI/3 ISA/1AGP	
Memory (Mb)		FPM, EDO, SDRAM. 4 72-pin & 3 DIMM sockets.
Cache (K)	512	
I/O	2S, 1P, floppy, 2 EIDE, IRDA	Winbond W83877. UDMA
Video		AGP

Switch	*Position*				*Function*
SW1	**1**	**2**	**3**	**4**	**CPU host bus speed**
1-4	On	Off	Off	Off	60 MHz
	Off	Off	Off	Off	66 MHz
SW1	**5**	**6**	**7**		**CPU clock multiplier**
5-7	Off	Off	Off		1.5x
	On	Off	Off		2x
	On	On	Off		2.5x
	Off	On	Off		3x
	Off	Off	Off		3.5x
SW2	**1**	**2**	**3**	**4**	**CPU voltage** (IO/Core)
1-4	On	On	On	On	3.3/3.5
	Off	Off	On	On	3.3/3.2
	On	On	Off	On	3.3/3.1
	Off	On	Off	On	3.3/3
	On	Off	Off	On	3.3/2.9
	Off	Off	Off	On	3.3/2.8
	On	On	On	Off	3.3/2.7
	Off	On	On	Off	3.3/2.6
	On	Off	On	Off	3.3/2.5
	On	Off	Off	Off	3.3/2.1
	On	On	On	On	Single voltage CPU
JP8	1-2*				Normal
	2-3				Clear CMOS
J13	1-4				Speaker
	11-15				Power LED and keylock
	7-17				ATX power on switch
	8-18				Turbo LED
	9-19				Reset
	10-20				HD LED

TI5VG+

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium/K6 etc	Super Socket 7
Speeds (MHz)		
Chipset	VIA MVP3	
BIOS	Award 4.51PG	
Bus	5 PCI/2 ISA	66-133
Memory (Mb)	384	
Cache (K)	1 Mb	
I/O	2S, 1P, floppy, 2 EIDE, IRDA	UDMA
Video	AGP	
Audio		
Performance		Fast

TI5VGA

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium/K6	Super Socket 7
Cache	2 Mb	
Chipset	Via MVP3	Supports UDMA 66
BIOS	Award	
Bus	6 PCI	UDMA/66
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2 EIDE, floppy USB, IR	
Video		AGP 2x
Performance		
Comments		Sound on board

TI5VGF

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium/K6 etc	Super Socket 7
Speeds (MHz)		
Chipset	VIA MVP3	
BIOS	Award 4.51PG	
Bus	6 PCI	66-133 MHz
Memory (Mb)	384	SDRAM only. 3 DIMM sockets
Cache (K)	1 Mb	
I/O	2S, 1P, floppy, 2 EIDE, IRDA	DMA/33
Video	AGP	
Audio		
Performance		

TI6NB(F)+

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	
Speeds (MHz)		
Chipset	82440BX	
BIOS	Award 4.51PG	
Bus	4 PCI/3 ISA	4/1 for BF+ 66-133
Memory (Mb)	768	64 Mb on board for B+
Cache (K)		
I/O	2S, 1P, floppy, 2 EIDE, IRDA	UDMA
Video	AGP	

TI6VG4

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III	
Speeds (MHz)		133 FSB
Chipset	Via Apollo Pro Plus	
BIOS	Award	
Bus	5 PCI/1 ISA	
Memory (Mb)	768	3 DIMM sockets. 64 Mb on board
Cache (K)		
I/O	2S, 1P, floppy, 2 EIDE, IRDA	UDMA
Video		AGP 2x (4x some boards)

TI7NBA

Item	Description	Notes
Form Factor	ATX	
CPU		Socket 370
Speeds (MHz)		
Chipset	440BX/ZX	
BIOS	Award 4.51PG	
Bus	4 PCI/2 ISA	
Memory (Mb)	768	
Cache (K)		
I/O	2S, 1P, floppy, 2 EIDE, IRDA	UDMA
Video	AGP	

TK7AG

Item	Description	Notes
Form Factor	ATX	
CPU	Athlon	Slot A
Speeds (MHz)		
Chipset	AMD 750	

Item	Description	Notes
BIOS		
Bus	4 PCI/3 ISA	UDMA/66
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2 EIDE, floppy	
Video		AGP
Performance		
Comments		Biostar M7MKA is a better choice

Tomatoboards

See Zida

Top Gun

Pentium MMX

Jumper	*Position*		*Function*
JP1	1-2		Normal
	2-3		Clear CMOS
JP3 A&B	1-2		Dual voltage CPU (P55C)
	2-3		Single voltage CPU (P54C)
JP4 A&B	1-2		5v DIMM
	2-3		3.3v DIMM
JP5 A&B	**A**	**B**	**Clock multiplier**
	1-2	1-2	Intel/AMD 1.5/3.5x
	2-3	1-2	Intel/Cyrix 2x
	2-3	2-3	Intel/AMD/Cyrix M2 2.5x
	1-2	2-3	3x
JP6	Open		2.5v CPU Core
	A		3.5v
	B		3.3v
	C		3.2v
	D		2.9v
	E		2.8v
JP7 A&B	A,B		60 MHz host clock
	B		66 MHz host clock
	A		75 MHz host clock
	Open		83 MHz host clock

Toshiba

www.toshiba.com

T1200

Jumper	Position		Function
PJ1			Keyboard
PJ3	1-2		Default
	2-3		Adjustment when modem card shipped
PJ4	1-2		Default
	2-3		Adjustment when modem card shipped
PJ5	1-2		Enable DTR
	2-3		Sets DTR always True
PJ6	1-2		Determine if carrier from distant modem
	2-3		Set carrier detect always True
PJ7			LED connector
PJ8			Modem connector
PJ9			Power supply (HDC)
PL11			LCD
PJ12			Power supply 5v
PJ13			FDD A
PJ14			FDD B
PJ15			I/O
PJ16			Power supply (signal)
PJ17	1-2		Twin floppies
	Out		Floppy/HD
PJ18,19	**PJ18**	**PJ19**	**ICE**
	1-2	Out	Normal
	2-3	1-2	Connected to copro socket
PJ20	1-2		Copro not installed
	Out		Installed
PJ21	1-2		Normal Font
	Out		North European (Denmark)

T2100

Switch	Position		Function	
S1	Off		IRQ4 to Toshiba card slot	
	On		IRQ4 to IBM-compatible card slots	
S2	Off		IRQ3 to Toshiba card slot	
	On		IRQ3 to IBM-compatible card slots	
S3			Reserved	
S4	Off		Enable internal display controller	
	On		Disable	
S5	Off		Unidirectional printer port	
	On		Bidirectional	
S6,7	**S6**	**S7**	**Serial 1**	**Serial 2**
	Off	Off	COM1	COM2
	Off	On	COM1	COM3
	On	Off	COM2	COM1
	On	On	COM2	COM3
S8	Off		External FDD is B	
	On		External FDD is A	
PJ1			Keyboard	
PJ3			Speaker	
PJ4			Expansion memory	

Switch	Position	Function
PJ6		Modem
PJ7		Plasma display
PJ8		FD2
PJ9		FD1
PJ10		Power supply
PJ11		Power supply
PJ12		HD
PL13		Colour CRT
PJ14		Composite video
PJ15		External FD/printer
PJ16		RS 232

T3200

Switch	Position				Function
S1	On				Auto switch display mode
	Off				IBM EGA
S2	On				Bidirectional LPT
	Off				Unidirectional
S3	On				Comms port is CH2
	Off				Comms port is CH1
S4	On				Double font in plasma for text
	Off				Single font
S5	On				Disable CRTC for Ext CRTC
	Off				Enable internal CRTC (normal)
S6	On				North European font on display
	Off				Other fonts
S7-10	**S7**	**S8**	**S9**	**S10**	**Monitor**
	Off	Off	Off	Off	Mono
	On	Off	Off	On	RGB 40 col
	Off	Off	Off	On	RGB 80 col
	On	On	On	Off	Enhanced RGB 200 line
	Off	On	On	Off	Enhanced RGB 300 line
PJ2	1-2				Reserved
	3-4				1.6 Mb floppy (Out) 2 Mb (In)
	5-6				1 floppy (Out) 2 floppies (In)
	7-8				Double density floppy (Out) HD (In)
	9-10				640K (Out) 512K (In)
	11-12				3Mb memory card exp/ext (Out) Expanded (In)
PJ3					Reserved
PJ4	1-2 In				MFM Method
	3-4 Out				
PJ5	1-2				10 ns HD delay
	3-4				15 ns
	5-6				20 ns
	7-8				25 ns
	9-10				30 ns

T5100

Jumper	Position	Function
PJ1	1-2	Brightness connected to PDP board
	2-3	Not connected
PJ2	1-2	Contrast connected to PDP board
	2-3	Not connected
PJ3	1-2	3 level grey scale
	2-3	4 level
PJ4	1-2	16H (horizontal) mode
	2-3	1H (horizontal) mode
PJ5		Power supply
PJ6		FDD
PJ7		AGS interface
PJ8		AGS interface
PJ9		HD
PJ13		External keyboard
PJ14		HD power
PJ15		Fan
PJ16		Speaker
PJ17		LED board connector

Switch	Position	Function
S1	On	Disable extended memory (above 1 Mb)
	Off	Enable
S2	On	512K base memory
	Off	640K base memory
S3	On	Disable internal CRT on AGS board
	Off	Enable
S4	On	Printer port to input
	Off	Output
S5	On	AGS board supports mono
	Off	Colour
S6	On	Internal RS232 secondary, external to primary
	Off	Internal RS232 primary, external to secondary

T8500

As for T2100, except:

Switch	Position	Function
PJ1		Expansion memory
PJ2		Lithium battery
PJ3		T3100 bus
PJ4		Motherboard
PJ5		FD
PJ8		Keyboard
PJ9		HD
PJ10		Internal SCSI
PJ15		Connector board I/F connector 1
PJ16		Connector board I/F connector 2
NMI		Non Maskable Interrupt

Totem

www.totem.com.tw

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C-00	TM 586IV v1.3	AC	TM 586-IP2
9	TM 486SPS	BC-00	TM 586IV2A
9C	TM 586-IP2/486SPS	DC-00	TM 586IV2 v3

Vision 1

As for DC 286

WS 286

As for DC 286

WS 386

As for DC 286, except no J6.

Transcend

www.transcend.nl

TS-AVD1

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium III	Slot 1
Speeds (MHz)		133 FSB
Chipset	Via Apollo Pro Plus	
BIOS	Award	
Bus	5 PCI/2 ISA	
Memory (Mb)	768	3 DIMM sockets
Cache (K)		
I/O	2S, 1P, floppy, 2 EIDE, IRDA	UDMA
Video		AGP 2x (4x some boards)

TS-AWE1

Item	Description	Notes
Form Factor	ATX	

Item	Description	Notes
CPU	Pentium III	Slot 1
Speeds (MHz)		100 FSB
Chipset	Intel 810E	
BIOS	Award	
Bus	5 PCI/1 AMR	
Memory (Mb)	768	3 DIMM sockets
Cache (K)		
I/O	2S, 1P, floppy, 2 EIDE, IRDA, joystick, audio	UDMA
Video		

Trigem

(800) 766 4377

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0	486SQR		

Tulip

AT 386/25

Jumper	*Position*	*Function*
J7	1-2	27256 EPROM
	2-3	27128 EPROM
J9	1-3	Reserved
	2-4	
J16	1-2	Colour display
	2-3	Mono
	Out	Selects mono mode
J19		Reserved
J20	In	Enable floppy
	Out	Disable

AT 386sx

Jumper	*Position*	*Function*
J5	1-2	Colour display CGA or TEVA-2)
	2-3	Mono
J9	1-2	27256 EPROM
	2-3	27128 EPROM
J17	1-2	Enable floppy
	2-3	Disable

Installation of VGA card does not require J5 to be set

AT Compact 1

Processor board

Jumper	*Position*				*Function*	
J287	**J287**	**JXD**	**JAP10**	**J8/10**	**CPU**	**Copro**
JXD	1-2	Out	1-2	1-2	8 MHz	5.33 MHz
JAP10	2-3	Out	2-3	1-2	8 MHz	8 MHz
J8/10	1-2	1-2	1-2	2-3	10 MHz	6.66 MHz
	2-3	1-2	2-3	2-3	10 MHz	10 MHz
S1,2	**S1**	**S2**			**Total RAM**	
	2-3	2-3			128K	
	2-3	1-2			256K	
	1-2	2-3			640K	
	1-2	1-2			1 Mb (not used)	
S3	All out				Mono display	
	1-2				Mono display	
	2-3				Colour	
S4	1-2				128K EPROM	
	2-3				256K EPROM	
JLM	1-2 Out				New revision memory expansion card (2.64 MB)	
	1-2 In				Old revision (640K)	
EM	In				Early memory timing mode	
	Out				Non-early	
JRL	1-2				Short RAS 160	
	2-3				Reserved	

AT Compact 2

Jumper	*Position*	*Function*
J?	1-2	Low fan speed
	2-3	High
J18	1-2	Mouse IRQ3
	3-4	Mouse IRQ4
	5-6	Mouse IRQ5
	7-8	COM2 IRQ 3
	9-10	COM1 IRQ4
	11-12	LPT2 IRQ5
	13-14	LPT1 IRQ7
	15-16	Enable COM2
	17-18	Enable COM1
	19-20	Disable serial port
	21-22	Enable LPT2
	23-24	Enable LPT1
	25-26	Disable parallel port

Compact 3

Jumper	*Position*	*Function*
J11	1-2	2 x 32K ROM (27256)
	2-3	2 x 16K ROM (27128)

Jumper	Position	Function
J15	1-2	Mono display
	2-3	Colour (CGA or TEVA-2)

DC 286

Jumper	Position	Function
J5	Out	Normal batteries
	In	Rechargeables
J6		LED, speaker & battery
J15	1-2	LPT1 unidirectional
	2-3	LPT1 bidirectional

DT 286

As for DC 286

DT 386

As for DC 286, except J17 is network access header

PC Compact 2

L2.1

Jumper	Position	Function
J8	All out	Mono
	3-4	40 col colour
	1-2	80 col colour
	All in	EGA
J10	1-2	Serial port IRQ4
	3-4	IRQ3
J12	1-2	IRQ2 for RTC
	3-4	IRQ3
	5-6	IRQ4
	All out	None
J13	1-2	IRQ2 for mouse port
	3-4	IRQ3
	5-6	IRQ4
	All out	None
J14	3-4	Enable LPT1
	5-6	Enable LPT2
	7-8	Enable COM1
	9-10	Enable COM2

L2.2-L2.5

As for 2.1, except:

Switch	Position			Function
SI,SE	**SI 1-2**	**SI 3-4**	**SE 1-2**	

Switch	*Position*			*Function*
	In	In	Out	Piggy back board installed
	Out	Out	In	FGL chip installed

L3

As for L2.2-2.5

L5 & L6

As for 2.1, except:

Jumper	*Position*	*Function*
J22	2-3	27128 EPROM
	1-2	27256 EPROM

L7

As for L5 & L6, except:

Jumper	*Position*	*Function*
JMEG	1-2	4C512 DRAMs
	2-3	4C1024 DRAMs (JLOHI must be set either position)
JLOHI	1-2	Low type 4C512 DRAMs
	2-3	High type

SX Compact 2

Jumper	Position	Function
J14	1-2	27256 EPROM
	2-3	27128 EPROM
J17	1-2	Mono display
	2-3	Colour display
	All out	Selects mono mode
J18	1-2	Mouse IRQ3
	3-4	Mouse IRQ4
	5-6	Mouse IRQ5
	7-8	COM2 IRQ 3
	9-10	COM1 IRQ4
	11-12	LPT2 IRQ5
	13-14	LPT1 IRQ7
	15-16	Enable COM2
	17-18	Enable COM1
	19-20	Disable serial port
	21-22	Enable LPT2
	23-24	Enable LPT1
	25-26	Disable parallel port
	27-28	Disable onboard HD
	29-30	Enable onboard HD
	31-32	Disable floppy
	33-34	Enable floppy

TR 386/25

As for AT 386/25

TR 386sx

As for AT 386sx

Twinhead

(408) 945 0808

Tyan

(408) 956-8000
www.tyan.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1C-00	Tempest II S1462	JC	Titan Pro 1668ATX
9C	Tomcat	JC	Titan III S11468/1466
9C-00	Trinity (S1592)	JC	S1563D (Tomcat III Dual)
AC-00	S1570/1590	JC-00	S1470 Titan VXAT
GC	S1562S	KC	S1468 (OEM Newtec, Korea)

S1590 Trinity AT

Item	Description	Notes
Form Factor	AT	
CPU	Pentium	Super Socket 7
Speeds (MHz)		
Chipset	VIA Apollo MVP3	
BIOS		
Bus	4 PCI/4 ISA	
Memory (Mb)		3 DIMM sockets, 2 SIMMs
Cache (K)	1 Mb	
I/O	2S, 1P, floppy, 2 EIDE, IRDA	UDMA
Video		AGP
Audio		
Performance		Excellent

S1598 Trinity

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium/K6	Super Socket 7
Cache	2 Mb	
Chipset	Via MVP3	
BIOS		
Bus	5 PCI/2 ISA	UDMA/33
Memory (Mb)	768 Mb	3 DIMM sockets
I/O	2 EIDE, floppy USB, IR	
Video		AGP 2x
Performance		
Comments		

S1810 Tomcat

Item	Description	Notes
Form Factor	Micro-ATX	
CPU	Celeron	Socket 370
Speeds (MHz)		
Chipset	Intel 810	
BIOS		
Bus	4 PCI	UDMA/66
Memory (Mb)	512 Mb	2 DIMM sockets
I/O	2 EIDE, floppy	

S1837

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	SMP Slot 1
Cache		
Chipset	Intel 440BX	
BIOS		
Bus	6 PCI/1 ISA	UDMA/33
Memory (Mb)	1 Gb	4 DIMM sockets
I/O	2 EIDE, floppy USB, IR, Intel 82559 LAN	Adaptec AIC-7896
Video		AGP 2x
Audio	ESS ES1373	
Comments		

S1846

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	
Speeds (MHz)	550	
Chipset	440 BX	

Item	Description	Notes
BIOS	AMI WinBIOS	
Bus	5 PCI/2 ISA	
Memory (Mb)	768	3 DIMM sockets.
Cache (K)		
I/O	2S, 1P, floppy, 2 EIDE, IRDA	UDMA
Video		AGP
Audio		
Performance		Average

S1854

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1 & Socket 370
Speeds (MHz)	550	
Chipset	Vis Apollo Pro 133A	
BIOS		
Bus	6 PCI/1 ISA	
Memory (Mb)	768	3 DIMM sockets.
Cache (K)		
I/O	2S, 1P, floppy, 2 EIDE, IRDA	UDMA
Video		AGP 4x supported
Audio		
Performance		Average

S1952DLU Thunder X

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II/Xeon	SMP Slot 2
Cache		
Chipset	Intel 440GX	
BIOS		
Bus	6 PCI/1 ISA	UDMA/33
Memory (Mb)	2 Gb	4 DIMM sockets
I/O	2 EIDE, floppy USB, IR	Adaptec AIC-7896N LVD
Video		AGP 2x
Performance		
Comments		

Tiger ATX

S1692S

Item	Description	Notes
Form Factor	ATX	
CPU	Pentium II	Slot 1
Speeds (MHz)	233-333	
Bus	5 PCI/2 ISA	

Item	Description	Notes
Memory (Mb)	512 SDRAM 1 Gb EDO	4 DIMM sockets. 3.3v.
Video		AGP

Thunder 2 ATX

S1696DLUA

Item	Description	Notes
Form Factor	ATX	
CPU	2 Pentium II	Slot 1
Speeds (MHz)	333	
BIOS		
Bus	4 PCI/2 ISA	1 each shared, 1 with RAID port extension
Memory (Mb)	512 SDRAM 1 Gb EDO	4 DIMM sockets
Video		AGP
Audio	Yamaha OPL4-ML	1 Mb wavetable ROM
Performance		Average. 66 MHz bus speed.

Tomcat I

Item	Description	Notes
Form Factor		
CPU	Pentium	
Speeds (MHz)	200	
Chipset	430HX	
BIOS	Award or AMI	
Bus	4 PCI/5 ISA	1 each shared
Memory (Mb)	512	Parity or ECC FPM or EDO in 8 slots.
Cache (K)	512	Pipelined burst
I/O	2S, 1P, Floppy, IDE, USB	

Tempest II

Item	Description	Notes
Form Factor		
CPU	2 Pentium	
Speeds (MHz)	166	
Chipset	Neptune	
BIOS		
Bus	4 PCI/5 EISA	
Memory (Mb)	512	FPM only in 8 slots.
Cache (K)	512	256 standard. Asynchronous.
I/O	No idea	

Titan III

Item	Description	Notes
Form Factor		
CPU	Pentium/Cyrix 6x86	
Speeds (MHz)	166	
Chipset	430FX	
BIOS	Award or AMI	
Bus	4 PCI/4 ISA	None shared
Memory (Mb)	128	3.3 or 5v FPM/EDO in 4 sockets
Cache (K)	512	Pipelined Burst. 256 standard.
I/O	IDE only	

Titan Pro

Item	Description	Notes
CPU	2 Pentium Pro	
Speeds (MHz)	200	
Chipset	440FX (Natoma)	
Bus	5 PCI/3 ISA	1 each shared
Memory (Mb)	1 Gb	Parity or ECC, EDO/BEDO/FPM
I/O	2S, 1P, Floppy, IDE, USB	

U

UHC

Umax

UMC

United Microelectronics

UMC88

Unicom

Unisys

PCI 3xx3

Jumper	*Position*		*Function*
J5	In		Pipeline mode enabled
J8	In		Colour display
	Out		Mono
J15	1-2	Out	SCSI IRQ9
	3-4	Out	SCSI IRQ10
	5-6	In	SCSI IRQ11
	7-8	Out	Primary host adapter address
	9-10	In	DMA DRQ0
	11-12	Out	DMA DRQ5
	13-14	Out	DMA DRQ6
	15-16	Out	DMA DRQ7
	17-18	In	DMA DACK0
	19-20	Out	DMA DACK5
	21-22	Out	DMA DACK6
	23-24	Out	DMA DACK7
	25-26	In	SCSI enabled
		Out	SCSI disabled
J17	In		Parallel port is LPT1
J18	Out		Parallel port is LPT2
J21	In		VGA controller enabled
	Out		Disabled
JP2	In		Intel coprocessor
	Out		Others

MPI 4xx3

Jumper	Position		Function
JP2	1-3,2-4,5-7,6-8 In		3.5" diskette connector goes to A
	1-2,3-4,5-6,7-8 Out		Alternate drive (5.25) connector goes to A
JP4,5	JP4	JP5	
	Out	Out	Enable HD controller
	In	In	Disable
JP6	In		Colour display
	Out		Mono
JP7	Out		Disable CPU option
	In		Enable
JP8	1-2 In		Enable LPT1
	2-3 Out		Enable LPT2
JP9	1-2 Out		SCSI IRQ15
	3-4 In		SCSI IRQ11
	5-6 Out		SCSI IRQ10
	7-8 Out		SCSI IRQ9
	9-10 Out		SCSI primary address (0340 or 0140)
	11-12	13-14	
	In	Out	Enable SCSI
	Out	In	Disable
JP10	1-2 Out		SCSI DMA DRQ7
	3-4 Out		SCSI DMA DRQ6
	5-6 Out		SCSI DMA DRQ5
	7-8 In		SCSI DMA DRQ0

Jumper	Position		Function
	9-10 Out		SCSI DMA DACK7
	11-12 Out		SCSI DMA DACK6
	13-14 Out		SCSI DMA DACK5
	15-16 In		SCSI DMA DACK0

MPI 4xx6

Jumper	*Position*		*Function*
JP1	Out		Normal 486DX operation
JP2	In		Colour display
	Out		Mono
JP3,4	**JP3**	**JP4**	
	Out	Out	Enable HD controller
	In	In	Use IDE HD
JP6	1-2 Out		SCSI IRQ15
	3-4 In		SCSI IRQ11
	5-6 Out		SCSI IRQ10
	7-8 Out		SCSI IRQ9
	9-10 Out		SCSI primary address (0340 or 0140)
	11-12	13-14	
	In	Out	Enable SCSI
	Out	In	Disable
	15-16 In		Enable onboard VGA controller
JP7	1-2 Out		SCSI DMA DRQ7
	3-4 Out		SCSI DMA DRQ6
	5-6 Out		SCSI DMA DRQ5
	7-8 In		SCSI DMA DRQ0
	9-10 Out		SCSI DMA DACK7
	11-12 Out		SCSI DMA DACK6
	13-14 Out		SCSI DMA DACK5
	15-16 In		SCSI DMA DACK0
JP8	1-2,3-4,5-6,7-8 In		3.5" diskette connector goes to A
	1-3,2-4,5-7,6-8 Out		Alternate drive (5.25) connector goes to A
JP10	1-2 In		Serial B is COM2/4
	2-3 Out		Serial B is COM1/3
JP11	1-2 In		Serial A is COM1/3
	2-3 Out		Serial A is COM2/4
JP12	1-2 In		Parallel port LPT1
	2-3 Out		Parallel port LPT2
JP15	1-2 In	2-3 Out	CPU speed select
JP16	1-2 Out	2-3 In	Enhancement socket select

Unitron

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	U7908		

Unknown

F4DXL-UC4.3D/DV (486)

Item	Description	Notes
Form Factor	AT	
CPU	486	
Speeds (MHz)		
Chipset	UMC	
BIOS		
Bus	7 ISA	3 VESA
Memory (Mb)	192 Mb	
Cache (K)	256	
Comments		

Jumper	*Position*						*Function*
JP4-6	**JP4**	**JP5**	**JP6**				**CPU Clock**
	Off	Off	On				25 MHz
	On	On	On				33 MHz
	Off	On	On				40 MHz
	On	Off	Off				50 MHz
JP11-13	**JP11**	**JP12**	**JP13**	**JP17**	**JP18**	**JP19**	**CPU Type**
JP17-19	Out	2-3	1-2,3-4	1-2	Out	Out	486DX/DX2
	Out	2-3	1-2,3-4	1-2	Out	Out	AMD 486DX/DX2 (5v)
	1-2,3-4	1-2,3-4 5-6	2-3	Out	2-3,4-5	2-3,4-5	Cyrix 486DX
	1-2,3-4 5-6	1-2,3-4 5-6	1-2,3-4	1-2	2-3,4-5	2-3	Cyrix 486DX2
	1-2,4-5	1-2,4-5	1-2,3-4	1-2	3-4,5-6	1-2,3-4	P24D
	1-2	1-2	1-2,3-4	2-3	5-6	1-2,3-4	P24T
	1-2	1-2	1-2,3-4	1-2	1-2	5-6	DX4/100
	2-3	2-3	1-2,3-4	1-2,3-4	1-2	Out	AMD 486DX4/100
	2-3	2-3	1-2,3-4	1-2,3-4	1-2	Out	AMD 486 DX2-80*
	Out	2-3	2-3	Out	Out	Out	486SX
	2-3	2-3	2-3	3-4	1-2	Out	UMC 486SX
							Insert wire between pin 4 of JP12 and pin 3 of JP20
JP14-16	**JP14**	**JP15**	**JP16**	**JP23**			**CPU voltage** (non-dip sw)
JP23	1-2	1-2	1-2	In			3.3v*
	1-2	1-2	1-2	Out			3.6v
	2-3	2-3	2-3	Out			5v
							Use VR LT1086 on U24
JP14-16	**JP14-16**	**SW1**	**SW2**	**SW3**			**CPU voltage** (dip sw)

Jumper	*Position*				*Function*
SW1-3	2-3	-	-	-	5v
	1-2	Off	Off	Off	4v
	1-2	Off	Off	On	3.6v
	1-2	Off	On	Off	3.45v
	1-2	On	Off	Off	3.3v
JP21	In				VESA >33 MHz
	Out				VESA <=33 MHz
JP22	In				VESA 1 WS
	Out				VESA 0 WS

M 601 (486)

Item	Description	Notes
Form Factor	AT	
CPU	486	
Speeds (MHz)		
Chipset		
BIOS		
Bus	7 ISA	3 VESA
Memory (Mb)	64 Mb	
Cache (K)	256	
Comments		

Jumper	*Position*					*Function*
JP2-6	**JP2**	**JP3**	**JP4**	**JP5**	**JP6**	**Cache size**
	Out	In	Out	1-2	Out	64K
	Out	In	In	2-3	2-3	128K
	In	In	In	1-2	1-2	256K
JP7,8	**JP7**	**JP8**				**TK 9207 Clock Generator**
	1-2	1-2				33 MHz
	2-3	1-2				40 MHz
	JP7	**JP8**				**KTS0808c/0801c/AV9107**
	1-2	1-2				40 MHz
	2-3	1-2				50 MHz
	JP7	**JP8**				**TK 9307**
	1-2	1-2				25 MHz
	2-3	1-2				33 MHz
	1-2	2-3				40 MHz
	2-3	2-3				50 MHz
	JP7	**JP8**	**JP24**			**PLL52C05/KTS KDN 802**
	2-3	1-2	1-2			25 MHz
	2-3	2-3	1-2			33 MHz
	1-2	1-2	2-3			40 MHz
	2-3	1-2	2-3			50 MHz
						v1.3E/F
JP16,17	**JP16**	**JP17**				**CPU Type**
	1-2,3-4	1-2				486DX
	2-3	Open				SX (Cyrix 486)
	1-2,3-4	2-3				P23N

3486

Item	Description	Notes
Form Factor	AT	
CPU	386/486	
Speeds (MHz)		
Chipset	UMC	
BIOS	AMI	
Bus	6 ISA	1 weird local bus slot
Memory (Mb)	32 Mb	
Cache	256K	

Jumper	*Position*					*Function*
JC1-4	1-2					80486
	2-3					80386 or Cyrix 486DLC
JC5,6	**JC5**	**JC6**				**CPU Select** (486 above)
	1-2,3-4	1-2				DX/DX2
	2-3	Out				SX
	1-2,3-4	2-3				487SX/Overdrive
JF1-5	**JF1**	**JF2**	**JF3**	**JF4**	**JF5**	**CPU Speed**
	Out	In	In	In	Out	25 MHz 386
	Out	Out	In	In	In	33 MHz 386
	Out	In	Out	In	In	40 MHz 386
	In	In	Out	Out	In	20 MHz 486
	Out	In	In	Out	In	25 MHz 486
	Out	Out	In	Out	In	33 MHz 486
	Out	Out	Out	Out	Out	50 MHz 486
J1-3	1-2					Local bus card in slot 5
	2-3					Normal card
J4	1-2					Normal
	2-3					486DX-50 with local bus device
J5	1-2					Normal
	2-3					386/486 DX-50 with local bus device

K5TI

Item	Description	Notes
Form Factor	AT	
CPU	Pentium	
Speeds (MHz)		
Chipset		
BIOS		
Bus	6 ISA	
Memory (Mb)		
Cache	256K	

Jumper	*Position*	*Function*
JP1,JP2	1-2	COM2
	2-3	Infrared – 87334=HP, 87336=HP or Sharp

Jumper	*Position*			*Function*
JP3	1-2,3-4			ECP DMA 0
	5-6,7-8			ECP DMA 1
	9-10,11-12			ECP DMA 2
JP4	Out			50 MHz bus speed
	3-4			60 MHz
	1-2,3-4			66 MHz
JP5,8	**JP5**	**JP8**		**BIOS Type**
	1-2	Out		EPROM
	2-3	2-3		12v Flash
	2-3	1-2		5v Flash
JP6,7	1-2			IDE0/1 IRQ 14/15
	2-3			IDE 0/1 MIRQ0/MIRQ1
JP9	1-2			AT bus PCICLK/3
	2-3			AT bus PCICLK/4
JP10	In			Clear CMOS
	Out			Normal
JP11-12	**JP11**	**JP12**	**JP14**	**Cache size**
14	1-2	1-2	Out	None
	2-3	1-2	Out	256K
	1-2	2-3	Out	512K
JP13	1-2			5v CPU voltage
	2-3			3.3v
JP15	In			CPU non-pipeline
	Out			Pipeline mode
JP16	In			L1 cache w/t
	Out			L1 cache w/b
JP17,18	**JP17**	**JP18**		**CPU clock multiplier**
	In	In		2.5x
	Out	In		3x
	In	Out		2x
	Out	Out		1.5
JP19	1-3			3.45 VRE voltage
	2-4			3.3 VRE/MD voltage
JP20-22	In			Enable onboard voltage regulator
	Out			Disable
JP23	1-3,2-4			5v SRAM
	3-5,4-6			3.3v SRAM
JP28	In			Normal speed
	Out			Turbo

SiS 486 PI

Item	Description	Notes
Form Factor	AT	
CPU	486	
Chipset		
BIOS		
Bus	3 PCI/3 ISA	
Memory (Mb)		4 72-pin
Cache	256K	

Jumper	*Position*								*Function*
JP1	1-2								32Kx8/8Kx8 Tag RAM
	2-3								16Kx8
JP2	1-2								128K cache
	2-3								256K cache
JP4	1-2								Normal
	2-3								Clear CMOS
JP5-12	**JP5**	**JP6**	**JP7**	**JP8**	**JP9**	**JP10**	**JP11**	**JP12**	**CPU Type (Yellow)**
	Off	1-2	1-2,6-7	4-5,6-7	On	2-3	1-2,3-4	4-5	Intel P24D/AMD SV8B
	3-4	1-2	1-2,6-7	4-5,6-7	On	2-3	1-2,3-4	4-5	AMD 5x86-P75
	Off	1-2	1-2,6-7	4-5,6-7	On	2-3	1-2,3-4	4-5	Cyrix/ST/IBM 5x86
	Off	Off	2-3	4-5,6-7	On	2-3	3-4	4-5	486 SLE DX/DX2/DX4
	Off	Off	5-6*	Off	Off	2-3	Off	4-5	AMD DX/DX2/DX4 (NV8T)
	2-3	2-3	7-8	2-3,5-6	On	2-3	2-3	4-5	TI/Cyrix DX2/DX4
	1-2	1-2	3-4	1-2,6-7	On	1-2	3-4	1-2	P24T (Pentium ODP)
	Off	Off	2-3	4-5,6-7	On	2-3	1-2,3-4	4-5	IBM/ST DX4-100
	*3v AMD DX2– 6-7 for AMD DX4								
JP13,W1	JP13	W1							CPU Voltage
	1-2	Out							3v
	2-3	Out							4v
	Out	In							5v
JP18	Out								25 MHz
	1-2								33 MHz
	3-4								40 MHz

VXPro Pentium

Possibly PC Chips

Item	Description	Notes
Form Factor	AT	
CPU	Pentium	
Chipset	VxPro	
BIOS		
Bus	4 PCI/3 ISA	
Memory (Mb)		2 DIMM, 4 72-pin
Cache	256K	

Jumper	*Position*			*Function*
JP1	1-2			Normal
	2-3			Clear CMOS
JP2	1-2			5v EDO/FPM DIMM
	2-3			3.3v SDRAM DIMM
JP3	**A**	**B**	**C**	**CPU Speed**
	2-3	2-3	2-3	50 MHz
	1-2	2-3	2-3	55 MHz
	2-3	2-3	1-2	60 MHz
	2-3	1-2	2-3	66 MHz
	1-2	2-3	1-2	75 MHz
JP3 D	1-2			PCI CPU CLK/2
	2-3			33 MHz
JP4	1-2			12v Flash ROM
	2-3			5v Flash ROM

Jumper	Position				Function
JP5	A	B			Clock Multiplier
	1-2	2-3			1.5/3.5
	2-3	1-2			2x
	2-3	2-3			2.5x
	1-2	2-3			3x
JP6	**A**	**B**	**C**	**D**	**CPU Core Voltage**
	In	Out	Out	Out	3.5v
	Out	In	Out	Out	3.2v
	Out	Out	In	Out	2.9v
	Out	Out	Out	In	2.8v
	Out	Out	Out	Out	2.5v
JP9	1-2				P55C (Dual voltage CPU)
	2-3				P54C (Single Voltage CPU)

USI

US Logic

www.uslogic.com

Notes

V

Vanilla

VAN3S33A-2NW

386SX-33 Processor Board

Switch	*Position*	*Function*
JP1	On	Colour
	Off	Mono
JP2	On	Enable Bus Mouse IRQ5
JP3	On	Enable Bus Mouse IRQ4
JP4	On	Enable Bus Mouse IRQ3
JP5	On	Enable Bus Mouse IRQ9
JP6	1-2	Onboard battery
	2-3	Clear CMOS
JP7	2-3	Select EPROM
JP8	1-2	Select bus mouse enabled
	2-3	Select bus mouse disabled

J1

Jumper	*Function*
1-4	Speaker
11-15	Power LED/Keyboard
7 & 17	Turbo switch
8 & 18	Turbo LED

Jumper	Function
9 & 19	Reset
10 & 20	HD LED

Colourtron

Jumper	Position	Function
1	On	IRQ9 enable
2	On	0 wait state
	Off	1 wait state
3	On	Enable card

Vextrec

www.vextrec.com

Victor

V286D

Switch	Position	Function
E1-2	In	Slim Add-PAK Receiver PCB is Master
	Out	Slave
E3-4	In	PDiag
E5-6	In	Pulldown resistor
E7-8	Out	RTC/RAM Normal operation
	In	Clear
E9-10	In	2 32K x 8 BIOS EPROMs
E14-15	In	Enable onboard video
E15-16	In	Disable onboard video
E17-18	Out	Standard/no video interrupt
	In	Video IRQ9
E19-20	In	VGA BIOS AT Mode
E20-21	In	VGA BIOS PS/2 Mode
E22-23	In	VGA analogue or multisync monitor
E23-24	In	Non-standard multi-frequency monitor
E31-32	In	Disable HD LED
E32-33	In	Enable HD LED

V286M

Backplane board

Switch	Position	Function
A	In	External Hercules/CGA
	Out	Onboard VGA
B	Out	Reserved
C		Reserved

Switch	*Position*	*Function*
JB1	1-4 Out	Reserved
	2-3 Out	Reserved
JB2	1-8 In	Enable COM1
	2-7 In	Enable COM2
	3-6 In	IRQ4 for COM1
	4-5 In	IRQ5 for COM2
J5	1-2 In	Parallel port is primary port
	2-3 In	Parallel port is secondary port
J6	1-2 In	Primary parallel port interrupt selected
	2-3 In	Secondary parallel port interrupt selected

V386DSX

Switch	*Position*	*Function*
S1	On	Enable parallel port
S2	On	Parallel port is LPT1
	Off	Parallel port is LPT2
S3	On	Enable serial port
S4	On	Serial port is COM1/3 (affects I/O port)
	Off	Serial port is COM2/4 (affects I/O port)
S5	On	Disable ext parallel port (bidirectional mode)
S6	On	Primary FD address 3F0-3F7
	Off	Secondary FD address 370-377
S7	On	Enable IDE type drive port
	Off	Disable
S8	On	Primary IDE port address 1F0-1F7 for CS0, 3F6-3F7 for CS1
	Off	Secondary IDE port address 170-177 for CS0, 376-377 for CS1
E1-E2		256K (32K x 8) BIOS
E5-E6		Reserved
E7-8		Colour video
E8-9		Mono
E10-11		Indicator on with power, half bright during IDE activity
E11-12		Indicator on with power only
E13-14		LPT IRQ5
E14-15		LPT IRQ7
E16-17		COM1 IRQ4
E17-18		COM2 IRQ3
E19-20		Enable onboard video
E20-21		Disable
E22-23		Disable video IRQ 9
E23-24		Enable
E25-26		Non-standard multi-frequency monitor installed
E26-27		VGA or standard
E28-29		Serial port is COM3 or COM4
E29-30		Serial port is COM1 or COM2

V386M/33

CPU Card

Switch	Position	Function
JB1	1-6 In	Reserved
	2-5 Out	Out-Disables looped manufacturing data
	3-4 In	Colour display Out=mono
J14	1-2	IDE responds to primary HD address
	2-3	IDE responds to secondary HD address

Backplane

Switch	Position	Function
JB1	1-4 Out	Reserved
	2-3 Out	Reserved
JB2	1-8	Enable COM1
	2-7	Enable COM2
	3-6	COM1 IRQ4
	4-5	COM2 IRQ5
J5	1-2	Parallel port is LPT1
	2-3	Parallel port is LPT2
J6	1-2	Primary LPT IRQ
	2-3	Secondary LPT IRQ

V386MW/33

CPU Card

Switch	Position	Function
JP1	1-2	Primary IDE address
	2-3	Secondary IDE address
	Out	No IDE
JP2		Reserved (all out)

Backplane

Switch	Position	Function
JB1	1-8	Enable COM1
	2-7	Enable COM2
	3-6	COM1 IRQ4
	4-5	COM2 IRQ3
J13,14	1-2	Enable LPT1
	2-3	Enable LPT2

V386MWX/20

CPU Card

Switch	Position		Function
JB2	1-6 In		Reserved
	3-4 In		Reserved
JB3	1-10		Out=1024x768 NI In=1024x768 Interlaced
	2-9	3-8	800x600 setting
	Out	Out	16 colour @ 72 Hz, 256 @ 60 Hz
	Out	In	16/256 @ 60 Hz
	In	Out	16 @ 72 Hz, 256 @ 56 Hz
	In	In	16/256 @ 56 Hz
	4-7		Out=AT VGA mode In=PS/2 VGA
	5-6		Out=Other monitor timing In=Multisync 1 timing
J4	1-2		Onboard speaker
	Out		Speaker connector
J12	In		Onboard video
	Out		Other VGA
J13	All Out		For piggyback VGA board

Backplane

Switch	Position	Function
JB1	1-8	Enable COM1
	2-7	Enable COM2
	3-6	COM1 IRQ4
	4-5	COM2 IRQ3
J13,14	1-2	Enable LPT1
	2-3	Enable LPT2

V386MX

CPU Card

Switch	Position	Function
A	In	External Hercules/CGA
	Out	Onboard VGA
B	Out	Reserved
C		Reserved

Backplane

Switch	Position	Function
JB1	1-4 Out	Reserved
	2-3 Out	Reserved
JB2	1-8 In	Enable COM1
	2-7 In	Enable COM2
	3-6 In	COM1 IRQ4
	4-5 In	COM2 IRQ3

Switch	Position	Function
J5	1-2 In	Parallel port primary address
	2-3 In	Parallel port secondary address
J6	1-2 In	Primary LPT IRQ
	2-3 In	Secondary LPT IRQ

V486M/33

CPU Card

Switch	Position	Function
JB1	1-6	Reserved
	3-4	Reserved
J8	1-2	Onboard speaker
	Out	Speaker connector
J9		Reset
J18	1-2	486SX
	2-3	486DX/487SX
J19	Out	486SX
	In	486DX/487SX
J20	1-2	486DX
	2-3	487SX
	Out	486SX
J21	In	Onboard video
	Out	External video

Backplane

Switch	Position	Function
J7		ADD-PAK lock I/O address
J8	1-2	LPT1 IRQ7
	2-3	LPT2 IRQ5
J9	1-2	LPT1 chip select
	2-3	LPT2 chip select
J10		Parallel port mode
J11	1-2	HD primary port I/O select
	2-3	HD secondary port I/O select
JB1	1-4	Floppy precompensation value
	2-3	Floppy drive type
JB2	1-8	COM1 selected
	2-7	COM2 selected
	3-6	Enable IRQ4
	4-5	Enable IRQ3

V486M/50

CPU Card

Switch	Position	Function
JB1	1-6	Reserved

Switch	*Position*	*Function*
	3-4	Reserved
J4		Keyboard lock
J8	1-2	Onboard speaker
	Out	Speaker connector
J18	1-2	486SX
	2-3	486DX/487SX
J19	Out	486SX
	In	486DX/487SX
J20	1-2	486DX
	2-3	487SX
	Out	486SX
J21	In	Onboard video
	Out	External video

Backplane

Switch	*Position*	*Function*
J7		ADD-PAK lock I/O address
J8	1-2	LPT1 IRQ7
	2-3	LPT2 IRQ5
J9	1-2	LPT1 chip select
	2-3	LPT2 chip select
J10		Parallel port mode
J11	1-2	HD primary port I/O select
	2-3	HD secondary port I/O select
JB1	1-4	Floppy precompensation value
	2-3	Floppy drive type
JB2	1-8	COM1 selected
	2-7	COM2 selected
	3-6	Enable IRQ4
	4-5	Enable IRQ3

V86M

CPU Card

Switch	*Position*		*Function*
JB1	**1-16**	**2-15**	**Floppy A**
	In	In	360 K
	In	Out	1.2 Mb
	Out	In	720 K
	Out	Out	1.44 Mb
	3-14	**4-13**	**Floppy B**
	In	In	360 K
	In	Out	1.2 Mb
	Out	In	720 K
	Out	Out	1.44 Mb
	5-12 In		1 floppy
	5-12 Out		2 floppies
	6-11	**7-10**	**HD select**
	In	In	No IDE

Switch	Position		Function
	Out	In	1st IDE
	Out	Out	2nd IDE
	8-9		Reserved

Backplane

Switch	Position	Function
JB1	1-4 Out	Reserved
	2-3 Out	Reserved
JB2	1-8 In	Enable COM1
	2-7 In	Enable COM2
	3-6 In	COM1 IRQ4
	4-5 In	COM2 IRQ3
J5	1-2	Parallel port is primary
	2-3	Parallel port is secondary
J6	1-2	Primary parallel port IRQ
	2-3	Secondary parallel port IRQ

V486MWX/20

CPU Card

Switch	Position	Function
JB1	1-6	Reserved
	3-4	Reserved
J4		Keyboard lock
J8		Speaker connector
J9		Reset
J18	1-2	486SX
	2-3	486DX/487SX
J19	Out	486SX
	In	486DX/487SX
J20	1-2	486DX
	2-3	487SX
	Out	486SX
J21	In	Onboard video
	Out	External video

Backplane

Switch	Position	Function
JB1	1-8	COM1 selected
	2-7	COM2 selected
	3-6	Enable IRQ4
	4-5	Enable IRQ3
J13,14	1-2	Enable LPT1
	2-3	Enable LPT2

V486MX/20

CPU Card

Switch	Position	Function
JB1	1-6 In	Reserved
	3-4 In	Reserved
	2-5 Out	Reserved
J4		Keyboard lock
J8	1-2	Onboard speaker
	Out	Speaker connector
J9		Reset
J18	1-2	486SX
	2-3	486DX/487SX
J19	Out	486SX
	In	486DX/487SX
J20	1-2	486DX
	2-3	487SX
	Out	486SX
J21	In	Onboard video
	Out	External video

Backplane

Switch	Position	Function
JB1	1-8	COM1 selected
	2-7	COM2 selected
	3-6	Enable IRQ4
	4-5	Enable IRQ3
J13,14	1-2	Enable LPT1
	2-3	Enable LPT2

V486MX/25

As for V486MWX/20

Vision Top

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	VT586-2/TX	CG-00	S7-MVP3
BC-00	S7-MVP3		

Vobis

VTech

(847) 215 9806
www.pcpartner.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1C	MP5-TRI	KC	MB500N
9C	MP5-TRI	LC	Platinum NSV/NST/NSP
9C-00	MB540N	HC	MP5-TRI
DC	HIS P6EX4-A3	KC	MB500N
DC-00	VIB804DSE	LC	MB500N
EC-00	MB520NH		

MB 520NH

Aristo AM 439VX

MB540N

Aristo AM 430TX/Yellow Dragon TX

VIB804DSE

Same as Digimate T5DX-VPX2E

VTI

See Vextrec

W

Walters International

325S

Switch	*Position*	*Function*
J1	In	Enable external battery
	Out	Disable
J2	1-2	Reserved
J3	In	Colour monitor
	Out	Mono
J4		8042 speed control pin
J5-8	In	Normal for 325S
	Out	Normal for 325SC
J9	1-2	32K cache
	2-3	64K cache
J10		Power LED/Keylock
J11		Turbo LED
J12	In	High speed
	Out	Low speed
J13		Speaker
J14		Reset

333S

As for 325S

333SC

As for 325S

MB1212C

Switch	*Position*	*Function*
J1	1-3	Power LED
	4-5	Keyboard LED
J2		Speaker
JP1		Turbo LED
JP2		Reset Switch
JP3		Turbo switch
JP4	1-2	Processor CLK
	2-3	External CLK
JP6	1-2	MGA monitor
	2-3	CGA/EGA/VGA
JP7	1-2	External power
	2-3	Internal power

200BE

Switch	*Position*	*Function*
JP3-8	1-3	Up to 4 Mb
	1-2	Up to 8 Mb
J5		High speed LED
J6		CPU display connector
J7	1-2	Normal
	2-3	Reset for chips register setup
J18		Power LED/Keylock
J19		Speaker
J24		External battery
J25	1-2	CPU CLK selectable by keyboard
	2-3	High speed
J30		Reset
JPG	1-2	Normal
	2-3	Reserved
SW1	1-2	Colour monitor
	2-3	Mono

120/160BE

As for 200BE

160A

Switch	*Position*	*Function*
J2	1-2	CPU CLK selectable by keyboard
	2-3	16 MHz
J3	1-2	High speed LED
J5	1-2	Colour monitor
	2-3	Mono
J6		Reset
J7	1-2	Normal
	2-3	Reset for chips register setup
J16		Power LED/Keylock
J17		Speaker
J18		External battery

120/160B

As for 160A

ELT 325P

Switch	*Position*		*Function*
SW1	1-2		Mono display
	2-3		Colour
JP3,4	**JP3**	**JP4**	**Memory**
	2-3	1-2	Bank 0,1 onboard, Bank 2,3 on card
	1-2	2-3	Bank 0,1 onboard or on card
J5			Turbo LED
J18			Power LED/Keylock
J19			Speaker
J24			External battery
J25	In		Turbo switch set low
	Out		Turbo switch set high
J30			Reset
J32	In		CPU pipeline
	Out		Non-pipeline

ELT 386sx/160D

Switch	*Position*		*Function*
JP2,3	**JP2**	**JP3**	**Memory**
	1-2	2-3	Card and SIP for base memory
	2-3	1-2	SIP for base memory
J5			LED
J18			Power LED/Keylock
J19			Speaker
J24			External battery
J25	1-2		Alt-Ctrl + for high speed

Switch	Position	Function
		Alt-Ctrl – for low speed
J30		Reset
J31		ESDI, Token Ring Compatible Jumper

Warpspeed

www.warpspeedinc.com

Western Digital

www.wdc.com

Faraday Bus PC

Switch	Position		Function
JU1	**1**	**2**	**Monitor Type**
	In	In	Disabled
	In	Out	80 x 25 graphics
	Out	In	40 x 25 graphics
	Out	Out	Mono
JU1-4	In		Enable COM1 RS422 transmitter
	Out		Enable software control COM1 RS422 transmitter
JU1	**5**	**6**	**EPROM**
	In	Out	27256
	Out	In	2764, 27128
JU2-1	In		Disable COM1
	Out		Enable
JU2-2	In		Disable COM2
	Out		Enable
JU 2-3	In		Enable LPT1
	Out		Disable
JU2-4,5	**4**	**5**	**EPROM**
	In	Out	27256
	Out	In	2764, 27128
JU2-6,7	**6**	**7**	**COM1**
	In	Out	RS422 RCV
	Out	In	RS232 RCV
JU2-8	In		RS422 terminator COM1
	Out		No Terminator
J2			RS232/422
J3			RS232
J4			Parallel port
J5			Reset
J6			Speaker
J7			6 pin keyboard connector
J8			9 pin keyboard connector
J9			NMI port

Faraday FE6400

SW1

Switch	*Position*			*Function*
1,7,8	**1**	**7**	**8**	**Floppy Drives**
	On	On	On	0
	Off	On	On	1
	Off	Off	On	2
	Off	On	Off	3
	Off	Off	Off	4
3,4	Off			Reserved
5,6	**5**	**6**		**Monitor Type**
	On	On		None
	Off	On		40x25
	On	Off		80x25
	Off	Off		Mono

SW2

Switch	*Position*					*Function*
1-4	**4**	**3**	**2**	**1**		**Memory Size**
	On	On	On	On		64K
	On	On	On	Off		96K
	On	On	Off	On		182K
	On	On	Off	Off		160K
	On	Off	On	On		192K
	On	Off	On	Off		224K
	On	Off	Off	On		256K
	On	Off	Off	Off		288K
	Off	On	On	On		320K
	Off	On	On	Off		352K
	Off	On	Off	On		384K
	Off	On	Off	Off		416K
	Off	Off	On	On		448K
	Off	Off	On	Off		480K
	Off	Off	Off	On		512K
	Off	Off	Off	Off		640K
J17	**9**	**10**	**11**	**12**		**Base Memory**
	In	Out	In	Out		65K
	Out	In	In	Out		128K
	Out	In	Out	In		256K
5-9	**5**	**6**	**7**	**8**	**9**	**Baud**
	Off	On	On	On	Off	75 (1-5,6 must be on)
	On	Off	On	On	Off	110
	Off	Off	On	On	Off	134.5
	On	On	Off	On	Off	150
	Off	On	Off	On	Off	300
	On	Off	Off	On	Off	600
	Off	Off	Off	On	Off	1200
	On	On	On	Off	Off	2400
	Off	On	On	Off	Off	4800
	On	Off	On	Off	Off	9600

Switch	*Position*					*Function*
	Off	Off	On	Off	Off	19200
J17-13	**J17-13**	**SW1-2**				**Coprocessor**
SW1-2	Out	Off				8087 installed
	In	On				Not installed
J2						Disable UART
J3	In					Disable EPROM
	Out					Enable
J5						NMI control
J14						Reset
J15						Speaker
J16,18						Keyboard connectors

J17

EPROM 0			EPROM 1			EPROM		
1	2	3	4	5	6	7	8	Type
In	Out	In	Out	In	Out	In	Out	2716
Out	In	In	Out	Out	In	In	Out	2732
Out	In	Out	In	Out	In	Out	In	2764/27128

Faraday FE641x

Switch	*Position*		*Function*
V1,2	**V-1**	**V-2**	**Monitor Type**
	In	In	Disabled
	Out	In	40 x 25 graphics
	In	Out	80 x 25 graphics
	Out	Out	Mono
JU1-1			Reserved
2	In		Enable LPT1
	Out		Disable
3	In		Enable COM1
	Out		Disable
4	In		Enable 256K base memory
	Out		64K
5	In		Enable EPROM
	Out		Disable
7,8	**7**	**8**	**EPROM Type**
	Out	In	2764
	Out	In	27128
	In	Out	27256
J10			Power Connector
J11			Reset
J12,13			Keyboard
J14			Speaker
J15			Floppy
J16			RS232
J17			LPT
J18			NMI
J21			Mono port

Faraday FE642x

Switch	*Position*		*Function*
J2	Out		64K RAM
	In		256K RAM
J3	Out		27256 EPROM
	In		27128, 2764
J4	Out		27128, 2764
	In		27256
J9			LPT
J10			Power
J11			Reset
J12,13			Keyboard
J15			Onboard floppy
J16,17			Serial ports
J18			Speaker
J19			NMI
SW1	**S1**	**S2**	**Monitor Type**
1,2	In	In	Disabled
	Out	In	40 x 25 graphics
	In	Out	80 x 25 graphics
	Out	Out	Mono

Faraday Micro PC/CMOS

Switch	*Position*		*Function*
JU1	**1**	**2**	**EPROM Type**
1,2	Out	Out	2764, 27128
	In	Out	27256
	In	In	27512
JU2	**1**	**2**	**Monitor Type**
1,2	In	In	Disabled
	In	Out	80 x 25 graphics
	Out	In	40 x 25 graphics
	Out	Out	Mono
J2,3			Keyboard
J4			Speaker
J5			Reset
J6			NMI

Faraday A-Tease

Switch	*Position*		*Function*
JF5	**3**	**4**	**EPROM Size**
3,4	Out	In	27128
	In	Out	27256
JF1-6	In		Disable COM1
	Out		Enable
JF1-7	In		Disable COM2
	Out		Enable
JF1-8	In		Enable LPT1
	Out		Disable

Switch	*Position*		*Function*
JF2-1	In		Enable COM1 RS422 Xmitter
	Out		Software control
JF2-2,3	**2**	**3**	
	In	Out	COM1 RS232 Receiver
	Out	In	COM1 RS422 Receiver
JF2-4	In		COM1 RS422 Terminator In
	Out		Out
JF2-5	In		Enable COM2 RS422 Receiver
	Out		Software control
JF2-6,7	**6**	**7**	
	In	Out	COM2 RS422 Receiver
	Out	In	COM1 RS232 Receiver
JF2-8	In		COM2 RS422 Terminator In
	Out		Out
JF3-4	In		Maintenance Mode
	Out		Normal
JF3,5-7			User defined – may be read by software
JF3-8	Out		AT keyboard
	In		PC keyboard
JF4-1	Out		Mono adapter
	In		CGA

JF1,JF5

JF1-2	JF1-3	JF1-4	JF1-5	JF5-1	JF5-2	Type
Out	In	Out	In	Out	In	2716
In	Out	Out	In	Out	In	2732
In	Out	In	Out	Out	In	2764/27128
In	Out	In	Out	In	Out	27256

WD286-LPM

Switch	*Position*	*Function*
W3	1-2	Mono
	2-3	CGA
W4	1-2	Disable onboard floppy
	2-3	Enable
W5	1-2	Reserved
W9	1-2	16/12.5 MHz 80C287maths copro
	2-3	6 MHz 80287
W11	1-2	Disable onboard VGA
	2-3	Enable
W12	1-2	Disable IDE LED
	2-3	Enable
W15	1-2	Enable IRQ9
	2-3	Disable
W16	In	Enable PS/2 IRQ12
	Out	Disable
W17		Reserved
J6		Reset
J15		Key switch/IDE

WD286-WDM2

Switch	*Position*	*Function*
W1	In	Enable MFM HD LED
W3	In	Enable HD controller chip select
W4	Out	Reserved
W5	In	HD controller IRQ14
W6	Out	Reserved
W7	1-2	Reserved
W8	In	Floppy IRQ6
W10	Out	IDE IRQ14
W11	Out	Disable IDE LED
W12	Out	AT keyboard
	In	XT keyboard
W13	In	Enable video IRQ9
W17	In	Enable PS/2 mouse IRQ12
W18	Out	Colour display
	In	Mono
W19	In	LPT IRQ7
W20	In	COM2 IRQ3
W21	In	COM1 IRQ4
W22	Out	IDE Chip select

WD286-WDM20

Switch	*Position*	*Function*
W3	In	Enable HD controller chip select
W4	Out	Reserved
W5	In	HD controller IRQ14
W10	Out	IDE support IRQ14
W6	Out	Reserved
W7	1-2	Reserved
W8	In	Floppy IRQ6
W12	Out	AT keyboard
	In	XT keyboard
W13	In	Enable video IRQ9
W17	In	Enable PS/2 mouse IRQ12
W18	2-3	Colour display
	1-2	Mono
W19	In	LPT IRQ7
W20	In	COM2 IRQ3
W21	In	COM1 IRQ4
W22	Out	IDE Chip select
W23	In	Enable video NMI
W24	1-2	Disable onboard video data buffer
	2-3	Enable
	In	Enable onboard video display

WD386SX-LPX

Switch	*Position*	*Function*

Switch	*Position*	*Function*
W1	In	Enable password memory clear
	Out	Disable
W2	Out	Reserved
W3	In	Reserved
W4	In	Enable PS/2 mouse IRQ12
	Out	Disable
W5	1-2	Mono display
	2-3	Colour
W6	1-2	External 8514/A video clock
	2-3	Onboard VGA clock
W7	1-2	Disable onboard VGA
	2-3	Enable
W8	1-2	Fixed frequency monitor
	2-3	Multi-frequency
W9	1-2	PC/AT VGA BIOS
	2-3	PS/2 VGA BIOS
W10	1-2	Enable onboard speaker
	2-3	Disable
W11	1-2	Disable onboard IDE LED
J6		Reset

Win

Maybe same as below

WinCo Electronic Co

www.winco.com.tw

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	P55TV2	AC-00	SL 586VT-2/WP55VT-2D
9C-00	WP55VT2D		

SL586VT-2

Same as Fong Kai SL 586VT-II

Win-Lan

Wintec (Win Technologies)

(408) 748 6961
www.wintec.com
See also Edom

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
0-00	MP 046-A	GC-00	MP 082 or 060 Rev A
9C	MP 066	HC	MP 054
AC	MP 071B	JC	MP 058
BC	MP 070	NC	MP 058
FC	MP 076	TC	MP 064

Wyse

WY 1100

Switch	Position	Function
JC4		Disable video
JC5		Disable COM1
JC6		Disable COM1 IRQ
JC7		Disable LPT1
JC8		Disable LPT1
R102		Trace cut for 256K RAM selection
P1		COM1
P2		COM2
P3		LPT1
J1		Keyboard
J2		Video
J12		Power
J13		Backplane connector
J14		Drive A
J16		Drive B
J17		Multifunction backplane
SW1		Reserved

WY 1400

Switch	Position	Function
S1	Off	Reserved
S2	On	No 8087
	Off	8087 installed
S3	Off	Reserved

Switch	Position				Function			
S4	Off				Reserved			
S5,5	**S5**	**S6**			**Primary Display Mode**			
	Off	Off			Mono			
	On	Off			80 column CGA			
	Off	On			40 column CGA			
	On	Off			EGA			
S7,8	**S7**	**S8**			**Floppies**			
	On	On			1			
	Off	On			2			
W1-4	**W1**	**W2**	**W3**	**W4**	**Cyls**	**Hds**	**WPC**	**HD Cap**
	In	In	In	In	306	2		5 Mb
	Out	In	In	In	612	4	256	20 Mb
	In	Out	In	In	306	6	128	15 Mb
	Out	Out	In	In	306	4	128	10 Mb
W5	Out				Reserved			
W6	Out				Reserved			

WY 2012i

Switch	Position			Function
J10	1-2			80 ns RAM
	2-3			120 ns RAM
J17	1-2			Power-on from power supply
	2-3			Power-on from system board
J28	1-2			Internal battery
	2-3			External battery
J30	Out			
	In			Fast ALE timing mode
J31	Out			1 wait state
	In			2 wait states
SW1	**S1**	**S2**	**S3**	**Total Memory**
1-3	On	Off	On	1 Mb
	Off	Off	On	2 Mb
	On	On	Off	4 Mb
S4	On			Colour video
	Off			Mono

WY 2108

Switch	Position	Function
WA	1-2	640/384K
	2-3	512/512K
WB	In	Enable extended memory
	Out	Disable
WG	In	512K RAM
	Out	1 Mb RAM
WH	In	Normal bus master
	Out	Not supported

Daughterboard

Switch	*Position*	*Function*
W8	In	Normal oscillator
	Out	Text oscillator
W10	In	128K ROM
	Out	256/512K ROM
W11	In	256/512K ROM
	Out	128K ROM
W13	In	512K ROM
	Out	256/512K ROM
J4	In	Test mode
	Out	Normal
WD	1-2	Colour display
	2-3	Mono

WY 2112/2214

Switch	*Position*					*Function*
J4,5	**J4**	**J5**				**BIOS ROM size**
	Out	In				256/128K
	In	Out				512K
J8	Out					1 ROM wait state
	In					0 ROM wait state
J9	Out					1 DRAM wait state
	In					0 DRAM wait state
J12	In					Colour display
	Out					Mono
J13	Out					Normal operation
J18	In					Enable DRAM parity
	Out					Disable
WF1-3	**WF1**	**WF2**	**WF3**	**J21**	**J22**	**80287-10 copro**
J21,22	In	Out	Out	Out	Out	10 MHz
	Out	In	In	In	In	Unsupported

Extended J24	Extended J25	Base J6(WB)	CPU Board JT(WA)	Base	Extended
In	In	In	In	512K	0
In	In	In	Out	640K	0
In	In	Out	In	512K	512K at 1000000h
In	In	Out	Out	640K	384K at 1000000h
Out	In	Out	In	512K	512K at 2000000h
Out	In	Out	Out	640K	384K at 2000000h
Out	Out	Out	In	512K	512K at 4000000h
Out	Out	Out	Out	640K	384K at 4000000h

WY 2116i

Switch	*Position*	*Function*
J1	In	256/512K ROM
	Out	128K ROM
J2	Out	256/512K ROM
	In	128K ROM

Switch	*Position*				*Function*
J3	1-2				16 MHz CPU
	2-3				Unsupported
J4	Out				512/640K base memory
	In				256K base memory
J6	In				0 RAM wait state
	Out				1 RAM wait state
J7	In				0 ROM wait state
	Out				1 ROM wait state
J8	Out				0 ROM wait state
	In				2 ROM wait state
J9	In				Enable parity
	Out				Disable
J12	1-2				Masked keyboard scanner chip
	2-3				Ceramic
J13	Out				Normal
	In				Test
J5,14-16	**J5**	**J14**	**J15**	**J16**	**RAM size**
	In	Out	In	2-3	1 Mb
	Out	In	Out	1-2	¼ Mb
J17	1-2				Reserved (normal)
	2-3				Reserved
J18,19	2-3				211003-02 LB ASIC revision
	1-2				211008-01 LB ASIC revision
WA	Out				640 K base memory
	In				512K base memory
WB	Out				Move split memory
	In				Disable
WD	In				Colour video
	Out				Mono video
WC,E,F	**WE**	**WC**	**J10**	**WF**	**80287-10 copro**
J10	In	Out	Out	Out	10 MHz
	Out	In	In	In	Unsupported

WY 2200

Switch	*Position*					*Function*
W1-5	**W1**	**W2**	**W3**	**W4**	**W5**	**EPROM**
	In	Out	Out	Out	In	2764
	Out	In	Out	Out	In	27128
	Out	Out	In	In	Out	27256
W6						Reserved
W7	Out					Disable 14.318 MHz oscillator
	In					Enable
W30	In					640K onboard RAM
	Out					Disable 512-640K for 128K plug-in cards
SW1	Colour					Colour display
	Mono					Mono
W100						Reserved
J17						Keyboard
J19						Battery
J24						Dual speed oscillator

WY 3116sx

Processor Board

Switch	*Position*		*Function*
W1	Out		Keyboard controller chip set at 250646-XX
	In		Keyboard controller chip set at 250230-12
WA/WB	In		Normal
	Out		Reserved
WC	1-2		512/256K BIOS
	2-3		128K BIOS
WD	2-3		128/256K BIOS
	1-2		512K BIOS
WQ,E	**WQ**	**WE**	
	1-2	In	Normal
	2-3	Out	Reserved
WF	1-2		Normal
	2-3		Reserved
WG	1-2		Colour Display
	2-3		Mono
WJ	2-3		No maths copro
	1-2		80387SX-16 Installed
WK	2-3		Keyboard controller chip set at 6805
	1-2		Keyboard controller chip set at 68705
WL	1-2		2 BIOS chips
	2-3		1 BIOS chip

WY 3216

Processor Board

Switch	*Position*	*Function*
	1-2	512/256K BIOS
	2-3	128K BIOS
	2-3	128/256K BIOS
	1-2	512K BIOS
WA	1-2	No 80387-16
	2-3	80387-16 installed
WB	2-3	No 80287-10 or 80387-16
	1-2	80287-10 and 80387-16 instaled
WF	1-2	Normal
	2-3	Reserved
WG	2-3	No 80387-16
	1-2	80387-16 installed
L/R	2-3	Static column memory
	1-2	Unsupported memory
WC	1-2	Normal
	2-3	Reserved
WD	1-2	Colour Display
	2-3	Mono

WY 3225

Processor Board

Switch	Position	Function
WA,B,V	In	Normal
	Out	Reserved
WC	1-2	512/256K BIOS
	2-3	128K BIOS
WD	2-3	128/256K BIOS
	1-2	512K BIOS
WE	In	Enable RAM parity
	Out	Disable
WF	1-2	Normal
	2-3	Manufacturing test
WG	2-3	Colour Display
	1-2	Mono
WH	In	Normal
	Out	Reserved
WI	Out	Normal
	In	Reserved
WJ	In	No 80387
	Out	80387 Installed
WK	1-2	Normal
	2-3	Reserved
WL	1-2	Enable Hidden Refresh
	2-3	Disable
WM	1-2	Normal
	2-3	Reserved
WN	1-2	Normal
	2-3	Reserved
WU/T/S	In	1 chip keyboard scanner
R/P/Q	Out	2 chips
J5		Connector for serial/parallel interface board

WY 386sx/16

Switch	Position	Function
JP3	2-3	Disable onboard IRQ2
	1-2	Enable
JP4	1-2	Enable onboard FD controller
	2-3	Disable
JP5	2-3	PS/2 mouse
	1-2	Serial mouse
JP6	2-3	Enable onboard video controller
	1-2	Disable
JP8	2-3	Mono monitor
	1-2	Colour
JP10	2-3	LPT1 IRQ7
	1-2	LPT1 IRQ5
JP11	2-3	COM1 IRQ4
	1-2	COM1 IRQ3
JP13	2-3	36 MHz VGA clock
	1-2	VGA feature clock

WY 386sx/20

Switch	*Position*	*Function*
JP1	1-2	20 MHz
	2-3	16 MHz
JP5	1-2	Colour video
	2-3	Mono
JP6	1-2	Internal battery
	2-3	External battery
JP7	2-3	Power good from power supply
	1-2	From system board
J1		Reset
J2		Keylock/Power LED
J3		Speaker
J4		Speed button
J5		Speed LED

Decision 386/25

Switch	*Position*	*Function*
JMP1	In	Colour video
	Out	Mono
JMP3	Out	Disable Diagnostic Select
	In	Enable
JMP4	2-3	Disable CMOS discharge
	1-2	Enable
JMP6	2-3	64K cache
	1-2	128K cache
J9		External battery
J13		Keylock/Power LED
J14		Speaker
J15		Turbo switch
J16		Reset
J12		Speed LED

Decision 486

Switch	*Position*	*Function*
W1	2-3	Colour Display
	1-2	Mono
W2	Out	Reserved
W3		Reserved
W4		Reserved
J2		Keyboard
J3		Battery
J12		Reset
J13		Turbo button
J14		Turbo LED
J15		Speaker
J16		Power LED

Decision 486-33(T)

As for Decision 486

Y

Yamashita

Yellow Dragon

EFA?

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
9C	P5TX-AT	9C-00	TX Board

TX Board

Vtech/PC Partner MB540N/Aristo AM 430TX

Yukon

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
DC	P54C		

Notes

Z

Zenith Data Systems

BM 200

Revisions 1 & 2

Switch	*Position*			*Function*	
ST2	In			0 WS read, 1 WS write RAM	
	Out			1 WS read, 1 WS write RAM	
ST3	In			1 WS ROM	
	Out			2 WS ROM	
ST4	In			12 MHz, fast mode	
	Out			8 MHz, normal mode	
ST5	In			8 MHz bus	
	Out			6 MHz bus	
ST6	In			48 MHz system clock connected	
	Out			Disconnected	
ST7-9	**ST7**	**ST8**	**ST9**	**Memory**	
	In	In	In	2 x 256K	512K
	In	In	Out	4 x 256K	1 Mb
	Out	In	Out	2 x 1 Mb	2 Mb
	In	Out	In	4 x 1 Mb	4 Mb
ST10				80/100 ns RAM	
ST11	In			27512 ROM	
	Out			27256 ROM	
ST12	In			Colour display	

Switch	*Position*		*Function*			
	Out		Mono			
ST13	In		Enable video I/O			
	Out		Disable			
ST14	In		1.8432 MHz clock connected			
	Out		Disconnected			
ST15	In		Enable 36 MHz VGA clock			
	Out		Disable			
ST16	In		Enable 25.175 MHz VGA clock			
	Out		Disable			
ST17	In		Enable 28.322 MHz VGA clock			
	Out		Disable			
ST19	Out		Reserved			
ST20	Out		Reserved			
ST21	Out		Reserved			
ST22	In		16-bit BIOS ROM data			
	Out					
ST23	In		Disable VGA BIOS			
	Out		Enable			
ST24,25	**ST24**	**ST25**	**9 pin**		**25 pin**	**Parallel**
	Out	Out	370-377h	COM2	LPT2	
	In	In	COM2		COM1	LPT1
	Out	In	390-397h	COM1	LPT1	
	In	Out	COM2		COM1	LPT2
ST26-33	In		Default port address			
ST34	In		187ns floppy precomp			
	Out		125ns			
ST35	In		DRQ2 from floppy interface			
	Out		Disconnected			
ST36,37	In		Default clocks			
ST38			120/150ns DRAM			
ST39	In		IRQ3 on COM2			
	Out		IRQ3 disconnected			
ST40	In		Ground to 0v link			
ST41	In		16-bit video memory access			
ST42	In		IOCHRDY connected for HD			
	Out		Disconnected			
ST43	In		Enable VGA memory			
	Out		Disable			
ST44			IRQ14 only			
ST45			IRQ14 + ACTDISK			
ST46			LPT IRQ15			
ST47			LPT IRQ7			
ST48-53	In		COM2 Handshake signal definition			
ST54			Leave connected			
ST55			Leave disconnected			
ST56			Not assigned			

BM 400 MCA

Switch	*Position*		*Function*
SW1,2	**SW1**	**SW2**	**Volume**
	On	On	0%

Switch	Position		Function
	On	Off	50%
	Off	On	100%
SW3	Off		Boot from diskette
	On		Disable diskette boot

BM 500 MCA

As for BM400 MCA.

BM 600

Revisions 1 & 2

Switch	Position				Function		
JP6-8	2-3				Coprocessor not installed		
	1-2				Installed		
JP12	1-2				Relocate to FA0000-FDFFFF		
	2-3				Do not relocate		
JP13-16	**JP13**	**JP14**	**JP15**	**JP16**	**Type**	**Block**	**RAM**
	2-3	2-3	1-2	1-2	512*9	A	2 Mb
	2-3	2-3	1-2	1-2	512*9	A+B	4 Mb
	1-2	1-2	1-2	1-2	512*9	A	6 Mb
	2-3	2-3	1-2	1-2	1 Mb*9	B	4 Mb
	1-2	1-2	2-3	2-3	1 Mb*9	A	4 Mb
	1-2	1-2	2-3	2-3	1 Mb*9	A+B	8 Mb

SW1

Switch	Position	Function
S1-8	S1 & 4 On, others off	EPROM & I/O overlap – do not change

SW2

Switch	Position				Function
S1	On				25-pin=COM1, 9-pin=COM2
	Off				Other way round
S2	On				Disable COM1
	Off				Enable
S3	On				Disable COM2
	Off				Enable
S4	On				Disable LPT1
	Off				Enable
S5-7	Off				Printer port=LPT1
	On				Printer port=LPT2
S8	Off				BIOS in RAM
	On				ROM BIOS
S9	Off				Mono display
	On				Colour
S10	On				Disable 2nd SIMM (B) Block
	Off				Enable
JP13-16	**JP13**	**JP14**	**JP15**	**JP16**	**Memory**
	2-3	2-3	1-2	1-2	2 Mb Bank A

Switch	*Position*				*Function*
	2-3	2-3	1-2	1-2	2 Mb Bank A + B
	1-2	1-2	1-2	1-2	2 Mb Bank A, 4 Mb Bank B

Cheetah

Same as Packard Bell PB 680.

Z148XT

SW 402

Switch	*Position*	*Function*
8MDS	On	Disable 8 MHz
	Off	Enable (front panel switch)
8087	On	Copro not installed
	Off	Installed
60 HZ	On	60 Hz video refresh
	Off	50 Hz video refresh
PRDS	On	Disable parity checking
	Off	Enable
S1	On	1 WS (4.77 MHz only)
S2	On	2 WS
S3	On	3 WS (4.77 + 8 MHz)
S4	On	4 WS
S5	On	5 WS

SW 403

Switch	*Position*		*Function*
FLIN	On		No floppy
	Off		1 or more floppies
2/1D	On		1 floppy
	Off		2 floppies
BTFL	**BTFL**	**BTWC**	**Boot Sequence**
BTWC	On	Off	HD
	Off	On	Floppy
	Off	Off	Manual from monitor

Z386/16 AT

Revisions 1 & 2

Switch	*Position*	*Function*
J201	1-2	80387 synchronous
	2-3	80387 asynchronous
J202	1-2	80287
	2-3	80387
J204	1-2	No coprocessor
	2-3	Coprocessor installed
J207	1-2	1 Mb memory card

Switch	Position	Function
	2-3	1 Mb memory card not used
J211	1-2	Low speed coprocessor
	2-3	High speed coprocessor

80387 Type	J201	J202	J204	J211
80287-10	2-3	1-2	2-3	2-3
80287-8	2-3	1-2	2-3	1-2
80387-16	2-3	2-3	2-3	2-3

Z-Station Campus

Same as Packard Bell PB 640.

Z-Station 510

Same as Packard Bell PB 470 (Thanks to Rudd Thornton).

Zida Technologies

Zida Technologies (Tomatoboards)
(914) 474 9832
www.zida.com

Award BIOS ID

The last two numbers of the BIOS part number.

Code	Motherboard	Code	Motherboard
1C-00	Tomato 4DPS-256K	BC-00	Tomato 5DTX
9C	5DHX (Tomato) rev 1.2	CC	Tomato 5DVX
9C-00	Tomato 5DVX	DC-00	Tomato 5STX

Notes

Connectors

Here are typical pinouts for a typical clone motherboard – yours may be different!

Power LED and Keyboard Lock

Usually a 5-pin keyed BERG strip, which means one jumper is missing at the Power LED end

Pin	Description
1	LED Power
2	Key (No Connection)
3	Ground
4	Keyboard Lock
5	Ground

Reset

2-pin BERG strip

Pin	Description
1	Ground
2	Reset Input

Turbo LED

2-pin BERG strip

Pin	Description
1	LED Anode
2	LED Cathode

Speaker

4-pin keyed BERG strip for an external 2-inch, 8-ohm speaker

Pin	Description
1	Speaker Data Out
2	Ground
3	Ground
4	+5 VDC

HD Activity LED

4-pin keyed BERG strip

Pin	Description
1	LED Anode (+)
2	LED Cathode (-)
3	LED Cathode (-)
4	LED Anode (+)

Keyboard

5-pin, circular-type DIN socket, or 6-pin Mini-DIN.

Pin	Description
1	Clock Signal
2	Data Signal
3	Not Used
4	Ground
5	+5V Fused VDC

Pin	Description
1	Data Signal
2	Reserved (N/C)
3	Ground
4	+5Volt DC
5	Clock signal
6	N/C

Power Supply (PS8 and PS9)

6-pin AT standard power connectors. Most power supplies have two six-wire connectors, two of the wires on each connector are black. Align the two black wires on each connector in the middle.

Pin	Connector PS8	Connector PS9
1	Power Good	Ground
2	+5 VDC	Ground
3	+12 VDC	-5 VDC

Pin	Connector PS8	Connector PS9
4	-12 VDC	+5 VDC
5	Ground	+5 VDC
6	Ground	+5 VDC

Parallel Port

2x13-pin male header.

Pin	Description	Pin	Description
1	STROBE	14	AUTO FEED XT
2	Data Bit 0	15	ERROR
3	Data Bit 1	16	INIT
4	Data Bit 2	17	SLCT IN
5	Data Bit 3	18	Ground
6	Data Bit 4	19	Ground
7	Data Bit 5	20	Ground
8	Data Bit 6	21	Ground
9	Data Bit 7	22	Ground
10	ACK	23	Ground
11	BUSY	24	Ground
12	PE	25	Ground
13	SLCT	26	No Connection

Serial Port

2x5-pin male headers, may be wired in one of two ways. The first arrangement is more modern.

1	3	5	7	9
2	4	6	8	10

1	2	3	4	5
6	7	8	9	10

Pin	Description	Pin	Description
1	Carrier Detect (CD)	6	Receive Data (RXD)
2	Transmit Data (TXD)	7	Data Terminal Ready (DTR)
3	Signal Ground	8	Data Set Ready (DSR)
4	Request To Send (RTS)	9	Clear To Send (CTS)
5	Ring Indicator (RI)	10	No Connection

Pin	Description	Pin	Description
1	Carrier Detect (CD)	6	Data Set Ready (DSR)
2	Receive Data (RXD)	7	Request To Send (RTS)
3	Transmit Data (TXD)	8	Clear To Send (CTS)
4	Data Terminal Ready (DTR)	9	Ring Indicator (RI)
5	Signal Ground	10	No Connection

Mouse

Pin	Description
1	Mouse Data Signal
2	Reserved (N/C)
3	Ground
4	+5Volt DC
5	Mouse Clock signal
6	N/C

Memory

Table Of Contents

Memory

The memory contains the instructions that tell the Central Processor what to do, as well as the data created by its activities. Since the computer works with bits that are either on or off, memory chips work by keeping electronic switches in one state or the other for however long they are required. Where these states can be changed at will or, more properly, the operating system is able to reach every part of memory, it is called *Random Access Memory*, or RAM.

The term comes from when magnetic tapes were used for data storage, and information could only be accessed sequentially; that is, not at random. A ROM, on the other hand, has its electronic switches permanently on or off, so they can't be changed, hence *Read Only Memory*.

ROMs are known as *non-volatile*, meaning that data inside isn’t lost when (mains) power is turned off. System memory, as described below, is *volatile*, so be careful if you use a RAM disk..

Static RAM

Static RAM (SRAM) is the fastest available, with a typical access time of 20 nanoseconds (the lower the number, the faster the access). It is expensive, however, and can only store a quarter of the data that Dynamic RAM (or DRAM) is able to, as it uses two transistors to store a bit against DRAM's one, although it does retain it for as long as the chip is powered (the transistors are connected so that only one is either in or out at any time; whichever one is in stands for a 1 bit).

Synchronous SRAM allows a faster data stream to pass through it, because it uses its own clock, which is needed for cacheing on fast Pentiums. Because of its expense, SRAM is used in caches in the CPU and between it and system memory, which is composed of *Dynamic RAM*.

Dynamic RAM

DRAM uses internal capacitors to store data, with a MOSFET transistor charging or discharging the capacitor to create your 1s and 0s in a write operation, or just to sense the charge, which is a read. The capacitors lose their charge over time, so they need constant refreshing to retain information, otherwise 1s will turn into 0s. The result is that, between every memory access, an electrical charge refreshes the capacitors to keep data in a fit state, which cannot be reached during that time (like changing the batteries millions of times a second). Normal bus operation is a 2-clock cycle external bus access; the first is called T1, and the second T2. Address and control signals are set up in the former, and the operation completed at the end of the latter.

Burst bus operation executes 4 consecutive external bus cycles. The first is the same setup and completion done in T1 and T2, and the next three operate without the setup cycle, by defining the sequence of addresses that follow the first. As the first takes the longest, burst timings look like 2-1-1-1 or similar. Memory addresses are found by a combination of row and column inside memory chips, with two strobe signals, *Row Address Strobe* (RAS) and *Column Address Strobe* (CAS), normally in that order. *Fast Page Mode* memory, for example, toggles CAS on and off as addresses change, that is, as columns are accessed within the row (further described under *Wait States*). FPM makes 60 ns RAM look like 40 ns, allowing you a 25 MHz CPU. Quick explanation: Under normal circumstances, a 33MHz CPU takes about 30 ns per cycle:

Clock Speed (MHz)	Cycle Time (ns)
1	1000
5	200
8	125
12	83
16	63
20	50
25	40
33	30
40	25

At that speed, memory chips need to operate at something like 20 nanoseconds to keep up, assuming the CPU needs only 1 clock cycle per 1 from the memory bus; 1 internal cycle for each external one, in other words. Intel processors mostly use 2 for 1, so the 33 MHz CPU is actually ready to use memory every 60 ns, but you need a little more for overheads, such as data assembly and the like, so there's no point in using anything faster anyway.

With *Static Column* memory, CAS may be left low (or active) with only the addresses changing, assuming the addresses are valid throughout the cycle, so cycle time is shorter.

The *cycle time* is what it takes to read from and write to a memory cell, and it consists of two stages; precharge and access. *Precharge* is where the capacitor in the memory cell is able to recover from a previous access and stabilise. *Access* is where a data bit is actually moved between memory and the bus or the CPU. Total *access time* therefore includes the finding of data, data flow and recharge, and parts of it can be eliminated or overlapped to improve performance, as with SDRAM. The combination of Precharge and Access=Cycle Time, which is what you should use to calculate wait states from (see below). Refresh is performed with the 8253/8254 timer and DMA controller circuit (Ch 0).

There are ways of making refreshes happen so that the CPU doesn't notice (i.e. *Concurrent* or *Hidden*), which is helped by being able to use its on-board cache and not needing to use memory so often anyway - turn this off first if you get problems. In addition, you can tinker with the *Row Access Strobe*, or have *Column Access Strobe* before RAS, as described in *Advanced Chipset Setup*. The fastest DRAM commonly available is rated at 60 nanoseconds (a nanosecond is a billionth of a second). Although SDRAM is rated at 10ns, it is not used at that speed – typically, between 20-50 ns is more like it, since the smaller figure only refers to reads from sequential locations in bursts – the larger one is for the initial data fetch. With a CPU clock cycle at 500 MHz taking, say, 2ns, you will get at least 5 CPU clock cycles between each SDRAM cycle, hence the need for special tricks.

As memory chips need alternate refresh cycles, under normal circumstances data will actually be obtained every 120 ns, giving you an *effective speed* of around 8 MHz for the *whole computer*, regardless of CPU speed, assuming no action is taken to compensate, which is a sobering thought when you're streaming audio through an ISA sound card.

One way of matching components with different speeds is to use wait states.

Wait states

These indicate how many ticks of the system clock the CPU has to wait for other parts of the computer, typically for memory—it will generally be 0 or 1, but can be up to 3 if you're using slower memory chips. They are needed because there is no "data valid" signal from memory, so the system waits a bit to ensure it's OK. Ways of avoiding wait states include:

- **Page-mode memory**. This uses cut-down address cycles to retrieve information from one general area, based on the fact that the second access to a memory location on the same page takes around half the time as the first; addresses are normally in two halves, with high bits (for row) and low bits (for column) being multiplexed onto one set of address pins. The page address of data is noted, and if the next data is in the same area, a second address cycle is eliminated as a whole row of memory cells can be read in one go; that is, once a row access has been made, you can get to subsequent column addresses in that row in the time available (you should therefore increase row access time for best performance). Otherwise, data is retrieved normally, taking twice as long.

  Fast Page Mode is a quicker version of the above; the DRAMs concerned have a faster CAS (Column Access Strobe) access speed, and can anticipate access to the next column while the previous column is deactivating, and the data output buffer is turned off, assuming the data you need is in that location. Memory capable of running in page mode is different from the normal bit-by-bit type, and the two don't mix. It's unlikely that low capacity SIMMs are so capable. With banks of page mode DRAM in multiples of 2, you can combine it with ...

- **Interleaved memory**, which divides memory into two or four portions that process data alternately; that is, the CPU sends information to one section while another goes through a refresh cycle; a typical installation will have odd addresses on one side and even on the other (you can have word or block interleave). If memory accesses are sequential, the precharge of one will overlap the access time of the other. To put interleaved memory to best use, fill every socket you've got (that is, eight 1 Mb SIMMs are better than two 4 Mb ones). The SIMM types must be the same. As an example, a machine in non-interleaved mode (say a 386SX/20) may need 60ns or faster DRAM for 0ws access, where 80ns chips could do if interleaving were enabled.

- A **processor RAM cache**, which is a (Level 2) bridge between the CPU and slower main memory; it consists of anywhere between 32-512K of (fast) Static RAM chips and is designed to retain the most frequently accessed code and data from main memory. It can make 1 wait state RAM look like that with 0 wait states, without physical adjustments, assuming the data the CPU wants is in the cache when required (known as a *cache hit*). To minimise the penalty of a cache miss, cache and memory accesses are often made in parallel, with one being terminated when not required.

  How much L2 cache you need really depends on the amount of system memory; according to Dell, jumping from 128K to 256K only increases the hit rate by around 5%, and Viglen think you only need more than 256K with over 32 Mb RAM. L2 cache is not as important if you use Fast Page Mode DRAM, but once you start clock doubling, and increasing memory writes, the need for a writeback cache becomes more apparent. Several Intel chipset designs, such as the HX (for Socket 7) may need additional TAG RAM to cache more than 64 Mb (i.e. more than 8-bit). Pentium Pro/II boards aren't restricted this way, as the cache is with the processor.

  A cache should be fast and capable of holding the contents of several different parts of main memory. Software plays a part as well, since cache operation is based on the assumption that programs access memory where they have done so already, or are likely to next, maybe through looping (where code is reused) or organising what's wanted to be next to other relevant parts. In other words, it works on the principle that code is sequential, and only a small proportion of it is used anyway. In fact, as cache is used for 80-90% of CPU memory accesses, and DRAM only 1-4% of the time, less errors result (actually a lower *Soft Error Rate*), hence the reduced need for parity; a side effect of a cache is that DRAM speed is not so critical.

  Asynchronous SRAM is the cheapest solution, which needs wait states. A basic design will look up an address for the CPU and return the data inside one clock cycle, or 20 ns at 50 MHz, with an extra cycle at the start for the tag lookup. As the round trip from the CPU to cache and back again takes up a certain amount of time, there's less available to retrieve data, which total gets smaller as the motherboard speed is increased.

Synchronous SRAM chips have their own internal clock and use a buffer to keep the whole 2 or 3 cycle routine inside one. The address for data required by the CPU is stored, and while that for the next is coming in to the buffer, the *data* for the previous set is read by the CPU. It can also use burst timing to send data without decoding addresses or, rather, sending the address only once for a given stream of data.

Pipeline SRAM also uses buffers, but for data reads from memory locations, so the complete distance doesn't have to be travelled, so it's a bit like a cache within a cache. *Pipeline Burst* SRAM will deliver 4 words (blocks of data) over four consecutive cycles, at bus speeds over 75 MHz. Up till 66 MHz, it delivers about the same performance as synchronous, but is cheaper to make. Data is read in packets, with only the first step slower than the other three, as it has to get the address as well. You will see these settings describes as 2-1-1-1 or similar, where lower numbers mean faster access.

In practice, it would appear that the performance between synchronous and pipeline cache is similar. Asynchronous is not often found on fast motherboards, anyway, but should be about the same at or below 50 MHz (it's the slowest and cheapest). Note that Level 2 cache can be unreliable, so be prepared to disable it in the interests of reliability, particularly with NT, but that defeats the object somewhat.

For maximum efficiency, or minimum access time, a cache may be subdivided into smaller blocks that can be separately loaded, so the chances of a different part of memory being requested and the time needed to replace a wrong section are minimised.

There are three mapping schemes that assist with this:

- **Fully Associative**, where the whole address is kept with each block of data in the cache (in tag RAM), needed because it is assumed there is no relationship between the blocks. This can be inefficient, as an address comparison needs to be made with every entry each time the CPU presents the address for its next instruction. Associative mapping relates specific cache cells to specific main memory cells based on the low order bits of the main memory address.

- **Direct Mapped**, also known as *1-way associative*, where a block of memory is mapped to one place in the cache, so only one address comparison is needed to see if the data required is there. Although simple, the cache controller must go to main memory more frequently if program code needs to jump between locations with the same index, which seems pointless, as alternate references to the same cache cell mean cache misses for other processes. In other words, memory cells mapped to the same location in cache will kick each other out. The "index" comes from the lower order addresses presented by the CPU.

- **Set Associative**, a compromise between the above two. Here, an index can select several entries, so in a *2 Way Set Associative* cache, 2 entries can have the same index, so two comparisons are needed to see if the data required is in the cache. Also, the tag field is correspondingly wider and needs larger SRAMs to store address information.

As there are two locations for each index, the cache controller has to decide which one to update or overwrite, as the case may be. The most common methods used to make these decisions *are Random Replacement, First In First Out* (FIFO) and *Least Recently Used* (LRU). The latter is the most efficient. If the cache size is large enough (say, 64K), performance improvements from this over direct-mapping may not be much. Having said that, 2-way set can be better than doubling the size of a direct-mapped cache, even though it is more complex. The higher the set-associativity, the longer it takes for the cache controller to find out whether or not the requested data is in the cache.

2-way set-associative cache allegedly equals the performance of a direct-mapped one twice its size. To find the equivalency, multipy the associativity by the size - a 256K cache with an eight-way associativity comes out as 2 Mb, whereas 512K with 2-way is 1 Mb.

NT can figure out the size of any set-associative L2 cache, using its Hardware Abstraction Layer. If it cannot (you may have a direct-mapped cache) it assumes 256K. To change this to your true value, go to **HKLM\System\CurrentControlSet\Control\Session Manager\Memory Management\SecondLevelDataCache**. Open a DWORD editor window, change from Hex to Decimal, then insert your L2 cache size in Kb.

A Write *Thru Cache* means that every write access is saved to the cache and passed on to memory, so although cache and memory contents are identical, it is slow, as the CPU has to wait for DRAMs. Buffers can be used to provide a variation on this, where data is written into a temporary buffer to release the CPU quickly before main memory is updated (see *Posted Write Enable*).

A *Write Back Cache*, on the other hand, exists where changed data is temporarily stored in the cache and written to memory when the system is quiet, or when absolutely necessary. This will give better performance when main memory is slower than the cache, or when several writes are made in a very short space of time, but is more expensive. "Dirty words" are the differences between cache and main memory contents, and are kept track of with dirty bits. Some motherboards don't have the required SRAM for the dirty bit, but it's still faster than Write Thru.

Write Back becomes more important with clock doubling, where more memory writes are created in the course of a CPU's work, but not all motherboards support it. *Early* Write cache exists where the address and data are both known and sent simultaneously to SRAM. A new address can be used once every clock. *Late Write* is where data follows the address by 1 clock cycle, so a new address can be written to every 2nd clock.

DOS-based software is happy with a 64K external cache because 64K is the largest chunk of memory that can be addressed, which is also true for Windows (3.x anyway) because it runs on top of DOS. You may need something like Windows '95, OS/2, Windows NT, Multiuser DOS 7, REAL/32 or NetWare 3/4 to get much out of a larger L2 cache. DOS has hit-rates of around 96% while multi-tasking operating systems tend to achieve 70% or so, because of the way that they jump around memory, so a cache can slow things down against a cache-less motherboard with efficient memory management. With multi-tasking, interleaving can often get more performance than a cache (check out Headland/ICL and OPTi chipsets, for example). Not only that, cache management often delays memory access by 1 to 2 clock cycles.

- **Refresh Bypass**, used by AMI on their 486-based motherboards.

- **Synchronous DRAM**, whose timing is linked directly to the PC's system clock, so you don't need wait states.

EDO (*Extended Data Output*) is an advanced version of fast page mode (often called *Hyper Page Mode*, but see below), which can be up to 30% better and only cost 5% more. *Single-cycle EDO* will carry out a complete memory transaction in 1 clock cycle by overlapping stages that otherwise would take place separately; for example, precharging can start while a word is still being read, and sequential RAM accesses inside the same page take 2 clock cycles instead of 3, once the page has been selected, because the data output buffer is kept open rather than being turned off, as it would be with Fast Page Mode Memory (see *Wait States*, below. It is assumed that if one address is needed, others nearby will be, too, so the location of the previous one is held open for a short while.

In other words, output is not turned off when CAS goes high (i.e. turned off, or has stopped allowing addresses to be moved to the device). In fact, data can still be output after CAS has gone high, then low again (and another cycle has therefore started), hence the name, *Extended Data Out*; data remains available until that from the next access begins to appear – a memory address can hold data for multiple reads. This means you can begin precharging CAS whilst waiting for data. The end result is that cycle time is cut by around 20% and data is available longer. The really neat thing is that CAS can go high before data appears (well, maybe not to you and me, but it is to a motherboard designer). EDO is only faster with memory reads, though; writes take place at the same speed as Fast Page Mode. In any case, it only works if you r cache controller supports pipeline burst transfer. When it does, it effectively reduces 60 ns RAM to 25 ns, giving you a 40 MHz CPU, without wait states.

The combination of DRAM plus an external latch between it and the CPU (or other bus mastering device), would look like EDO DRAM because the external latch can hold the data valid while the DRAM CAS goes high and the address is changed. It is simpler and more convenient to have the latch inside the DRAM, hence EDO. As it replaces a Level 2 cache and doesn't need a separate controller, space on the motherboard is saved, which is good for notebooks. It also saves on battery power. In short, EDO gives increased bandwidth due to shortening of the page mode cycle (and 3-2-2-2 bursts rather than 7-4-4-4) - an entire block of memory can be copied to its internal cache and a new block collected while the CPU is accessing it. It appears to be able to run (unofficially) above 66 MHz. Don't get 70 ns EDO, as it will be difficult to upgrade the CPU.

BEDO, or *Burst Extended Data Out*, is as above, but has a pipeline stage and a 2-bit burst counter that can read and write large streams of data in 4-cycle bursts for increased performance, based on the addresses being dealt with in the first cycle. The pipelining system can save 3 cycles over EDO. It is designed to achieve 0 wait state performance at 66 MHz and upwards, as it brings your 60 ns RAM down to 15 ns (again, see chart above). The relevant speeds for Fast Page Mode and EDO are 25 and 40, respectively, and the increase in performance 100% and 40%.

Enhanced DRAM (**EDRAM**) replaces standard DRAM and the L2 cache on the motherboard, typically combining 15ns SRAM inside 35ns DRAM. Since the SRAM can take a whole 256 byte page of memory at once, it gives an effective 15ns access speed when you get a hit (35ns otherwise), so system performance is increased by around 40%. The L2 cache is replaced with an ASIC chip to sort out chipset/memory requirements (an ASIC chip is one specially made for the purpose). EDRAM has a separate write path that accepts and completes requests without affecting the rest of the chip.

NEC is producing *RDRAM* which, they say, gives 2ns access speed. It interconnects with a system called RAMBUS, which is a narrow, but ultra high speed, local memory bus, made with CMOS technology. It also uses a packet technique for data transfer, rather than coping with individual bytes. BIOS support is needed in the chipset for this to work as system memory. Although its data transfer rate is twice that of SDRAM, it suffers from latency problems, which reduces the performance edge, and is more expensive. RDRAM has its own communications bus with a separate controller that mediates between it and the CPU, using a relatively narrow serial connection 16 bits wide with separate lines for row and column signals. It runs at 400 MHz and uses both sides of the clock cycle. As the signal lines are separate from the data lines, you can be reading or writing at the same time as preparing for a second or even a third operation. The memory itself will come in RIMMs, which are similar to DIMMs but with a heat sink, required because the chips are more tightly packed together, even though they require less power and generate less heat. The 820 chipset supports only 2 RAMBUS modules from mixed suppliers.

Virtual Channel RAM (**VCRAM**) is a development of SDRAM (see below), also from NEC, using standard DIMM sockets. Because of its low latency and speed (133 MHz), it is a very good choice, and is supported by VIA’s Apollo Pro Plus chipset.

WRAM (*Windows RAM*), created by Samsung, is dual ported, like VRAM, but costs about 20% less and is 50% faster with around 25% more bandwidth (dual porting means reading and writing takes place at the same time). It runs at 50 MHz and can transfer blocks and support text and pattern fills. In other words, some graphics functions are built in, so look for these on graphics cards. **VRAM**, by the way, is used on graphics cards that need to achieve high refresh rates; DRAM must use the same port as it does for data to do this, where VRAM uses one port to refresh the display and the other to change the data. Otherwise, it is generally the same speed as DRAM. **SGRAM**, or *Synchronised Graphics RAM*, is single ported, using dual banks where 2 pages can be opened at once. It has a block write system that is useful for 3D as it allows fast memory clearing.

Synchronous DRAM (**SDRAM**) was originally a lower cost alternative to VRAM. It is synchronised to the system clock (that is, the external CPU frequency), taking memory access away from the CPU's control; internal registers in the chips accept a request, and let the CPU do something else while the data requested is assembled for the next time it talks to the memory, as the memory knows when the next cycle is due because of the synchronisation. In other words, SDRAM works like standard DRAM, but includes interleaving, synchronisation and burst mode, so wait states are virtually eliminated (SDRAM DIMMs also contain two cell banks which are automatically interleaved). It's not actually faster than DRAM, just more efficient; although the chips are rated at 10 ns, they are not used at that speed – typically, between 20-50 ns is more like it, since the smaller figure only refers to reads from sequential locations in bursts – the larger one refers to the initial data fetch. Data bursts are twice as fast as with EDO (above), but this is slightly offset by the organisation required. The peak bandwidth of 133 SDRAM is about 33% higher than that of 100.

SLDRAM uses an even higher bus speed and a packet system. However, with a CPU running at 4 or 5 times the memory speed, even SDRAM is finding it hard to keep up, although DDR (*Double Data Rate*) SDRAM doubles the memory speed by using the rising and falling edges of the clock pulse (it has a lot of misreads and miswrites, though, which make it less efficient than RAMBUS). Performance wise, SDRAM only really comes into its own with a memory bus above 75 MHz.

Hitachi have developed a way of replacing the capacitor in DRAM with a transistor attached to the MOSFET, where a 1 or 0 is represented by the presence (or not) of electrons between its insulating layers. This means low power requirements, hence less heat, and speed.

Shadow RAM

ROMs are used by components that need their own instructions to work properly, such as a video card or cacheing disk controller; the alternative is loading the instructions from disk every time they are needed. ROMs are 8-bit devices, so only one byte is accessed at a time; also, they typically run between 150-400 ns, so using them will be slow relative to 32-bit memory at 60-80 ns, which is also capable of making four accesses at once (your effective hard disk interleave will drop if data is not picked up in time).

Shadow RAM is the process of copying the contents of a ROM directly into extended memory which is given the same address as the ROM, from where it will run much faster. The original ROM is then disabled, and the new location write protected. You may need to disable shadow RAM whilst installing Multiuser DOS.

If your applications execute ROM routines often enough, enabling Shadow RAM will increase performance by around 8 or 9%, assuming a program spends about 10% of its time using ROM instructions, but theoretically as high as 300%. The drawback is that the RAM set aside for shadowing cannot be used for anything else, and you will lose a corresponding amount of extended memory; this is why there is a shortfall in the memory count when you start your machine if shadowing is enabled. The remainder of Upper Memory, though, can usually be remapped to the end of extended memory and used there. However, with Windows, including 3.x, or other operating systems that take over some BIOS functions directly, like NT, it is arguable as to whether any performance increase is actually noticeable, as the old slow routines are not used anyway.

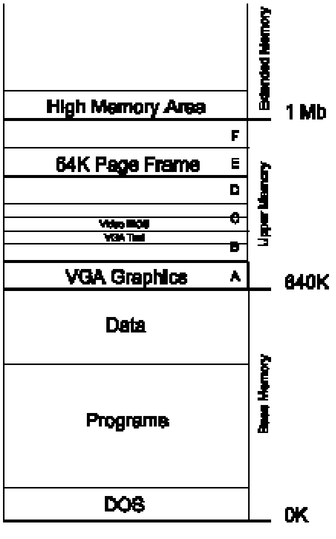
With some VGA cards, if video shadow is disabled, you might get DMA errors, because of timing when code is fetched from the VGA BIOS, when the CPU cannot accept DMA requests. Some programs don't make use of the video ROM, preferring to directly address the card's registers, so you may want to use the extended memory for something else. You may also get better results from increasing the ISA bus clock speed.

If your machine hangs during the startup sequence for no apparent reason, check that you haven't shadowed an area of upper memory containing a ROM that doesn't like it—particularly one on a hard disk controller, or that you haven't got two in the same 128K segment. NetWare doesn't really benefit from Shadow RAM, certainly for the video, and can make better use of the memory.

Flash ROM is now quicker than DRAM, so if you have a Flash BIOS you may find Shadow RAM is not required.

Random Access Memory

There are 6 types of Random Access Memory a program can use:



Base (or conventional) Memory

The first 640K available, which traditionally contains DOS, device drivers, TSRs and any programs to be run, plus their data, so the less room DOS takes up, the more there is for the rest. Different versions of DOS are better or worse in this respect. In fact, under normal circumstances, you can expect the first 90K or so to consist of:

- An **Interrupt Vector Table**, which is 1K in size, including the name and address of the program providing the interrupt service. Interrupt vectors point to any of 255 routines in the BIOS or DOS that programs can use to perform low level hardware access. The *interrupt vector table* is an index of them. DOS uses **io.sys** and **msdos.sys** for the BIOS and DOS, respectively. This also includes user-defined hard disk data (Type 47). During the POST, the BIOS checks the CMOS for an I/O port, which is assigned a hardware address by the CPU, to which the vector table points when moving instructions back and forth between the device and software.

- **ROM BIOS tables**, which are used by system ROMs to keep track of what's going on. This will include I/O addresses.

- **DOS itself**, including the resident portion of **command.com**, plus any associated data files it needs (e.g. buffers, etc).

Note: Sometimes, on the A+ exam (depending on which book you read), the whole of the first 1 Mb of memory is referred to as conventional memory, and the remainder of the 640K *after* DOS, etc, has been loaded as base memory.

DOS was written to run applications inside the bottom 640K block simply because the designers of the original IBM PC decided to—memory then was expensive, and most CP/M machines only used 64K anyway (the PC with 128K was $10,000!). Other machines of the same era used more; the Sirius allowed 896K for programs.

Contrary to popular belief, Windows uses memory below 1Mb, for administration purposes; although it pools all memory above and below 1 Mb (and calls it the *Global Heap*), certain essential Windows structures must live below 1 Mb, such as the *Task DataBase* (TDB) which is necessary for starting new tasks. Every Windows application needs 512 bytes of memory below 1Mb to load, but some will take much more, even all that's available, thus preventing others from loading, which is one source of "Out Of Memory" messages. There are programs that will purposely fragment base memory so it can't be hogged by any one application.

Rather than starting at 0 and counting upwards, memory addressing on the PC uses a two-step **segment:offset** addressing scheme. The *segment* specifies a 16-byte paragraph, or segment, of RAM; the *offset* identifies a specific byte within it. The reason for using two numbers for an address is that using 16 bits by themselves will only give you 65536 bytes as the longest number you can write.

The CPU finds a particular byte in memory by using two registers. One contains the starting segment value and the other the offset, the maximum that can be stored in each one being

65,536 (FFFF in hex), as we said. The CPU calculates a physical address by taking the contents of the segment register, shifting it one character to the left, and adding the two together (see *High Memory*, below). To get a decimal number, multiply the segment by 16 and add the offset to the total.

Sometimes you'll see both values separated by a colon, as with FFFF:000F, meaning the sixteenth byte in memory segment FFFF; this can also be represented as the effective address 0FFFFFh. When referring only to 16-byte paragraph ranges, the offset value is often left out. The 1024K of DOS memory is divided into 16 parts of 64K each. Conventional memory contains the ten from 0000h to 9FFFh (bytes 0 to 655,167), and Upper memory (below) contains the six ranging from A000h to FFFFh.

Upper Memory

The next 384K is reserved for private use by the computer, so that any expansion cards with their own memory or ROMs can operate safely there without interfering with programs in base memory, and *vice versa*. Typical examples include Network Interface Cards or graphics adapters. *There is no memory in it*; the space is simply reserved. This is why the memory count on older machines with only 1 Mb was 640 + 384K of *extended memory* (see below); the 384K was *remapped* above 1 Mb so it could be used. When upper memory blocks are needed, as when using **emm386.exe**, that memory is remapped back again, so you lose a bit of extended memory. This area is split into regions, A-F, which in turn are split into areas numbered from 0000 to FFFF hexadecimally (64K each). With the right software, this area can be converted into *Upper Memory Blocks* for use by TSRs (memory-resident programs) to make more room downstairs. The amount of upper memory available varies between computers, and depends on the amount of space taken up by the System BIOS and whether you have a separate VGA BIOS (on board video sometimes has its BIOS integrated in the system BIOS). It also depends on the number of add-in cards you have, e.g. disk controllers, that normally take up around 16K.

Some chipsets (such as Chips & Technologies) will always reserve this 384K area for shadowing, so it will not appear in the initial memory count on power-up, the system configuration screen, or when using **mem** (if you've ever wondered why you're missing 384K, this is the reason). Other chipsets have a *Memory Relocation* option which will re-address it above 1 Mb as extended memory.

Occasionally, some ROM space is not needed once the machine has booted, and you might be able to use it. A good example is the first 32K of the System BIOS, at F000 in ISA machines. It's only used in the initial stages of booting up, that is, before DOS gets to set up device drivers, so this area is often useable (the Stealth feature supplied with **qemm** takes advantage of this). Note that many proprietary machines, such as Compaq or NEC, and particularly portables, have different arrangements; VGA ROMs sometimes turn up at E000!

If you have Plug and Play, you will lose another 4K for ESCD (*Extended System Configuration Data*), which is part of the specification and largely a superset of Extended ISA (EISA) that stores information on PnP or non-PnP EISA, ISA or PCI cards, so the operating system can reserve specific configurations, which is its primary purpose, that is, to lock them down for individual PnP adapters.

ESCD occupies part of Upper Memory (from E000-EDFF), which is not available to memory managers. PC Cards, incidentally, like to use 4K at D000.

Extended Memory

Memory above 1 Mb is known as *extended memory*, and is not normally useable under DOS, except to provide RAM disks or caches, because DOS runs in *real mode*, and it can't access extended memory in protected mode; you need something like OS/2 for that.

However, some programs, such as AutoCAD (and Windows!), are able to switch the CPU from one to the other by themselves, and some can use DPMI, the *DOS Protected Mode Interface*. DPMI is a method of allowing programs to run in protected mode, as is VCPI, another system promoted by Phar Lap Software (**win.com** starts a DPMI host, used to run the rest of Windows). The difference between the two:

- **VCPI** provides an interface between DOS Extenders and Expanded Memory Managers so they can run smoothly together by allowing them both access to extended memory with the same interrupt as that used for expanded memory (see below). It was originally designed for 386 systems and above, and doesn't support multitasking (or windowed DOS displays in Windows), hence.....

- **DPMI** allows multitasking under similar circumstances as VCPI, but also works on a 286. It was designed by Microsoft, with the object of supporting Windows and controlling DOS software using 32-bit addressing in protected mode on any CPU.

Although extended memory first appeared on the 286, and some software was written to take advantage of it, the 286 was used mostly as a fast XT, because DOS wasn't rewritten (history again). It wasn't until the 386, with its memory paging capability, that extended memory came to be used properly.

High Memory

The first 64K (less 16 bytes) of extended memory, which is useable only by 286, 386 or 486 based computers that have more than 1Mb of memory. It's a quirk in the chip design (or a bug!) that can be exploited by playing with certain I/O addresses to use that portion of extended memory as if it were below 1 Mb, leaving yet more available for programs in base memory. In other words, it is extended memory that can be accessed in real mode. It is activated with **himem.sys** (MS-DOS/ Novell DOS) or **hidos.sys** (DR DOS).

HMA access is possible because of the **segment:offset** addressing scheme of the PC, which can actually count to just under 64K more than 1 Mb, but the 20 address lines still restrict you. If you remember, memory addresses on a PC are 20 bits long, and are calculated by shifting the contents of a 16-bit register (a paragraph) one character to the left, and adding it to a 16-bit offset. For example, address 1234:5678 is interpreted like this:

```
1234          Segment Register
 5678         Address Register
179B8         20-bit address
```

Shifting 1 to the left is the same as adding a zero to the right, thus multiplying by 16 to get the total byte count (like you do with decimals).

Address references near the last memory address in Upper Memory (FFFF:000F, or the sixteenth byte in segment FFFF) generate a "carry bit" when the 16-bit offset value (0FFFFh) is added to the 20-bit shifted segment value (FFFF0h):

```
FFFF        segment (FFFF0, or 1Mb-16bytes)
FFFF        offset (64K)
10FFEF
```

The 8088, with only 20 address lines, cannot handle the address carry bit (1), so the processor simply wraps around to address 0000:0000 after FFFF:000F; in other words, the upper 4 bits are discarded (the number 1 above).

On a 286 or later, there is a 21st memory address which can be operated by software (see below), which gives you a carry bit. If the system activates this bit while in 8088 (real) mode, the wraparound doesn't happen, and the high memory area becomes available, as the 1 isn't discarded.

The reason for the HMA's size restriction is simply that it's impossible to create an address more than 64K above 1 Mb using standard real mode segments and offsets. Remember that segments in real mode become selectors in protected mode and don't have to follow the same rules; they can address more than 1 Mb.

Gate A20

So, the 8088 in the original PC would wrap around to lowest memory when it got to 1 Mb; the 286 would do it at 16 Mb. On some machines, an AND Gate was installed on CPU address line 20 (the 21st address line) that could switch to allow either wraparound, or access to the 16 Mb address space, so the 286 could properly emulate the 8088 in real mode. A spare pin on the keyboard controller was used to control the gate, either through the BIOS or with software that knew about it.

Windows enters and leaves protected mode through the BIOS, so Gate A20 needs to be continually enabled and disabled, at the same time as the command to reset the CPU into the required mode is sent. Programs in the HMA must be well behaved enough to disable the A20 line when they are not in use and enable it when they are. Only one program at a time can control A20, so only one can run in the HMA, which should do so as efficiently as possible. *DOS Extenders* were one way of using this under DOS until something like OS/2 came along. Many were incorporated into applications, such as Lotus 123, v3 or AutoCAD. They typically intercept interrupts, save the processor state, switch the CPU into real mode, reissue the interrupt, switch back to protected mode, restore the CPU state and resume program execution. All very long-winded.

XMS

As there was originally no operating system to take advantage of extended memory, developers accessed it in their own way, often at the same time. Lotus, Intel and Microsoft, together with

AST, came up with an eXtended Memory Specification that allowed real-mode programs to get to extended memory without interfering with each other. The software that provides XMS facilities in DOS is **himem.sys**.

Expanded Memory

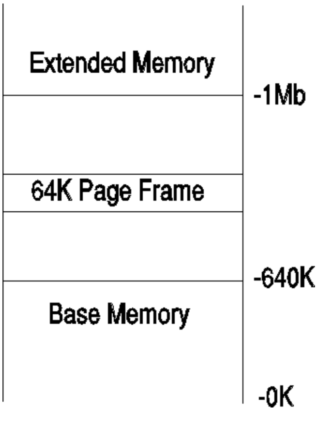
This is the most confusing one of all, because it sounds so much like *expansion memory*, which was what extended memory was sometimes called! Also, it operates totally outside the address space of the CPU.

Once the PC was in the market, it wasn't long before 640K wasn't enough, particularly for people using *Lotus*, the top-selling application of the time, and the reason why many people bought PCs in the first place. They were creating large spreadsheets and not having enough memory to load them, especially when version 2 needed 60K more memory than the original. It wasn't entirely their fault; Lotus itself in its early days was very inefficient in its use of memory.

Users got onto Lotus, Intel and Microsoft for a workaround, and they came up with LIM memory (from the initials), also known as *Expanded*. It's a system of physical bank-switching, where several extra banks of memory can be allocated to a program, but only one will be in the address space of the CPU at any time, as that bank is switched, or *paged*, in as required. In other words, the program code stays in the physical cells, but the electronic address of those cells is changed, either by software or circuitry.

You added a memory card to your PC that divided its memory into *pages* of 16K, up to 8 Mb. Four of those (contiguous) 16K pages were allocated space in upper memory, added to base memory and used to access the card. Software was used to map pages back and forward between the card and upper memory.

In effect, LIM (4.0) directly swaps the contents of any 16K block of expanded memory with a similar one inside upper memory; actually, no swapping takes place, but pages have their address changed to look like it does; bank switching. Once the *page frame* is mapped to a page on the card, the data in that page can be seen by the CPU (imagine software using a torch through the page frame, and seeing the memory where the light falls). Points to note about LIM:



- It's normally for data (not program code).
- Programs must be specially written for it.

There are two LIM standards, 3.2 and 4, the latter incorporating standards from E(nhanced)EMS, which came from AST. Although, in theory, LIM 4 doesn't need a page frame, the programs you run may well expect to see one. In addition, there could be up to 64 pages, so you could bank switch up to a megabyte at a time, effectively doubling the address space of the CPU, and enabling program code to be run, so you could multitask for the first time (check out

desqview). This was called *large-frame EMS*, but it still used only four pages in upper memory; the idea was to remove most of the memory on the motherboard. The memory card *backfilled* conventional memory and used the extra pages for banking. On an 8086 or 286-based machine, expanded memory is usually provided by circuitry on an expansion card, but there are some (not altogether successful) software solutions. 386 (and 486) -based machines have memory management built in to the central processor, so all that's needed is the relevant software to emulate LIM (**emm386.exe** or similar). At first this idea used the hard disk for the pages (on 286s), but later they were moved to extended memory; the extended memory is made to look like expanded memory to those programs that require it, helped by protected mode and the paging capabilities of the 386 and above.

When manually selecting a page frame, you will need 64K of contiguous upper, or non-banked, memory (that is, it needs to be all together in one place). Various programs (such as **msd**, which comes with Windows, or DOS 6) will inspect upper memory and tell you how it's being used, and help you place the page frame properly. Try and place it directly next to a ROM, and not in the middle of a clear area, so what's left is as contiguous as possible for other programs. A good place is just under the system ROM, at E000, or above the video ROM, at C800 (its position in the diagram above is for illustration purposes only).

Virtual Memory

"Virtual" in the computer industry is a word meaning that something is other than what it appears to be. In view of that, Virtual Memory isn't memory at all, but hard disk space made to look like it; the opposite of a RAM disk, in fact. Windows uses virtual memory for *swap files* when physical memory runs out (on the PC, you can only use virtual memory with 286s and above, because you need protected mode). Like disk cacheing, VM was used on mainframes for some time before migrating to the PC; VMS, the OS used on DEC VAXes, actually stands for *Virtual Memory System*. There is a speed penalty, of course, as you have to access the hard disk to use it, but Virtual Memory is a good stopgap when you're running short.

Shared Memory

This is where VGA and System memory share the same chips, and needs a BIOS to suit (and a little more RAM!). It comes under the name of *Unified Memory Architecture* (UMA) and uses three buses, two of which share memory address, data and control (CAS, RAS, WE). The third arbitrates between them all. There will be a buffer for the screen display, and you often have to set this in the BIOS. Typically, the graphics controller has to wait its turn behind the CPU, PCI or ISA master. Shared memory lives either at the top of overall system memory or the top of the first bank of DRAM. A *scramble table* is used to translate between the CPU host address and memory Row and Column address.

Timing is quite important, as you can imagine. The graphics controller must be able to get to as much data as possible in the short time it has access to its memory, often done while the CPU is accessing L2 cache.

Memory Management

This mainly revolves around finding unused areas of upper (or high) memory and using them for TSRs and the like (including DOS), so you get more room in base memory for programs and data.

The programs are still within the 1 Mb access area and can therefore be seen in real mode. Having got them there, you need to worry about their arrangement. Most memory management is carried out with **config.sys**.

If you use Windows only, you might not need to bother about this, but as soon as you use DOS programs under Windows, the memory available inside that DOS session is a direct reflection of that available when Windows starts (and don't forget Windows needs memory below 1 Mb).

Basic Rules

- Load the larger programs first, although certain software, such as network drivers, must be loaded in a particular sequence (many of these now load themselves high automatically—Novell's lsl.com, however, works best low). The mouse driver (amongst others), although it ends up as 15K, actually uses 60K to load properly. If you try with less than this available, and it can't expand properly, it will load in low memory, so put this one first of all. How do you find out how each program behaves? Refer to Memmaker, below.

- Next, make sure you aren't allocating EMS, or at least a page frame, unnecessarily; not only will the page frame take up 64K, but valuable XMS memory could be lost as it's converted over to expanded.

- Exclude areas of upper memory occupied by ROMs on expansion cards, or needed by PCMCIA enablers when they're initialised. NetWare managers often exclude all of it.

- Have as large a contiguous area available as possible, by putting ROMs, etc, at one end or the other.

Software used

HIMEM.SYS

This program activates the A20 memory address line, providing a gateway into extended memory, so is required by Windows. It also activates the high memory area. You can control how the HMA is used with command line switches, explained in *System Configuration Files*.

EMM386.EXE

This is not necessary to run Windows, but is needed if you want to use upper memory, or emulate expanded memory for DOS programs when running Windows(3.x) in Standard mode. Version 4.49 comes with DOS 6.22. As you need to remap extended memory to use it, it can be a performance drain, so is best avoided if you can. It also runs the machine in *Virtual 8086* mode, which some programs don't like.

MEMMAKER

Comes with DOS and finds the best area of upper memory for the programs you want to load there. However, it won't change the *order* of your programs, as **qemm** or **386max** will do. Use **memmaker** to produce a file called **memmaker.sts**, which will give you two parameters for each program (it's a text file). The parameters are:

- **FinalSize**, or how much RAM is occupied once loaded, and

- **MaxSize**, or the RAM it needs to initialise.

Look for programs with the largest difference between the two and load them first. An example section is:

```
Command=c:\dos\doskey /Insert /Bufsize=256
Line=1
FinalSize=3888
MaxSize=6384
FinalUpperSizes=0
MaxUpperSizes=0
ProgramType=PROGRAM
```

MEM

This is a DOS command that keeps changing the way it looks, certainly between DOS versions 5 and 6. I'm using the one that comes with PC-DOS 6.3 (just to be different), so your own system may not look the same (**/A** gives HMA usage):

```
Memory Type          Total  =   Used  +   Free

Conventional          640K       27K      613K
Upper                  59K       39K       20K
Reserved              384K      384K        0K
Extended (XMS)*     7,109K    1,509K    5,600K

Total memory        8,192K    1,959K    6,233K

Total under 1Mb       699K       66K      633K

Total Expanded (EMS)      1,408K (1,441,792 bytes)
Free Expanded (EMS)*      1,024K (1,048,576 bytes)

* EMM386 is using XMS memory to simulate EMS as needed.

Free EMS memory might change as free XMS changes.

Largest executable program size  613K (627,504 bytes)
Largest free upper memory block  20K  (20,128 bytes)


PC DOS is resident in the high memory area.
```

It says PC-DOS because I was using a Thinkpad at the time (it also comes with Virtual PC for the Mac)..

Total memory is 8 Mb, or 8192 K.

Of the 640K of conventional memory, 27 is used for DOS and related files, 613K is available for applications (you might see 634 if you're using QEMM). If you see 639K here, it could be for one or two reasons, such as a virus, which typically take 1K at this point. Another is untidy housekeeping by Windows, which doesn't always release memory properly when it quits.

In the upper memory area, out of a total of 59K of remappable space found by **emm386.exe**, 39K is being used, leaving 20K free. We should have 7168 Mb of XMS memory (7 Mb), but 7109 is reported, as **emm386.exe** borrows some to fill in upper memory areas, hence 7109 + 59 = 7168.

MSD

This is *Microsoft Diagnostics*, which is provided with Windows 3.1/3.11 and MS-DOS 6/6.2. It gives you a view of your PC's memory map, as well as an inkling of what's going on in the rest of it. It was issued originally for beta testers, who would be told to run **msd**, print the screen if they got a problem, and fax the results to the Microsoft programmers.

The display isn't as pretty as **manifest**'s, but it's free (it was written by a Microsoft programmer in his spare time). Neither is it authoritative, in that it only reflects the memory setup you've specified in **config.sys** and **autoexec.bat**; that is, interrupts need software to activate them before **msd** picks them up. Because **msd** runs in text mode, the VGA graphics area (A000-AFFF) will show available as well.

The best version is 2.10; it reports the Windows version correctly, aside from giving descriptions about the drivers available (2.11 doesn't). The latest (2.13) comes on the Windows '95 CD, in **\other\msd**.

Switches

/B	Black and white display.
/I	Bypass initial hardware detection (if it hangs up on launch).
/P filename	Writes a full report to *filename.*
/S filename	Writes a summary report to *filename.*

Memory Chips

The speed is indicated by the last number of the ID, typically after a hyphen, like -70, which means 70 nanoseconds. There may or may not be a leading zero. Numbering on a chip is split into two, although it never looks like that. The first part indicates complexity, and the second the data path size, or how many bits can be read or written at the same time. To find capacity, multiply the first part by the second, divide by 8 and throw away the remainder:

- ❑ banks of 256, meaning 1 Mb
- ❑ bank of 1 Mb, meaning 1 Mb
- ❑ banks of 1 Mb, meaning 4 Mb

You might see a date looking like this:

```
8609=9th month of 86.
```

The decode for each manufacturer listed below is as follows (using Alliance as an example):

```
AS4C14405-60JC
       AS = Alliance
       4 = DRAM
       C = 5volt
       6 = 4K refresh (7=2K, 8=1K)
       40 = 1Meg x 4 (256K16=256Kx16, 1M16=1Megx16)
       0 or F = Fast Page (5 or E=EDO)
       50=50ns, 60=60ns, 70=70ns etc
```

SIMMs

SIMM stands for *Snap-In Memory Module* (or *Single In-line*). It is a small circuit board a few inches long on which are soldered some memory chips, vertically or horizontally. A 256K chip on a SIMM has connections on all sides. If there are nine on each side, it is parity memory. Nine of these on a SIMM makes a 256 K SIMM with parity. A 1 Mb chip has 10 on each side, in two groups of 5, or 13 on each side. A 4 Mb chip is mostly about 20% wider than a 1 Mb, also with 10 leads in two groups of 5, or 14 on each side. The latter will be slightly taller.

SIMMs can identified with chip ID (see above) and placement, e.g. whether horizontal, vertical, on both sides, etc., and resistors, which are often used to tie the presence detect pins, 67-70, to ground.

If you really want to show off, you can ID 72-pin SIMMs by checking the resistance of those pins against 72, which is ground (if the notch is on the left, 72 is the one on the far right). For example, this table refers to IBM products:

70	69	68	67	Size speed and part no
I	I	I	I	Not valid
I	I	I	C	1 Mb 120 ns
I	I	C	I	2 Mb 120 ns
I	I	C	C	2 Mb 70 ns 92F0102
I	C	I	I	8 Mb 70 ns 64F3606
I	C	I	C	Reserved
I	C	C	I	2 Mb 80 ns 92F0103
I	C	C	C	8 Mb 80 ns 64F 3607
C	I	I	I	Reserved
C	I	I	C	1 Mb 85 ns 90X8624
C	I	C	I	2 Mb 85 ns 92F0104
C	I	C	C	4 Mb 70 ns 9F0105
C	C	I	I	4 Mb 85 ns 79F1002
C	C	I	C	1 Mb 100 ns 8 Mb 80 ns 79F1004
C	C	C	I	2 Mb 100 ns
C	C	C	C	4 Mb 80 ns 92F33372 Mb 85 ns 79F1003

30 pin

There are two types, so-called 3-chip or 9-chip. You may as well include 2-chip or 8-chip if you ignore the parity bit. In theory, software can't tell the difference, but Windows has been known to work better on the 9-chip variety; there are cost and refresh timing differences between the two, and some motherboards work with one but not the other.

72 pin

These come as a longer circuit board with fine edge connectors and a notch in between. Some manufacturers, such as IBM, move the notch so the SIMM will only fit into one machine, or rather that their machine will only take one type of SIMM (guess whose?). They are 32 bits wide (or 36 with parity). The 4 extra bits in a 36-bit SIMM can be used for ECC instead, where single-bit errors will be corrected and not halt the machine, unlike parity which will merely report the error and halt it. Multiple-bit errors are reported with a halt.

SIMMs have address lines and a select line—a chip will respond when its select line is active. Motherboards that can only accept single-sided SIMMs have only one select line, so will not read the two select lines on a double-sided SIMM.

1Mb, 4Mb, 16Mb and 64 Mb SIMMs are generally single-sided, and 2Mb, 8Mb, and 32Mb SIMMs double-sided. They all load the chipset equally, as they use 4 x chips, except for one version of the 64 Mb, which uses 4 x 16 Mb ones, although the others are becoming available. Using conventional 16 Mb SIMMs (4 x 16) with the Triton II is not recommended, and only use up to 2 with the Natoma. Note that electrically single-sided SIMMs may look double sided; they just have chips on both sides. Motherboards use these in different ways; some may treat a double-sided SIMM as two singles, and some may take two double sided or four single sided. You can't use a double sided as a 64-bit chip in a Pentium based machine; they can still only be accessed 32 bits at a time.

There are two types of 36-bit SIMMs; those with logic parity, and those with true parity. A logic parity chip is programmed to answer yes if the computer checks for parity. If you use one in a machine that does more than just query for parity, it will complain loudly (e.g. Gateways), as it adds extra loading to the memory bus and the parity bit is computed later, so it also runs slower. Non-parity chips can be used in machines that either don't use parity (Macs) or allow you to turn off parity checking in the BIOS.

DIMMs

These are 64/72 bit modules, so you only need one for Pentiums. They use one set of contacts and chips for each side of the circuit board, have 168 pins and run at 3.3 and 5.0V. They are 5¼ inches wide and range from 1-1½ in height.

Video

The RAM on a video card is called the *frame buffer*, which holds a complete frame and defines the colour of each pixel. It follows that the greater the frame buffer (or the more memory there is on your card) the greater the resolution and/or colour depth you get.

How much video memory you need depends on the resolution you are using, plus the colour depth and refresh rate. At 60 MHz at 800 x 600, the controller is drawing dots on the screen at 40 MHz to keep up. For 256 colours, one byte is needed for each one. With 24-bit colour at 72 KHz, 103, 680, 000 bytes are being written to the screen every second, without you making any changes! 24-bit colour uses 3 bytes per dot and 16-bit only 2.

For a particular resolution, multiply the horizontal pixels by the vertical; 1024 x 768 = 786,43, for example. 256 colours needs 1 byte per dot, so in this case you need 768 K of RAM. 800 x 600 needs 469 K and300 is needed for 640 x 480.

Manufacturers

AMI prefer chips from manufacturers in this order: Hitachi, Fujitsu, Micron, NEC, Samsung and Toshiba, although others are typically OK.

AEP

Number	Capacity	Notes
SS 4K32		128K (4Kx32)
SS 8K32		256K (8Kx32)
SS 64K8		512K (64Kx8)
SS 256K8	2 Mb (256Kx8)	
SS 256K9	2 Mb (256 x 9)	44 pin SIP
SS 128K8	1 Mb (128K x 8)	
SS 32K16	512K (32K x 16)	
SS 128K16	2 Mb (128Kx16)	

Alliance

Cache

```
AS4C14405-60JC
AS = Alliance
4 = DRAM
C = 5volt
6 = 4K refresh (7=2K, 8=1K)
40 = 1Meg x 4
         256K16=256Kx16
         1M16=1Megx16
0 or F = Fast Page (5 or E=EDO)
50=50ns, 60=60ns, 70=70ns etc
```

Number	Capacity	Notes
AS 7C256	32K x 8	
AS 7C3256	32K x 8	3.3V

Array Technology

Number	Capacity	Notes
AT 212SZ		
AT 212		
AT 612CP		40 pin DIP
AT 656CP	256K (16K x 6)	40 pin DIP

AT&T

Cache

Number	Capacity	Notes
ATT 7C167	16K x 1	
ATT 7C168	4K x 4	
ATT 7C171	4K x 4	
ATT 7C172	4K x 4	
ATT 7C116	2K x 9	
ATT 7C187	64K x 1	
ATT 7C164	16K x 4	
ATT 7C166	16K x 4	
ATT 7C165	16K x 4	
ATT 7C185	8K x 8	
ATT 7C195	64K x 4	
ATT 7C199	32K x 8	
ATT 7C106	256K x 4	
ATT 7C109	128K x 8	
ATT 7C180	4K x 4	Tag
ATT 7C174	8K x 8	Tag

Cypress Multichip

Number	Capacity	Notes
CYM 1240HD	1 Mb (256K x 4)	28 pin DIP
CYM 1420HD	1 Mb (128K x 8)	32 pin
CYM 1421HD	1 Mb (128K x 8)	32 pin DIP
CYM 1422PS	1 Mb (128K x 8)	30 pin SIP
CYM 1441PZ	2 Mb (256K x 8)	60 pin ZIP
CYM 1460PS	4 Mb (512K x 8)	36 pin SIP
CYM 1461PS	4 Mb (512K x 8)	36 pin SIP
CYM 1464PD	4 Mb (512K x 8)	32 pin DIP
CYM 1540PS	2 Mb (256K x 9)	44 pin SIP
CYM 1541PD	2 Mb (256K x 9)	44 pin DIP
CYM 1610HD	256K (16K x 16)	40 pin DIP
CYM 1621HD		
CYM 1622HV		
CYM 1623HD	1 Mb (64K x 16)	40 pin DIP
CYM 1624PV	1 Mb (64K x 16)	40 pin DSIP
CYM 1626PS	1 Mb (64K x 16)	40 pin SIP
CYM 1641HD	4 Mb (256K x 16)	48 pin DIP
CYM 1821PZ	512K (16K x 32)	64 FR-4 ZIP
CYM 1822HV	512K (16K x 32)	88 pin DSIP
CYM 1830HD	2 Mb (64K x 32)	60 pin DIP
CYM 1831PZ	2 Mb (64K x 32)	64 pin ZIP
CYM 1831PM	2 Mb (64K x 32)	64 pin SIMM
CYM 1832PZ	2 Mb (64K x 32)	60 pin ZIP
CYM 1840HD	8 Mb (256K x 32)	60 pin DIP
CYM 1841PZ	8 Mb (256K x 32)	64 pin ZIP

Number	Capacity	Notes
CYM 1841PM	8 Mb (256K x 32)	64 pin SIMM

Cache

Number	Capacity	Notes
CY 7C106	256K x 4	
CY 7C109	128K x 8	
CY 7C178	32K x 18	Burst Pent
CY 7C167(A)	16K x 1	
CY 7C168(A)	4K x 4	
CY 7C169(A)	4K x 4	
CY 7C171(A)	4K x 4	
CY 7C172(A)	4K x 4	
CY 7C128(A)	2K x 8	
CY 7C187(A)	64K x 1	
CY 7C164(A)	16K x 4	
CY 7C166(A)	16K x 4	
CY 7C185(A)	8K x 8	
CY 7C186(A)	8K x 8	
CY 7C195	64K x 4	
CY 7B195	64K x 4	
CY 7C198	32K x 8	
CY 7C199	32K x 8	
CY 7B198	32K x 8	
CY 7B199	32K x 8	
CYC 1399	32K x 8	3.3v

Dense-Pac

Number	Capacity	Notes
DPS 16X5	80K (16K x 5)	28 pin SIP
DPS 16X17	256K (16K x 16)	36 pin DSIP
DPS 257	256K (16K x 16) (32K x 8, 64K x 4)	40 pin DIP
DPS 1024	1 Mb (256K x 4) (128K x 8, 64K x 16)	42 pin DIP
DPS 1026	1 Mb (256K x 4) (128K x 8, 64K x 16)	40 pin DIP
DPS 1027	1 Mb (256K x 4) (128K x 8, 64K x 16)	40 pin DIP
DPS 2516	4 Mb (256K x 16)	44 pin DIP
DPS 4648	512K (64K x 8)	32 pin DIP
DPS 5124	2 Mb (512Kx4 256Kx8)	54 pin DIP
DPS 6432	2 Mb (64K 32)	60 pin DIP
DPS 8M612		
DPS 8M624		
DPS 8M656	256K (16K x 6)	40 pin DIP
DPS 10241	1 Mb (1024K x 1)	30 pin SIP
DPS 40256	256K (32K x 8)	28 pin DIP
DPS 41257	256K (32K x 8)	28 pin DIP
DPS 41288	1 Mb (128K x 8)	32 pin DIP

Number	Capacity	Notes
DPS 45128	4 Mb (512K x 8)	48 pin DIP
DPS 45129	4 Mb (256K x 16)	48 pin DIP
DPS 512S8	4 Mb (512K x 8)	32 pin DIP
DPS 3232V	1 Mb (32K x 32)	66 pin HIP
DPE 3232V	1 Mb (32K x 32)	66 pin HIP

EDI

Number	Capacity	Notes
8M1664C		
8M16256C	4 Mb (256K x 8)	48 pin DIP
8M16257C	4 Mb (256K x 16)	40 pin DIP
8F3254C	2 Mb (64K x 32)	60 pin DIP
8M32256C	8 Mb (256K x 32)	60 pin DIP
8M4257C	1 Mb (256K x 4)	28 pin DIP
8M8128C	1 Mb (128K x 8)	32 pin DIP
8M8130C	1 Mb (128K x 8)	32 pin DIP
8M8130P	1 Mb (128K x 8)	32 pin DIP
8M8256C	2 Mb (256K x 8)	32 pin DIP
8F8257C	2 Mb (256K x 8)	32 pin DIP
8F8258CMSC	2 Mb (256K x 8)	36 pin SIP
8M8512C	4 Mb (512K x 8)	32 pin DIP
8M864C	512K (64K x 8)	32 pin DIP
EDH81H256C	256K (256K x 1)	24 pin DIP
EDH816H16C	256K (16K x 16)	36 pin DSIP
EDH84H64C	256K (64K x 4)	24 pin DIP
EDH8808	64K (8K x 8)	28 pin SIP
EDH8832C	256K (8K x 8)	28 pin DIP
8F1664C	1 Mb (64K x 16)	40 pin DIP

Cache

Number	Capacity
EDI 8164	64K x 1
EDI 8416	16K x 4
EDI 8417	16K x 4
EDI 8808CB	8K x 8
EDI 8466CA	64K x 4
EDI 8466CB	64K x 4
EDI 8833C/P/L	32K x 8
EDI 8834C/A	32K x 8
EDI 84256CS	256K x 4
EDI 84256LPS	256K x 4
EDI 88130C/LP	128K x 8

Fujitsu

16 Megabit

```
MB81V17405A-60
MB = Fujitsu
V = 3.3volt (blank = 5v)
18 = 1K refresh
          17 = 2K refresh
          16 = 4K refresh
40 = 4Meg x 4
          80 = 2Meg x 8
          16 = 1Meg x 16
0 = Fast Page
5 = EDO
MB81V17405A-60
50=50ns (60=60ns, 70=70ns
```

SIMM

Number	Capacity	Notes
MB 85301A	1 Mb (256K x 8)	30 pin
MB 85306A	1 Mb (256K x 9)	30 pin
MB 85331	1 Mb (256K x 32)	72 pin 32 bit
MB 85336	1 Mb (256K x 36)	72 pin 36 bit
MB 85376	1 Mb (256K x 40)	72 pin 40 bit
MB 85332	1 Mb (512K x 32)	72 pin 32 bit
MB 85337	1 Mb (512K x 36)	72 pin d/s 36 bit
MB 85377	1 Mb (512K x 40)	72 pin d/s
MB 85230	1 Mb (1M x 8)	30 pin 8 chip
MB 85235	1 Mb (1M x 9)	30 pin
MB 85303	4 Mb (1M x 8)	30 pin
MB 85308	4 Mb (1M x 9)	30 pin
MB 85341	4 Mb (1M x 32)	72 pin
MB 85346	4 Mb (1M x 36)	72 pin
MB 85378	4 Mb (1M x 40)	72 pin
MB 85342	4 Mb (2M x 32)	72 pin
MB 85347	4 Mb (2M x 36)	72 pin
MB 85379	4 Mb (2M x 40)	72 pin d/s
MB 85280	4 Mb (4M x 8)	30 pin
MB 85290	4 Mb (4M x 8)	30 pin
MB 85285	4 Mb (4M x 9)	30 pin
MB 85295	4 Mb (4m x 9)	30 pin

DRAM

Number	Capacity	Notes
MB 8264	64K x 1 bit	DRAM
MB 85402	256K (16K x 16)	36 pin DSIP
MB 85403	2 Mb (256K x 8)	44 pin SIP
MB 85410	512K (64K x 8)	60 pin ZIP
MB 85411	512K (64K x 9)	70 pin ZIP
MB 85414	512K (16K x 32)	64 pin ZIP
MB 85415	512K (16K x 36)	70 pin ZIP
MB 85420	2 Mb (256K x 8)	60 pin ZIP

Cache

Number	Capacity
MB 81C67	16K x 1
MB 81C68A	16K x 1
MB 81C69A	4K x 4
MB 81C71	64K x 1
MB 81C71A	64K x 1
MB 81C74	16K x 4
MB 81C75	16K x 4
MB 81C78A	8K x 8
MB 82B78	8K x 8
MB 81C84A	64K x 4
MB 82B85	64K x 4
MB 8298	32K x 8
MB 82B88	32K x 8
MB 82B005	256K x 4
MB 82B008	128K x 8

Galvantech

Cache Chip

```
GVT7132B36Q-9
GVT = Galvantech Inc.
58 = SyncBurst SRAM
          4 = DRAM
          28 = Flash (Dual Supply
          41 = SGRAM
          48 = Synchronous DRAM
          57 = DDR SDRAM
          59 = Sync Late Write SRAM
L = 3.3v (blank = 5v, V = 2.5v)
C = CMOS (B = BiCMOS)
32B36 = 32K x 36
B3 = 3.3v signal levels only
9 = 9ns etc
```

GoldStar (LGS)

16 Megabit EDO or FPM

```
GM71C17400BJ6
GM7 = LGS: Lucky Gold Star
1 = FPM or EDO, 2=SDRAM
1 = 16 Megabit (4=4 Megabit)
C = 5 volt (V=3.3 v)
8 = 1K refresh (7=2K, 6=4K)
10 = 16Meg x 1
```

```
          16 = 1Meg x 16
          40 = 4Meg x 4
          80 = 2Meg x 8
          1 = 16 Megabit
          2 = 128 Megabit
          5 = 256 Megabit
          6 = 64  Megabit
0 = FPM (3 = EDO, 5 = EDO)
5=50ns (6=60ns, 7=70ns)
```

SDRAM

```
GM72V661641CT7J
GM7 = LGS: Lucky Gold Star
1 = FPM or EDO, 2=SDRAM
1 = 16 Megabit (4=4 Megabit)
C = 5 volt (V=3.3 v)
1 = 16 Megabit
          2 = 128 Megabit
          5 = 256 Megabit
          6 = 64  Megabit
16162 = 1Meg x 16 (16Mb)
          1642  = 4Megx4 (16Mb)
          1682  = 2Megx2 (16Mb)
          28164 = 8Megx16 (128Mb)
          2844  = 32Meg x 4 (128Mb)
          2884  = 16Meg x 8 (128Mb)
          56164 = 16Meg x 16(256Mb)
          5644  = 64Meg x 4 (256Mb)
          5684  = 32Meg x 8 (256Mb)
          66164 = 4Meg x 16 (64Mb)
          6644  = 16Meg x 4 (64Mb)
          6684  = 8Meg x 8  (64Mb)
1 = ?
CT = ?
10K = PC66 spec (tCK=15ns, tAC=9ns,
CL=2, tRCD=2, tRP=2)
7K = PC100,222 spec (tCK=10ns,
tAC=6ns, CL=2, tRCD=2, tRP=2)
7J = PC100,322 spec (tCK=10ns,
tAC=6ns, CL=3, tRCD=2, tRP=2)
8 = 125MHz spec (tCK=8ns, tAC=6ns,
CL=3, tRCD=3, tRP=3)
75 = PC133 spec (tCK=7.5ns,
tAC=5.4ns, CL=3, tRCD=3, tRP=3),
7 = 143MHz spec (tCK=7ns,
tAC=5.4ns, CL=3, tRCD=3, tRP=3)
```

Number	Capacity	Notes
GM 71C1000J	1 Mb	72 pin
GMM 794000S	4 Mb	30 pin

Harris

Number	Capacity	Notes
HM 8808	64K (8K x 8)	28 pin DIP
HM 8816	128K (16K x 8)	28 pin DIP
HM 92560	256K (32Kx8) (16Kx16)	48 pin DIP synch

Hitachi

```
HM51W4265CJ6
HM5 = Hitachi Memory
W = 3,3volt (blank=5v)
1 = 16 Megabit (4 = 4  Megabit)
2 = 512 refr (4=1K,8=1K,7=2K,6=4K)
26 = 256K x 16
          40 = 1Meg x 4
          80 = 512K x 8
          10 = 16Meg x 1 (16M)
          16 = 1Meg x 16 (16M)
          40 = 4Meg x 4 (16M)
          80 = 2Meg x 8 (16M
0 = Fast Page (5 = EDO)
5=50ns (6=60ns, 7=70ns)
```

Number	Capacity	Notes
HM 4864	64K x 1	DRAM
HB 56A25640BR	1 Mb (256K x 40)	72 pin 40 bit
HB 56A51240BR	1 Mb (512K x 40)	72 pin d/s 40 bit
HB 56G25632B	1 Mb (256K x 32)	72 pin 32 bit
HB 56G25636B	1 Mb (256K x 36)	72 pin 36 bit
HB 56G51232SB	1 Mb (512K x 32)	72 pin 36 bit
HB 56G51236SG	1 Mb (512 x 36)	72 pin d/s 32 bit
HM 514400AS	1 Mb	72 pin
HB 56A18B	1 Mb (1M x 8)	30 pin
HB 56A19B	1 Mb (1Mb x 9)	30 pin
HB 56G18B	4 Mb (1M x 8)	72 pin
HB 56G19B	4 Mb (1M x 9)	30 pin
HB 56D132SBR	4 Mb (1M x 32)	72 pin
HB 56D136SBR	4 Mb (1M x 36)	72 pin
HB 56D136SBS	4 Mb (1M x 36)	72 pin
HB 56A140BR	4 Mb (1M x 40)	72 pin
HB 56A232SBT	4 Mb (2M x 32)	72 pin d/s
HB 56D236SBS	4 Mb (2M x 36)	72 pin d/s
HB 56A240BR	4 Mb (2M x 40)	72 pin d/s
HB 56A48BR/AR	4 Mb (4M x 8)	30 pin
HB 56A48ATR	4 Mb (4M x 8)	30 pin
HB 56A49BR/AR	4 Mb (4M x 9)	30 pin
HB 56A49ATR	4 Mb (4M x 9)	30 pin low prof
HB 56A432SB	16 Mb (4M x 32)	72 pin
HB 56D436SBR	16 Mb (4M x 36)	72 pin
HB 56A440B	16 Mb (4M x 40)	72 pin d/s
HB 56A832SB	16 Mb (8M x 32)	72 pin d/s
HB 56D836SB	16 Mb (8M x 36)	72 pin d/s
HB 56A840B	16 Mb (8M x 40)	72 pin d/s
HB 56A168B	16 Mb (16M x 8)	30 pin d/s
HB 56A169B	16 Mb (16M x 9)	30 pin d/s
HM 66203(L)	1 Mb (128K x 8)	32 pin DIP
HM 66204	1 Mb (128K x 8)	32 pin DIP
HM 62256(L)P	256K (32K x 8)	28 pin DIP

Cache

Number	Capacity
HM 6267	16K x 1
HM 6268	4K x 4
HM 6716	2K x 8
HM 6287	64K x 1
HM 6787	64K x 1
HM 6288	16K x 4
HM 6788	16K x 4
HM 6289	16K x 4
HM 6789	16K x 4
HM 6709A	64K x 4
HM 62832H	32K x 8
HM 624256A	256K x 4
HM 628127H	128K x 8

Hyundai

4 Megabit

```
HY514400-60
HY = Hyundai
514 = 4  Megabit
          511 = 16 Megabit
          31 = 1  Megabit
          534 = 1  Megabit
          53C = 256 Kilobit
100 = 4Meg x 1/? refresh
260 = 256K x 16/512 refresh
400 = 1Meg x 4/1K refresh
800 = 512K x 8/1K refresh
50=50ns (60=60ns, 70=70ns)
```

16 Megabit

```
HY51V17400BJ-60
HY = Hyundai
511 = 16 Megabit
          514 = 4  Megabit
          516 = 64 Megabit
          531 = 1  Megabit
          534 = 1  Megabit
          53C = 256 Kilobit
V = 3,3volt (blank=5v)
6 = 4K refresh (7=2K, 8=1K)
10 = 16Meg x 1
          16 = 1Meg x 16
          40 = 4Meg x 4
0 = Fast Page (4 = EDO)
50=50ns (60=60ns, 70=70ns)
```

64 Megabit

```
HY51V645400BJ-60
HY = Hyundai
51 = DRAM (57 = SDRAM see below)
V = 3,3volt (blank=5v)
64 = 64 Megabit (8K refresh)
          65 = 64 Megabit(4K
refresh)
          1  = 16 Megabit
          4  = 4  Megabit
5 = ? K refresh
16 = ? (40=?, 80=8Meg  x 8
0 = Fast Page (4 = EDO)
50=50ns (60=60ns, 70=70ns)
```

SDRAM 64 Megabit

```
HY57V651620TC-10
HY = Hyundai
57 = SDRAM
V = 3,3volt (blank=5v)
16 = 16 Megabit
          65 = 64 Megabit
1610 = 16 * 4K (2 bank)
          1620 = 16Megx4 (4 bank
64Mb)
          4010 = 4 * 16K (2 bank)
          4020 = 4 * 16K (4 bank)
          8010 =  8 * 8K (2 bank)
          8020 =  8 * 8K (4 bank)
TC  = PC66-222 spec (old G3)
ATC = PC100-323 spec (Blue G3 OK)
BTC = PC100-222 spec (Blue G3 OK)
CTC = PC100-222 spec (Blue G3 OK)
DTC = PC100-222 spec (Blue G3 OK)
10 = 10 ns
```

Number	Capacity	Notes
HYM 591000AM	1 Mb	72 pin
HYM 514400ALJ	4 Mb	72 pin
HYM 536100AM	4 Mb	72 pin
HYM 594000M	4 Mb	30 pin
HYM 536410M	16 Mb	72 pin

IBM

4 Megabit

```
IBM014400J1F
IBM = IBM
014 = 4 Megabit
          011 = 16 Megabit
          016 = 64 Megabit
40 = 1Meg x 4
          80 = 512 x 8
          16 = 256 x 16
0 = Fast Page Mode (5 = EDO)
```

16 Megabit

```
IBM0116405BT1E
IBM = IBM
011 = 16 Megabit
          014 = 4 Megabit chip
          016 = 64 Megabit chip
          025 = VRAM chip
8 = 1K refresh
          7 = 2K refresh
          6 = 4K refresh
40 = 4Meg x 4
          80 = 2Meg x 8
          16 = 1Meg x 16
0 = Fast Page Mode (5 = EDO)
blank = 5v
          B = 3.3v
          M = 5v low power
          P = 33v low power
50=50ns (60=60ns, 70=70ns)
```

VRAM

```
IBM025170LGB-60
IBM = IBM
025 = VRAM
          011 = 16 Megabit
          016 = 64 Megabit
          014 = 4 Megabit
160 = 256K x 16 Multiport (4Mbit)
161 = 256K x 16 Multiport (4Mbit)
170 = 256K x 16 Multiport (4Mbit)
171 = 256K x 16 Multiport (4Mbit)
N = 3.3 volt (L = 5 volt)
50=50ns (60=60ns, 70=70ns)
```

Number	Capacity	Notes
57G8887	4 Mb	30 pin

IC Works

Cache

Number	Capacity	Notes
ICW 73B586A	32K x 18	Burst Pent
ICW 73B586B	32K x 18	Burst Pent

IDT

Cache

```
IDT71V433
IDT = Integrated Device Technology
71 = ?
blank = 5v (V = 3.3v)
256 = 32K x 8
          432 = 32K x 32
          433 = 32K x 32
          632 = 64K x 32
          633 = 64K x 32
```

Inmos

Cache

Number	Capacity
IMS 1403	16K x 1
IMS 1423	4K x 4
IMS 1600	64K x 1
IMS 1605	64K x 1
IMS 1620	16K x 4
IMS 1625	16K x 4
IMS 1624	16K x 4
IMS 1629	16K x 4
IMS 1630	8K x 8
IMS 1635	8K x 8

Inova

Number	Capacity	Notes
S 128K8(L)	1 Mb (128K x 8)	32 pin DIP
S 32K8	256K (32K x 8)	JEDEC 28 pin DIP

Lifetime

16 Megabit

```
2X8LE-SS = 3.3v EDO/2Meg x 8
S4004SB1DJ-06 = 5v
S4004SE1DJ-06 = 5v EDO
S4004LB1DJ-06 = 3.3v FPM
S4004LE1DJ-06 = 3.3v EDO
5=50ns (6=60ns, 7=70ns)
```

Logic Devices

Number	Capacity	Notes
LMM 4016	4 Mb (256K x 16)	48 pin DIP
LMM 624	1 Mb (64K x 16)	40 pin DIP
LMM 824	1 Mb (128K x 8)	32 pin DIP
LMM 456	256K (64K x 4)	28 pin SIP

Micron

4 Megabit

```
MT4C4007J-6
```

```
MT = Micron Technology Inc.
4 = DRAM
C = CMOS
1004 = 4M x 1, FPM, ? refresh
          4001 = 1M x 4, FPM, ? refr
          4007 = 1M x 4, EDO, 1K refr
          16270 = 256K x 16, EDO, ?ref
          16257 = 256K x 16, FPM, ?ref
5 = 50ns (6 = 60ns, 7=70ns)
```

16/64 Megabit

```
MT4LC4M4E8DJ-6
MT = Micron Technology Inc.
4 = DRAM
28 = Flash (Dual Supply)
          41 = SGRAM
          46 = Double Data Rate
SDRAM
          48 = Synchronous DRAM
          57 = DDR SDRAM
          58 = SyncBurst SRAM
          59 = Sync Late Write SRAM
L = 3.3v (blank = 5v, V = 2.5v)
C = CMOS (B = BiCMOS)
8M8 = 8Meg x 8
          4M4 = 4Meg x 4
          2M8 = 2Meg x 8
          1M16 = 1Meg x 16
E5 = 1K refresh – EDO
          E7 = 2K refresh – EDO
          E8 = 2K refresh – EDO
          E9 = 4K refresh – EDO
          A1 = 4K refresh – FPM
          B1 = 2K refresh – FPM
          C3 = 1K refresh - FPM
5 = 50ns (6 = 60ns, 7=70ns)
```

Cache

```
MT58LC64K18B2LG-10
MT = Micron Technology Inc.
58 = SyncBurst SRAM
          4  = DRAM
          28 = Flash (Dual Supply)
          41 = SGRAM
          48 = Synchronous DRAM
          57 = DDR SDRAM
          59 = Sync Late Write SRAM
L = 3.3v (blank = 5v, V = 2.5v)
C = CMOS (B = BiCMOS)
64K18 = 64K x 18
64K36 = 64K x 36
32K36 = 32K x 36
B2 = Takes 3.3 v & 5 v signal
levels
          B3 = 3.3v signal levels
only
10 = 10ns etc
```

BEDO DRAMs

Number	Capacity
MT4LC4M4G6	4 M x 4
MT4LC16M4D7	16 M x 4
MT4LCI6M4D9	16 MX4
MT4LC2M8F4	2 M x 8
MT4LC8M8W4	8 M x 8
MT4LC8M8W5	8 M x 8
MT4LC1 M16H5	1 M x 16
MT4LC4M16U2	4 M x 16
MT4LC4M16U6	4 M x 16

EDO DRAMs

Number	Capacity
MT4C4007J (L)	1 M x 4
MT4LC4M4E8 (L)	4 M x 4
MT4LC16M4G3	16 M x 4
MT4LC16M4H9	16 M x 4
MT4LC2M8E7 (L)	2 M x 8
MT4LC8M8P4	8 M x 8
MT4LC8M8C2	8 M x 8
MT4C16270	256K x 16
MT4LC1M16E5 (L)	I M x I6
MT4LC4M16N3	4 M x 16
MT4LC4M16R6	4 M x 16

FPM DRAMs

Number	Capacity	Notes
MT4C1004J (L)	4 M x 1	
MT4C4001J (L)	1 M x 4	72 pin
MT4LC4M4B1 (L)	4 M x 4	
MT4LCI6M4A7	16 M x 4	
MT4LCI6M4T8	16 M x 4	
MT4LC2M8B1 (L)	2 M x 8	
MT4LC8M8E1	8 M x 8	
MT4LC8M8B6	8 M x 8	
MT4C16257 (L)	256K x 16	
MT4LC1M16C3 (L)	1 M x 16	
MT4LC4M16K2	4 M x 16	
MT4LC4MI6F5	4 M x 16	

SGRAM

Number	Capacity
MT41LC256K32D4 (S)	256K x 32

DRAM SIMMs

Number	Capacity
MT2D25632	256K x 32
MT4D51232	512K x 32
MT8D132 (X)	1 M x 32
MT2D(T)132 (X)(B)	1 M x 32
MT16D232 (X)	2 M x 32
MT4D(T)232 (X)	2 M x 32
MT4D232 B	2 M x 32
MT8D432 B	4 M x 32
MT8D432 (X)	4 M x 32
MT16D832 (X)	8 M x 32
MT12D436	4 M x 36
MT24D836	8 M x 36

DRAM DIMMs

Number	Capacity
MT2LDT132H (X)(L)	1 M x 32
MT4LDT232H (X)(L)	2 M x 32
MT8LDT432H (X)(L)	4 M x 32
MT16D164	1 M x 64
MT4LD(T)164 (ABX)	1 M x 64
MT8D264 (X)	2 M x 64
MT8LD264 (ABX)	2 M x 64
MTI6LD464 (ABX)	4 M x 64
MT9LD272(ABX)	2 M x 72
MT18LD472 (ABX)	4 M x 72
MT36LD872 (X)	8 M x 72

Assorted

Number	Capacity	Notes
MT 4264	64K x 1 bit	DRAM
MT 8C16256	4 Mb (256K x 16)	48 pin DIP
MT 8C3216	512K (16K x 32)	64 pin ZIP
MT 8C3264	2 Mb (64K x 32)	64 pin ZIP
MT 8C32256	8 Mb (256K x 32)	64 pin ZIP
MT 85C8128		
MT 85C1632		
MT 85C1664		
MT 9D136M	4 Mb	72 pin

Syncburst Pipelined SRAMs

Number	Capacity
MT58LC64K16C5	64K x 16
MT58LC64K16D8	64K x 16
MT58LC128K16C5	128K x 16
MT58LC128K16D8	128K x 16
MT58LC128K16F1	128K x 16
MT58LC128K16G1	128K x 16
MT58LC256K16F1	256K x 16
MT58LC256K16G1	256K x 16
MT58LC64K18C5	64K x 18
MT58LC64K18D8	64K x 18
MT58LC64K18C4	64K x 18
MT58LC64K18D7	64K x 18
MT58LC128K18C5	128K x 18
MT58LC128K18D8	128K x 18
MT58LC128K18F1	128K x 18
MT58LC128K18G1	128K x 18
MTS8LC256K18F1	256K x 18
MT58LC256K18G1	256K x 18
MT58LC32K32C4	32K x 32
MT58LC32K32D7	32K x 32
MT58LC32K32C5	32K x 32
MT58LC32K32D8	32K x 32
MT58LC32K32G1	32K x 32
MT58LC64K32C5	64K x 32
MT58LC64K32D8	64K x 32
MT58LC64K32F1	64K x 32
MT58LC64K32G1	64K x 32
MT58LC128K32C5	128K x 32
MT58LC128K32D8	128K x 32
MT58LC128K32F1	128K x 32
MT58LC128K32G1	128K x 32
MT58LC32K36C4	32K x 36
MT58LC32K36D7	32K x 36
MT58LC32K36C5	32K x 36
MT58LC32K36D8	32K x 36
MT58LC32K36G1	32K x 36
MT58LC64K36C5	64K x 36
MT58LC64K36D8	64K x 36
MT58LC64K36F1	64K x 36
MT58LC64K36G1	64K x 36
MT58LC128K36C5	128K x 36
MT58LC128K36D8	128K x 36
MT58LC128K36F1	128K x 36
MT58LC128K36G1	128K x 36

Syncburst Flow--Through SRAMs

Number	Capacity
MT58LC64K16B2	64K x 16
MT58LC64K16B3	64K x 16
MT58LC128K16B3	128K x 16
MT58LC128K16E1	128K x 16
MT58LC256K16E1	256K x 16
MT58LC64K18B2	64K x 18
MT58LC64K18B3	64K x 18

Number	Capacity
MT58LC128K18B3	128K x 18
MT58LC128K18E1	128K x 18
MT58LC256K18E1	256K x 18
MT58LC32K32B2	32K x 32
MT58LC32K32B3	32K x 32
MT58LC64K32B3	64K x 32
MT58LC64K32F1	64K x 32
MT58LC128K32B3	128K x 32
MT58LC128K32E1	128K x 32
MT58LC32K36B2	32K x 36
MT58LC32K36B3	32K x 36
MT58LC64K36B3	64K x 36
MT58LC64K36E1	64K x 36
MT58LC128K36B3	128K x 36
MT58LC128K36E1	128K x 36

Synchronous SRAM Module

Number	Capacity
MT3L5T3264	32K x 64
MT3LST3264P	32K x 64
MT5LST6464	64K x 64
MT5LST6464P	64K x 64

Assorted

Number	Capacity	Notes
MT 5C1601	16K x 1	
MT 5C1604	4K x 4	
MT 5C1606	4K x 4	
MT 5C1607	4K x 4	
MT 5C1608	2K x 8	
MT 5C6401	64K x 1	
MT 5C6404	16K x 4	
MT 5C6405	16K x 4	
MT 5C6408	8K x 8	
MT 5C2565	64K x 4	
MT 5C256B	32K x 8	
MT 5C2568	32K x 8	
MT 5LC2568	32K x 8	3.3v
MT 5LC2568	32K x 8	3.3v
MT 5C1005	256K x 4	
MT 5C1008	128K x 8	

Mitsubishi

16 Megabit

```
M5M4V17400CJ-6
M5M = Mitsubishi
41 = 16 Megabit
V = 3.3v (blank = 5v)
6 = 4K refresh
        7 = 2K refresh
        8 = 1K refresh
10 = 16Meg x 1
        16 = 1Meg x 16
        40 = 4Meg x 4
```

Notes	Capacity	Notes
M5 4164	64K x 1 bit	
M5K 4164	64K x 1	DRAM
M5M 4256P		DRAM
MH 25632BJ/XJ	1 Mb (256K x 32)	72 pin
MH 25636XJ	1 Mb (256K x 36)	72 pin
MH 51232BJ/SXJ	1 Mb (512K x 32)	72 pin d/s
MH 51236SXJ	1 Mb (512K x 36)	72 pin d/s
MH 1M08B0J	1 Mb (1M x 8)	30 pin
MH 1M9B0DJA	1 Mb (1M x 9)	30 pin 9 chip
MH 1M08A0AJ	4 Mb (1M x 8)	30 pin
MH 1M09A0AJA	4 Mb (1M x 9)	30 pin
MH 1M32ADJ	4 Mb (1M x 32)	72 pin
MH 1M36ADJ	4 Mb (1M x 36)	72 pin
MH 1M36EJ	4 Mb (1M x 36)	72 pin
MH 2M32EJ	4 Mb (2M x 32)	72 pin d/s
MH 2M36EJ/AST	4 Mb (2M x 36)	72 pin d/s
MH 2M40AJ	4 Mb (2M x 40)	72 pin d/s
MH 4M08A0J	4 Mb (4M x 8)	30 pin
MH 4M09A0J/DJA	4 Mb (4M x 9)	30 pin
MHIM 36BNDJ	4 Mb	72 pin
M5M 44100AJ	4 Mb (4M x 1)	8 chip
M5M 444000AJ33ISH15		
(MH2M365EJ)	8 Mb	72 pin
MH 4M36ANXJ	16 Mb	72 pin
MH 4M36AJ	16 Mb (4M x 36)	72 pin d/s
MH 16M08	16 Mb (16M x 8)	30 pin d/s
MH 16M09	16 Mb (16M x 9)	30 pin d/s
MH 12808TNA		
MH 12908TNA		
MH 25608S1N	2 Mb (256K x 8)	35 pin SIMM
MH 25608TNA	2 Mb (256K x 8)	32 pin DIP
MH 51208SN	4 Mb (512K x 8)	64 pin SIMM

Cache

Number	Capacity
M5M 21C67	16K x 1
M5M 21X68	4K x 4
M5M 5187A	64K x 1
M5M 5187B	64K x 1
M5M 5188A	16K x 4
M5M 5188B	16K x 4
M5M 5189A	16K x 4
M5M 5189B	16K x 4
M5M 5178	8K x 8
M5M 5259B	64K x 4

Number	Capacity
M5M 5278	32K x 8
M5M 51004	256K x 4

Mosaic

Number	Capacity	Notes
MS 1256CS	256K (256K x 1)	25 pin SIP
MS 1664BCX	1 Mb (64K x 16)	40 pin DIP
MS 3216RKX	512K (16K x 32)	JEDEC 40 pin DIP
MS 3264FKX	2 Mb (64K x 32)	60 pin DIP
MS 3264RKX	2 Mb (64K x 32)	JEDEC 64 pin ZIP
MS 32256FKX	8 Mb (256K x 32)	60 pin ZIP
MS 32256RKX	8 Mb (256K x 32)	64 pin ZIP
MS 8128SLU	1 Mb (128K x 8)	32 pin DIP
MS 8256RKL	2 Mb (256K x 8)	32 pin SIP
MS 8512	4 Mb (512K x 8)	32 pin DIP
PUMA 2S1000	1 Mb (32K x 32)	66 pin HIP
PUMA 2E1000	1 Mb (32K x 32)	66 pin HIP

Mosel

Number	Capacity	Notes
MS 88128	1 Mb (128K x 8)	32 pin DIP

Mostek

Number	Capacity	Notes
MK 4564	64K x 1 bit	DRAM

Motorola

16 Megabit

```
MCM518165BV-60
MCM = Motorola Memory
2/3/5 = Fab Indicator (worldwide)
          4 = Not for sale in USA
18 = 1K refresh
          17 = 2K refresh
          16 = 4K refresh
40 = 4Meg x 4
          16 = 1Meg x 16
0 = Fast Page
          5 = EDO
B = ? (C = ?)
V = 3.3v (blank = 5v)
50=50ns (60=60ns, 70=70ns)
```

Number	Capacity	Notes
MCM 3264	2 Mb (64K x 32)	64 pin ZIP
MCM 6665	64K x 1 bit	DRAM
MCM 8256	2 Mb (256K x 8)	60 pin ZIP
SCM 91781		DRAM

Cache

Number	Capacity	Notes
MCM 6268	4K x 4	
MCM 6287B	64K x 1	
MCM 6288	16K x 4	
MCM 6290	16K x 4	
MCM 6264C	8K x 8	
MCM 6209	64K x 4	
MCM 6206	32K x 8	
MCM 62V06	32K x 8	3.3v
MCM 6306D	32K x 8	3.3v
MCM 6229	256K x 4	
MCM 6226	128K x 8	
MCM 67B518	32K x 18	Burst Pent
MCM 67M518	32K x 18	Burst Power PC
MCM 67H518	32K x 18	Burst Pent

National

Number	Capacity	Notes
MN 4164	64K x 1 bit	DRAM

NEC

1 Megabit

```
421000AA64FB-60
42 = NEC DRAM
1000 = 1Meg x 1/? refresh
4256 = 256K x 4/? refresh
50=50ns (60=60ns, 70=70ns)
```

4 Megabit

```
42S4400GS-60
42 = NEC DRAM
S = low power (blank = normal)
4 = 4  Megabit
          1 = 16 Megabit
100 = 4Meg x 1/? refresh
          260 = 256K x 16/512
refresh
          400 = 1Meg x 4/1K refresh
          800 = 512K x 8/1K refresh
0 = Fast Page
50=50ns (60=60ns, 70=70ns)
```

Number	Capacity	Notes
D 41256		
D 4164C	64K x 1	DRAM
PD 4164	64K x 1 bit	DRAM
SM 591000A	1 Mb	72 pin

Number	Capacity	Notes
MC 120	1 Mb (128K x 8)	32 pin DIP
MC 42256A36	1 Mb (256K x 36)	72 pin
MC 42512A36	1 Mb (512 x 36)	72 pin d/s
MC 42512AA40	1 Mb (512K x 40)	72 pin d/s
MC 421000A8	1 Mb (1M x 8)	30 pin
MC 421000A9	1 Mb (1M x 9)	30 pin
MC 421000A36BE	4 Mb (1M x 36)	72 pin
MC 421000A40	4 Mb (1M x 40)	72 pin
MC 422000A32B	4 Mb (2M x 32)	72 pin d/s
MC 422000A36B	4 Mb (2M x 36)	72 pin d/s
MC 422000AA40	4 Mb (2M x 40)	72 pin d/s
MC 424000AB	4 Mb (4M x 8)	30 pin
MC 424100A9	4 Mb (4M x 9)	30 pin
MC 424000A36BE	16 Mb	72 pin

Cache

Number	Capacity
uPD 4311	16K x 1
uPD 4314C	4K x 4
uPD 4361	64K x 1
uPD 4362	16K x 4
uPD 4363	16K x 4
uPD 4368	8K x 8
uPD 43253	64K x 4
uPD 43258	32K x 8
uPD 431004	256K x 4
uPD 431008	18K x 8

OKI

4 Megabit

```
M51V4260-70J
M51 = OKI
V = 3.3v (blank = 5v)
1 = 16 Megabit
         4 = 4 Megabit
8 = 1K refresh
         7 = 2K refresh
         6 = 4K refresh
10 = 4Meg x 1
         26 = 256K x 16
         40 = 1Meg x 4
         80 = 512K x 8
         90 = 512K x 9
0 = Fast Page (5 = EDO)
50=50ns (60=60ns, 70=70ns)
```

16 Megabit

```
M51V17160-70J
M51 = OKI
V = 3.3v (blank = 5v)
1 = 16 Megabit
         4 = 4 Megabit
8 = 1K refresh
         7 = 2K refresh
         6 = 4K refresh
10 = 16Meg x 1
         16 = 1Meg x 16
         40 = 4Meg x 4
         80 = 2Meg x 8
0 = Fast Page (5 = EDO)
50=50ns (60=60ns, 70=70ns)
```

64 Megabit

```
51V17405B-60
51 = OKI
V = 3.3v (blank = 5v)
1 = 16 Megabit
         4 = 4  Megabit
8 = 1K refresh
         7 = 2K refresh
         6 = 4K refresh
10 = 16Meg x 1
16 = 1Meg x 16
40 = 4Meg x 4
80 = 2Meg x 8
0 = Fast Page (5 = EDO)
50 = 50ns (60=60ns, 70=70ns)
```

Number	Capacity	Notes
MSM 3764	64K x 1 bit	DRAM
M 514400B	1 Mb	72 pin
MSC 2328B	1 Mb (256K x 8)	30 pin
MSC 2332B	1 Mb (256K x 9)	30 pin
MSC 2327B	1 Mb (256K x 32)	72 pin
MSC 2320B	1 Mb (256K x 36)	72 pin
MSC 2333B	1 Mb (512K x 32)	72 pin d/s
MSC 2321B	1 Mb (512K x 36)	72 pin d/s
MSC 2322B	1 Mb (512K x 40)	72 pin d/s
MSC 2313B	1 Mb (1M x 8)	30 pin
MSC 2312B	1 Mb (1M x 9)	30 pin
MSC 23109	4 Mb (1M x 9)	30 pin
MSC 23108	4 Mb (1M x 8)	30 pin
MSC 2316B	4 Mb	72 pin
MSC 23132	4 Mb (1M x 32)	72 pin
MSC 23136	4 Mb (1M x 36)	72 pin
MSC 23S136	4 Mb (1M x 36)	72 pin
MSC 23140	4 Mb (1M x 40)	2 pin

Number	Capacity	Notes
MSC 23232	4 Mb (2M x 32)	2 pin d/s
MSC 23236	4 Mb (2M x 36)	72 pin d/s
MSC 23408	4 Mb (4M x 8)	30 pin
MSC 23409	4 Mb (4M x 9)	30 pin
M 5114100A	4 Mb	30 pin SIMM, 9-chip
M 514900	4 Mb	72 pin

Panasonic

16 Megabit

```
MN41V17405CSJ-06
MN = Panasonic
41 = 16 Megabit
V = 3.3v (blank = 5v)
6 = 4K refresh
         7 = 2K refresh
         8 = 1K refresh
10 = 16Meg x 1
         16 = 1Meg x 16
```

Paradigm

Cache

Number	Capacity	Notes
PDM 41298	64K x 4	
PDM 41256	32K x 8	
PDM 41028	256K x 4	
PDM 41024	128K x 8	
PDM 44258	32K x 18	Burst Pent

Performance

Cache

Number	Capacity
P4C 168	4K x 4
P4C 1681	4K x 4
P4C 1682	4K x 4
P4C 116	2K x 8
P4C 187	64K x 1
P4C 188	16K x 4
P4C 198	16K x 4
P4C 164	8K x 8
P4C 1298	64K x 4
P4C 1256	32K x 8

Quality

Cache

Number	Capacity	Notes
QS 8768	4K x 4	
QS 8761	4K x 4	
QS 8762	4K x 4	
QS 8888	16K x 4	
QS 8886	16K x 4	
QS 8885	16K x 4	
QS 86446	64K x 4	
QS 83280	32K x 8	
QS 83280	32K x 8	
QS 812880	128K x 8	
QS 8780	4K x 4	Tag
QS 83291	32K x 9	Burst 486

Samsung/SEC

DRAM 4 Megabit

```
KM416C1200AJ-6
KM = Samsung/SEC
5 = 50ns (6 = 60ns, 7=70ns)
```

16/64 Megabit and others

```
KM48V2104ALT-6
KM4 = Samsung/SEC
V = 3.3v (C = 5v)
G = SGRAM
4-256= 1Mb  256k x 4
         4-4  = 16Mb 4Meg x 4
         4-4  = 16Mb 4Meg x 4
         8-2 = 16Mb 2Meg x 8
         8-8 = 64Mb 8Meg x 8
         8-5 = 4Mb 512K x 8 4
Mbit
         16-1 = 16Mb 1Meg x 16
         16-2 = 4Mb 256K x 16 4
Mbit
00 = 4K refresh
         10 = 2K refresh
         20 = 1K refresh
0 = Fast Page
         4 = EDO
5 = 50ns (6 = 60ns, 7=70ns)
```

VRAM

```
KM4216C256G-60
```

```
KM4 = Samsung/SEC
2 = VRAM
V = 3.3v (C=5v, W=5v (WRAM))
8-128 = 128K x 8 (1M bit)
          16-256 = 256K x 16 (4M
bit)
          16-258 = 256K x 16 (4M
bit)
          32-259 = 256K x 32 (8M
bit)
50 = 50ns (60 = 60ns, 70 = 70ns)
```

SGRAM

```
KM4132G271BQ-10
KM4 = Samsung/SEC
1 = VRAM
G = SGRAM
32-271 = 256K x 32 (8M bit)
32-512 = 512K x 32(16M bit)
```

Number	Capacity	Notes
KMM 366S203AT	(2M x 64)	SDRAM
KMM 532512BW	2 Mb	72 pin
KMM 5361003C	4 Mb	72 pin
KMM 594000B	4 Mb	30 pin
KMM 5364100A	16 Mb	72 pin
KMM 5368103AK	32 Mb	72 pin

Cache

Number	Capacity	Notes
KM 6165	64K x 1	
KM 6465	16K x 4	
KM 6466	16K x 4	
KM 64B67	16K x 4	
KM 6865	8K x 8	
KM 64258	64K x 4	
KM 68257	32K x 8	
KM 688V257	32K x 8	3.3v
KM 641001	256K x 4	
KM 681001	128K x 8	

SGS

Cache

Number	Capacity	Notes
MK 41H67	16K x 1	
MK 41H68	4K x 4	
MK 41H87	64K x 1	
MK 41H80	4K x 4	Tag
Mk 41S80	4K x 4	Tag

Number	Capacity	Notes
MK 48S74	8K x 8	Tag

Sharp

Number	Capacity	Notes
LH 6764	64K x 1	DRAM

Cache

Number	Capacity
LH 5267A	16K x 4
LH 52253	64K x 4
LH 52258	32K x 8
LH 52258	32K x 8
LH 521002	256K x 4
LH 52100	128K x 8

Siemens

4 Megabit

```
HYB514175BJL-60
HYB = Siemens
31 = 3.3v (51=5v)
39 = SDRAM
          410 = 4Meg x 1
          417 = 256K x 16
          426 = 256K x 16
          440 = 1Meg x 4
8 = 1K refresh (7=2K, 6=4K)
40 = 4Meg x 4
          80 = 2Meg x 8
          16 = 1Meg x 16
0 = Fast Page
          1 = Fast Page
          5 = EDO
B = Product revision
J = SOJ
40=40ns (50=50ns, 60=60ns, 70=70ns)
```

16 Megabit

```
HYB5117800BJL-60
HYB = Siemens
31 = 3.3v (51=5v)
39 = SDRAM
1 = 16 Megabit
          4 = 4  Megabit
          6 = 64 Megabit
8 = 1K refresh
          7 = 2K refresh
          6 = 4K refresh
40 = 4Meg x 4
          80 = 2Meg x 8
```

```
          16 = 1Meg x 16
0 = Fast Page
          5 = EDO
          7 = Burst-EDO
B = Product revision
J = SOJ
40=40ns (50=50ns, 60=60ns, 70=70ns)
```

64 Megabit

```
HYB516XXX0BJL-60
HYB = Siemens
31 = 3.3v/51=5v
39 = SDRAM
6 = 64 Megabit
          4 = 4  Megabit
          1 = 16 Megabit
4 = 8K refresh
          5 = 4K refresh
          6 = 2K refresh
16 = 4Meg x 16
          40 = 16Meg x 4
          80 = 8Meg x 8
0 = Fast Page (5=EDO, 7=Burst-EDO)
B = Product revision
J = SOJ
40 = 40ns (50=50ns, etc)
```

SDRAM

```
HYB = Siemens
39S = 3.3v SDRAM
16 = 16 Megabit
64 = 64 Megabit chip
1616 = 1Meg x 16
16400 = 4Meg x 4
16800 = 2Meg x 8
64160 = 4Meg x 16 (4 bank 64Mb)
64400 = 16Meg x 4 (4 bank 64Mb)
64800 = 8Meg x 8  (4 bank 64Mb)
A = Product revision
T = P-TSOPII
L = Low Power (blank=Normal Pwr)
10 = PC66-222 specs (only old G3)
8B = PC100-323 specs (Blue G3 OK)
8  = PC100-222 specs (Blue G3 OK)
```

Number	Capacity	Notes
HYB 41256		DRAM
HYB 4164	64K x 1	DRAM
HYB 514256A	256K x 4	DRAM

Silicon Magic

```
SM81LC256K16A1-30
SM = Silicon Magic
81 = fixed
L = 3.3v (blank = 5v)
C = CMOS
256 = fixed
16 = 256K x 16 (4Mb)
          32 = 256K x 32 (8Mb)
28 = 28ns (30 = 30ns, 35 = 35ns)
```

Sony

Cache

Number	Capacity
CXK 5164	64K x 1
CXK 5464A	16K x 4
CXK 5466	16k x 4
CXK 5465/7	16K x 4
CXK 5863	8K x 8
CXK 58258	32K x 8
CXK 541000	256K x 4
CXK 581120	128K x 8

Texas Instruments

4 Megabit

```
TMS44100DZ-60
TMS = Texas Instruments
44 = ?
10 = 4Meg x 1/1K refresh
          16 = 256K x 16/1K refresh
          40 = 1Meg x 4/1K refresh
0 = Page Mode
          5 = Page Mode (2WE)
          9 = EDO
50 = 50ns (60=60ns, 70=70ns)
```

16 Megabit

```
TMS418160DZ-60
TMS = Texas Instruments
2 = 3.3v (1 = 5v)
6 = 4K refresh
          7 = 2K refresh
          8 = 1K refresh
10 = 16Meg x 1
          16 = 1Meg x 16
          40 = 4Meg x 4
          80 = 2Meg x 8
0 = Fast Page
          9 = EDO
50=50ns (60=60ns, 70=70ns)
```

64 Megabit

TMS464400DZ-60
TMS = Texas Instruments
l = ?
416 = 4Meg x 16/8K refresh
440 = 16Meg x 4/8K ref
480 = 8Meg x 8/8K ref
516 = 4Meg x 16/4K ref
540 = 16Meg x 4/4K ref
580 = 8Meg x 8/4K ref
0 = Fast Page (9 = EDO)
50=50ns (60=60ns, 70=70ns)

SDRAM

TMS626812DGE-12
TMS = Texas Instruments
12 = SDRAM
162 = 1M x 16 (16 Mb)/2 bank
412 = 4Mx4 (16 Mbit)/2 bank

Number	Capacity	Notes
TMS 4164	64K x 1	DRAM

Cache

Number	Capacity
TM 6716	2K x 8
TM 6787	64K x 1
TM 6788	16K x 4
TM 6789	16K x 4

Toshiba

4 Megabit

TC51V4400CSJ-60
TC5 = Hitachi Memory
1 = OK
2 = VRAM
V = 3.3v (blank = 5v)
4 = 4 Megabit
1 = 16 Megabit
26 = 512 refresh
40 = 1K refresh?
26 = 256K x 16
40 = 1Meg x 4
0 = Fast Page
5 = EDO
50=50ns (60=60ns, 70=70ns)

16/64 Megabit

TC51V17400CSJ-60
TC5 = Hitachi Memory
V = 3.3v (blank = 5v)
1 = 16 Megabit
6 = 64 Megabit
4 = 4 Megabit
8 = SRAM chip
8 = 1K refresh
7 = 2K refresh
6 = 4K refresh

SIMMs

BS/AS=SIMM
BL/AL=SIPP

Number	Capacity	Notes
THM 82500BS/AS	1 Mb (256K x 8)	30 pin, 2 chip
THM 92500BS/AS	1 Mb (256K x 9)	30 pin, 3 chip
THM 85100BS/AS	1 Mb (512K x 8)	30 pin 4 chip
THM 81000BS/AS	1 Mb (1M x 8)	30 pin 8 chip
THM 81020BL/AL	1 Mb (1M x 8)	30 pin 8 ch d/s
THM 322500BS/AS	1 Mb (256K x 32)	72 pin 32 bit
THM 3225B0BS/AS	1 Mb (256K x 32)	72 pin 2 ch 32 bit
THM 91000BS/AS	1 Mb (1M x 9)	30 pin 9 chip
THM 91020BL/AL	1 Mb (1M x 9)	30 pin 9 chip
THM 91010BSG/AS	1 Mb (1M x 9)	30 pin
THM 91050BS/AS	1 Mb (1M x 9)	30 pin
THM 362500BS/AS	1 Mb (256K x 36)	72 pin 36 bit
THM 362570BS/AS	1 Mb (256K x 36)	72 pin 9 ch 36 bit
THM 36250B0BS	1 Mb (256K x 36)	72 pin 2 ch 36 bit
THM 402500BS/AS	1 Mb (256K x 40)	72 pin 10 ch 40 b
THM 402510BS/AS	1 Mb (256K x 40)	72 pin 10 ch 40 b
THM 325120BS/AS	1 Mb (512K x 32)	72 pin d/s 32 bit
THM 3251C0BS	1 Mb (512K x 32)	72 pin 4 ch d/s 32 b
THM 325140BSG	1 Mb (512K x 32)	72 pin 32 bit
THM 325180BS/AS	1 Mb (512K x 32)	72 pin 32 bit
THM 365120BS/AS	1 Mb (512K x 36)	72p 36 bit d/s
THM 365140BSG	1 Mb (512K x 36)	72p 36 b d/s
THM 365160BD/AS	1 Mb (512K x 36)	72p 36 b d/s
THM 3651C0BS	1 Mb (512K x 36)	72p d/s 36 b
THM 405120BS/AS	1 Mb (512K x 40)	72p d/s 40 b
THM 405140BS/AS	1 Mb (512K x 40)	72p d/s 40 b
THM 81070BS/AS	4 Mb (1M x 8)	30 pin 2 chip
THM 91070AS/AL	4 Mb (1M x 9)	30 pin 3 chip
THM 161000BS/AS	4 Mb (1M x 16)	72 pin 4 chip
THM 181000AS	4 Mb (1M x 18)	72 pin
THM 181010AS	4 Mb (1M x 18)	72 pin 6 chip
THM 84000BS/AS	4 Mb (4M x 8)	30 pin 8 chip
THM 84020BL/AL	4 Mb (4M x 8)	30 pin 8 ch d/s
THM 321000BS/AS	4 Mb (1M x 32)	72 pin 8 ch 32
THM 321090BS/AS	4 Mb (1M x 32)	72 pin
THM 331000BS/AS	4 Mb (1M x 33)	2 pin 8 ch 33
THM 94000BS/AS	4 Mb (4M x 9)	30 pin
THM 94020AL	4 Mb (4M x 9)	30 pin 9 ch
THM 361000AS	4 Mb (1M x 36)	72 pin
THM 361020AS	4 Mb (1M x 36)	72 pin d/s
THM 361010AS	4 Mb (1M x 36)	72 pin 36 bit
THM 361070BS/AS	4 Mb (1M x 36)	72 pin 36 bit 9 ch

Number	Capacity	Notes
THM 401000BS/AS	4 Mb (1M x 40)	72 pin JEDEC
THM 401010BS/AS	4 Mb (1M x 40)	72 pin
THM 88020B/ATS	4 Mb (8M x 8)	30 pin d/s
THM 164020BS/AS	4 Mb (4M x 16)	72 pin d/s
THM 322020BS/AS	4 Mb (2M x 32)	72 pin d/s
THM 322080BS/AS	4 Mb (2M x 32)	72 pin
THM 98020B/ATS	4 Mb (8M x 9)	30 pin d/s
THM 184020BS/AS	4 Mb (4M x 18)	72 pin d/s
THM 184040BS/AS	4 Mb (4M x 18)	72 pin d/s
THM 362020AS	4 Mb (2M x 36)	72 pin d/s
THM 362040AS	4 Mb (2M x 36)	72 pin d/s
THM 362060BS/AS	4 Mb (2M x 36)	72 pin d/s
THM 402020BS/AS	4 Mb (2M x 40)	72 pin d/s
THM 402040BS/AS	4 Mb (2M x 40)	72 pin d/s
THM 324080BS/AS	4 Mb (4M x 320	72 pin
THM 334080BS/AS	4 Mb (4M x 33)	72 pin
THM 364080BS/AS	4 Mb (4M x 36)	72 pin d/s
THM 3225B0BS	4 Mb (256K x 32)	
THM 3625B0BS	4 Mb (256K x 36)	
THM 3251C0BS	4 Mb (512K x 32)	
THM 3651C0BS	4 Mb (512K x 36)	
THM 324000S	16 Mb (4M x 32)	72 pin
THM 364020S	16 Mb (4M x 36)	72 pin d/s
THM 364060SG	16 Mb (4M x 36)	72 pin
THM 81620S	16 Mb (16M x 8)	30 pin d/s
THM 91620S	16 Mb (16M x 9)	30 pin d/s
THM 404020SG	16 Mb (4M x 40)	72 pin d/s
THM 328020S	16 Mb (8M x 32)	72 pin d/s
THM 368020S	16 Mb (8M x 36)	72 pin d/s
THM 368060S	16 Mb (8M x 36)	72 pin d/s
THM 408020S	16 Mb (8M x 40)	72 pin d/s

DRAM

Number	Capacity	Notes
TC 511000BJ/AJ	1M x 1	No parity
TC 5116100J		
TC 5117400J		
TC 51256		
TC 5141000		
TC 514256AJ		256K x 8
TC 514260BJ		
TC 514280BJ		
TC 514400ASJ		
TMN 4164	64K x 1	DRAM

Cache

Number	Capacity	Notes
TMM 2018	2K x 8	
TC 5561	64K x 1	
TC 5562	64K x 1	
TC 55416(-H)	16K x 4	
TC 55417(-H)	16K x 4	

Number	Capacity	Notes
TC 5588	8K x 8	
TC 55465	64K x 4	
TC 55328	32K x 8	
TC 55B328	32K x 8	
TC 55V328	32K x 8	3.3v

Valtronic

Number	Capacity	Notes
M 107	1 Mb (64K x 16)	40 pin DIP

Vitarel

Number	Capacity	Notes
VMS 10A24	1 Mb (64K x 16) (128K x 8) (64K x 8)	40 pin DIP
VMS 32K8	256K (32K x 8)	28 pin DIP
VMS 128K8M	1 Mb (128K x 8)	28 pin DIP

Vitelic

SDRAM

```
V54C365804VBT8PC
V54 = Vitelic
3 = 3.3 v (5 = 5 v)
16 = 16 Megabit
          64 = 64 Megabit
164 = 4M x 16 (4 bank 64Mb)
          404 = 16M x 4 (4 bank
64Mb)
          804 = 8M x 8 (4 bank
64Mb)
V = ?
B = Product revision
L = Low Power (blank = Normal)
7 = Freq=143MHz ClockCycle=7ns
75 = Freq=133MHz ClockCycle=7.5ns
8 = Freq=125MHz ClockCycle=8ns
8PC = PC100 Freq=125MHz
ClockCycle=8ns
```

White Technology

Number	Capacity	Notes
WS 128K8	1 Mb (128K x 8)	32 pin DIP

Zyrel

Number	Capacity	Notes
Z 108	1 Mb (128K x 8)	32 pin DIP
Z108	1 Mb (128K x 8)	32 pin DIP

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Peripherals

Table of Contents

Input

Computers talk in *binary language*, which means that they count to a base of 2 (we use 10). When electrical signals are sent around the computer, they are either On or Off, which matches this perfectly. A state of On or Off is called a **B**inary Dig**it**, or **Bit** for short, and is represented on paper by a 1 for On or 0 for Off (the same as on power switches for electrical appliances). To place one character on the screen takes eight bits (a byte), so when a machine is spoken of as being *eight*- or *sixteen-bit*, it's effectively dealing with one or two letters of the alphabet at the same time—a 32-bit computer can therefore cope with 4 characters in one go. 2 bytes are called a word, 4 bytes (32-bits) are a double word and 16 bytes are a paragraph.

Because it uses multiples of 8, a computer will also count to a base of 16, or *hexadecimal*, which uses letters as well as numbers, and the order is 0 1 2 3 4 5 6 7 8 9 A B C D E F (numbers run out after 9).

Keyboards

Always turn the system off before removing or inserting a keyboard, or, if you can't, do so very, very, slowly! For one thing, the keyboard is being scanned constantly for signals, and, for another, if you pull the connector out too quickly you might fry something. It's the same as touching the positive terminal of a car battery with the end of a screwdriver, then taking it away suddenly – you will get quite a big spark.

Note: This is also one reason why you shouldn't remove expansion cards when the machine is switched on – you will certainly get the aforementioned spark, which could scramble the CMOS, but also you might not do it straight and cross some connections - the ISA bus has some data lines very near some voltage lines. On this point, be careful with ATX machines, as power is still flowing through the machine when the front switch is off (actually about 3 watts an hour). Don't forget to turn off the switch on the power supply as well, or, better yet, unplug the cable!

The grid behind the keys is called a *matrix*, consisting of rows and columns, intersecting underneath each one. When you press a key, a contact is made, which shorts out the matrix and the amount of voltage tells the computer which one you pressed, and for how long. There is a small buffer of 16 bytes to cope with multiple keypresses. The keyboard controller converts the information into a scan code. The connection between the keyboard and computer is serial.

If the springing mechanism is weak, and you press the key too hard, the key will bounce and the system might interpret this as multiple keystrokes, which is why the scan rate is very high, both to detect this and reduce electrical noise which is always present anyway.

Mechanical

This type of keyboard uses metal contacts and a spring, which gives you some feedback. More adventurous technicians have been known to change individual switches around when a commonly-used key fails. All it takes is a little skill at desoldering.

Foam Element

Older keyboards use a plunger, foam and foil. The circular bit of foam (or felt) is at the end of the plunger and the foil is on the end of that. there is a spring to return the plunger back afterwards. With these, you can just clean the foil.

Rubber Dome

Here, the spring is replaced with a rubber dome, with a carbon contact on the inside, which doesn't corrode so easily. When you press the key, the dome collapses, like a ping pong ball, and springs back the same way. the dome also provides a seal. Although cheap, the rubber domes under frequently used keys will stretch and become less effective over time.

Membrane

These are used in industrial environments or point of sale applications, where they can be easily cleaned.

Capacitance

Two plastic plates inside a switch housing designed to detect changes in the capacitance of a circuit. Corrosion free and highly resistant to dust and dirt.

Connectors

5-pin DIN connectors on non-ATX machines, and 6-pin mini-DIN connectors on others and with ATX, originally designed for IBM's PS/2 machines. IBM keyboards also have a detachable cable.

Mice and Trackballs

Both are covered here, as they are essentially the same device, but the other way up. Inside, a ball moves two rollers at right angles to each other, which are linked to a mechanism with notched wheels called an *encoder*. If you calculate the number of times the contacts on the wheels touch the wall of the mouse you can figure out where the pointer should be.

The use of the right mouse button is known (in the A+ exam, at least) as "alternative clicking", which is nothing to do with the **alt** key on the keyboard.

An optical mouse has no moving parts, but uses a reflective mouse pad that reflects a beam of light back to a sensor inside the mouse, from where it came in the first place.

Opto-mechanical mice use a ball to move a photo-interrupter disk, so the calculations are made from counting the interruptions to a beam of light.

Scanners

Used to take a copy of a document and make it useable by software, converting analogue patterns to digital information (photocopiers make analogue images). They can be SCSI, USB or parallel, with the data transfer limitations of the respective interfaces, but the latter two can at least be moved relatively easily between machines.

They work by capturing a reflection from a light source, sometimes magnetically. A series of photoelectric cells called *Charged Coupled Devices* (CCDs), which are also found in digital cameras, are lined up in a row and produce electricity whenever light is present, in the shape of pixels, which are the equivalent of dots on paper. The more dots per inch you get, the better the resolution of the scanner – this can be obtained with smaller CCDs. Because your eye has limitations, the apparent resolution can be increased with software, called *interpolation*. Whenever you see a figure like 1200x600, it means that the horizontal resolution is 1200 dpi, and the vertical 600. In a scanner, this would mean there are 1200 CCDs in the row, which moves 600 steps in a certain time interval, rather like raster scanning on a TV, or painting the image on the drum inside a laser printer.

The copy comes into the computer as a *picture*, but with OCR (*Optical Character Recognition*) software, you can get it to convert any text for use in a wordprocessor to save you typing. With a fax modem, a scanner can allow the computer to be used instead of a standalone fax machine. The normal type is the flatbed, but there are handhelds as well, and some you can use like a pen away from the computer for capturing just lines of text. Since the front end of a fax machine is a scanner, you can use one with your computer for the same purpose. Some even have buttons on the front for you to tell the machine what to do with the document automatically, that is, whether to route the data to the modem or just copy it.

After that, you need to look at the colour depth. A 24-bit scanner can cope with 16 million colours (so don't drop one or you'll have to clean them all up). For 30-bits, you can expect a billion colours and 68.7 billion with 36-bit. All this needs extra storage space, though, and your eyes stop at about 16 million.

The higher the *dynamic range*, the better the colour will be, particularly in shadows and highlights. It is directly related to the bit depth – 30-bit colour makes 1 billion unique colours possible. The trouble is, video card technology only goes up to 24-bit, which even then allows more colours than the human eye can differentiate. Using 30-bit allows the choice of the best colours and gives more accuracy. Desktop flatbeds mostly have a low dynamic range, typically about 2 (in comparison, negative scanners are about 3 and professional drum scanners up to 4).

An A4 or letter-sized page at 300 *dots per inch* would need about 20 Mb of space, so you want about 5 times that plus about 17.5 for Windows '98 (more for NT) for efficient editing, which means about 128 Mb, or at least 64.

Output

Video

For desktops, the two main types available are *Cathode Ray Tube* (CRT) and *LCD Panels*. On notebooks, expect to see *Passive* and *Active Matrix* and *Dual Scan*.

The CRT is a vacuum tube with a layer of phosphor at one end and an electron gun at the other, which fires electrons at the phosphor which glows when hit by an electron - we are looking at the rear side of it when we look at our screens. In a colour monitor, there are three electron guns, one for each primary colour. They are made to glow in varying combinations to give us the millions of colours available. In monitors, the three separate colours are *Red*, *Green* and *Blue* (RGB), while in printing (see below), they are Cyan, Magenta and yellow, or CMY. The difference is because reflected light from solid materials behaves differently than when glowing.

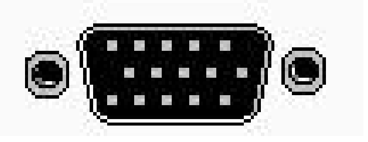
There are resolution standards here, too. Standard VGA (VGA stands for *Video Graphics Array*) has a horizontal resolution of 640 pixels and 480 vertically. This is what Windows 95/98 reverts to when starting safe mode. As such, it relies entirely on the CPU for the screen display and does no processing by itself. VGA incorporates everything that went before, including EGA and has seven subsystems:

- **Display memory**, which stores the display data and is split into 64K colour planes.
- The **Graphics Controller** performs calculations on the data being written to the display memory above.

- The **Attribute Controller** holds a colour lookup table that matches colours displayed by pixels to digital values in memory
- The **Serialiser** converts data in display memory to a serial bitstream and sends it to the attribute controller
- The **Sequencer** controls the timing, turning the colour planes on or off.
- The **CRT controller** sends the synchronising frequencies to the guns to control scan and refresh rates.
- **Graphics Command Language**
- **Frame buffer**. Where data is held before being sent to the screen. Since the image moves constantly, although it often never seems like that, it is similar to a movie, which consists of frames sent to the screen in quick succession, hence the name. the constant movement, or scanning, is required because phosphor loses its glow very quickly and has to be refreshed.

SVGA was never formally defined, but has come to be accepted as higher than 800x600 and 256 colours. However, various standards are defined by VESA.

Monitors are connected to the base unit with a male 15-pin connector:



Screen sizes are measured diagonally, ranging from 14 to 21 inches, but these days 15 inches is the minimum and 17 and 19 inches becoming increasingly popular. 21 inch monitors are all very well, but they are expensive and heavy. Although these are called *Full Page Monitors*, you still have to persuade Word that it has all that real estate, because it often just comes up with a very large half page. Monitors wider than they are tall are called landscape, and portrait for the other type.

The area that displays the image is called the *raster*, and is officially smaller than the screen size – TV pictures are overscanned to take up the extra space. On an LCD panel, or similar, you will get a black border if the pixels are not used, as you would get if you had a 640x480 image on a screen capable of 1024x768 (Exam question – nudge, nudge, wink, wink).

The refresh rate is the rate at which the image lines are drawn across the screen from top left to bottom right. the minimum to avoid flickering (and headaches) is 70 MHz. Interlacing is a technique that allows for cheaper monitors by taking two passes to draw the image, using every other line on each pass. This, naturally, is slower, and the cost difference today is minimal, so all monitors are non-interlaced.

The dot pitch is the space between each pixel triad, measured in millimetres (technically, the diagonal measurement between the centres of two neighbouring triads, which is the same as between the centres of two phosphor dots of the same colour). However, manufacturers have ways of twisting the truth slightly here, so beware! The smaller the dot pitch is, the sharper the image is supposed to be. Anywhere between .24 and .28 is good enough.

Convergence concerns the alignment of each pixel in a triad, which ought to be in line with all the others, on top of each other, for a clear and sharp display. The bandwidth is the range of signal frequencies a monitor can work with, and hence how much information it can process.

Liquid Crystal

Many items come under this heading, mostly used on notebooks, but increasingly coming onto the desktop (Flat panel displays are *not* the same as Flat technology Monitors!).

Liquid crystals can exist in solid or near-liquid states, in the latter being able to pass light. They are normally straight, but will twist into a right angle when stimulated by electricity. Most light is polarised according to its wavelength, and the lenses of polarised glasses make the molecules in each one line up in rows leaning over at an angle, so only light waves at that angle are allowed to pass. If you then hold another polarised lens over the original, then rotate it, all the light will be blocked out when they are at 90 degrees to each other.

LCD panels have two polarised planes of glass at right angles to each other, with a layer of liquid crystals between them and a light source at the back. from the discussion above, we know that light will not be able to get past. When a current is sent to a crystal at a specific location, it bends and allows light to pass through the front panel, since it is at the same angle. However, the viewing angle is quite restricted.

Later, crystals were developed that could cut out all colours except one. By turning on one crystal in a triad, you get the same effect as with a monitor. These crystals can't produce light by themselves.

Passive Matrix

Dual Scan

Some panels are divided in two, which are refreshed at the same time. This, unfortunately, reduces the contrast, and is slow, but it also uses less power and is cheap. The slowness is why you get a shadowy trail across it when you move the mouse.

CSTN

Colour Supertwisted Nematic screens are faster and with a wider viewing angle. This was developed by Sharp.

HPA

High Performance Addressing has higher contrast.

Ferroelectric

This uses liquid crystals that stary polarised for a relatively long time, which reduces the refresh rate and flicker.

Active Matrix

Passive matrix screens have only one switch per column. Active Matrix allows every crystal its own switch so they can be turned on and off quicker and controlled better. They are therefore more complex and expensive, but have good contrast. the types available are TFT (*Thin Film Transistor*) where each crystal is controlled by up to four transistors, MIM (*Metal Insulator Metal*) and PALC (*Plasma Addressed Liquid Crystal*).

Plasma

These use an ionised gas between glass panels which glows when electricity is applied. Old technology now.

Printers

Printers are an alternative method of getting information out of your computer (as opposed to the screen). Think of them as typewriters without keyboards; the instructions about what to print come from the computer, although a keyboard is used to get them into the computer in the first place.

You won't have to program the printer, except when you write programs yourself (in which case you shouldn't need this book). The printer is controlled completely by your software, according to standard procedures. If you want *italic printing*, or **bold**, for instance, you tell your program, which sends the instructions on your behalf.

However, your programs need to be told what sort of printer they're talking to, otherwise they will send the wrong commands, and confuse the whole issue. The more common choices are mentioned below, although you should see if your software supports the badge on the front of it first. Printers also comply with certain popular standards, the same as computers do, so you must also tell the printer itself what its identity is. This used to be done with mechanical devices called DIP switches, but can now be done with buttons on the front (if you really want to know, the initials stand for *Dual In-line Package*). Nowadays, however, with intelligent connections, the printer can be controlled directly from the keyboard.

Running costs are important. Although a printer might be cheap to buy, the cost of printing per page may well be extortionate in terms of consumables, such as ink or ribbons.

Paper

You might get *continuous feed*, or the c*ut sheet* variety. Continuous feed is the stuff that comes with the holes down each side, and cut sheet is what you put in a photocopier. Continuous feed is only used in dot matrix and some daisy wheel printers that have a *tractor feeder*.
If a tractor feeder is installed, turn the platen friction *Off*, otherwise the paper will twist and clog things up. In other words, let the tractor do the feeding by itself, and don't include the roller. For those printers, it's also possible to use a *cut sheet feeder*, which supplies the printer with cut sheets automatically, so you can go and have a coffee while it prints and not have to feed it by hand. Continuous feed paper is best bought as *microperforated*, so it's easier to tear off the strips with the holes in.

Paper comes in various sizes, all of which have Meaningful Names (especially to laser printers). *A4* is a standard European size that is 11.69 inches by 8.27, and therefore has 70 lines if you use a density of 6 lines to an inch, which is fairly standard. On a laser printer, though, this may reduce to 60 because of the printable area available; finding out what you can actually print may take some experimentation.

Letter is an American size that is 11.5 inches by 8.5; similar to, but not quite A4. The relevance of this lies in using laser printers with paper trays that only accept a certain kind of paper, and the next most common reason why you don't get printing. The printer is able to detect what sort of tray is fitted (and hence the size of paper), and if your software tries to print on a letter-sized page when you have an A4 tray fitted, you will get a continual prompting from the printer to load the right size of paper, but no printing. Solve this by entering the *Page Setup* routine of your program and changing the page size, or pressing the *Continue* button on the printer.

Standard listing paper (used by programmers when listing their programs) is usually continuous feed. It has 66 lines per page.

Types of Printer Available

For maintenance, the usual common sense things apply, such as getting rid of bits of paper that accumulate here and there. If you use a vacuum cleaner (not in a laser!), make sure it's properly protected from static. Alternatively, use a compressed air spray, available at any photographic shop. As printers require friction to work, it's not a good idea to be too liberal with the oil or grease, especially on pinch rollers, platens, tractor belts and sprockets. about the only place you might expect to use any is light oil on the print head rails. Use rubbing alcohol to get rid of any excess, as it evaporates quickly, leaving almost no residue.

Daisy Wheel

A hammer forces a letter on to the page through a carbon ribbon. Out of date and noisy, but still used by some companies for mailing lists.

Change the daisy wheel about once a year. Some alignment required.

Dot Matrix

A 24 or 9 pin print head strikes paper through a ribbon. The print head (sometimes more than one) moves from side to side, and often has to be adjusted so it doesn't strike the paper too hard (you get dark printing, with streaks between the letters). You get better quality with 24-pin, of course.

Pros and cons:

- You can print multiple forms.
- Cheap to buy and run.
- Rugged and reliable.
- Fast for text, slow for graphics.
- Can be noisy

If you need to revitalise a ribbon quickly, the *merest squirt* of WD-40 will do the job; just don't overdo it!

The replacement cost of a print head is often more than the secondhand value of the printer; they can be taken apart, but not suddenly! You can often clear a blocked pin with WD40, and an older printer may well burn out, as the print head gets very hot. If your printer is a newer one, and it shuts down for no particular reason, check the thermistor.

Check the tension of any belts, particularly on older printers.

Clean off the ink about once every 6 months—again, if you use gloves watch out for static production. Don't oil everything; it just collects rubbish. Ordinary hair spray is good at removing ink from fabric.

Inkjet

Ink is expanded (with heat) until forced through holes on to the page. Holes can be finer because they don't need the structural strength to cope with impacts. There are around 56 holes on the Deskjet. The Bubblejet heats ink in a tube until a bubble is formed, which then splatters on to the paper. Piezoelectric crystals change size when electricity is applied to them, and this property can be used to pull an exact quantity of ink from a reservoir.

As far as quality goes, they can exceed laser printers, and are sometimes nearly as fast. They are quiet, though, and if you need ink in a hurry (for a bubble jet), just use fountain pen ink.

Pros and cons:

- Cheaper to buy than lasers, but more expensive to run.
- Quiet and portable.
- Faster than Dot Matrix, slower than lasers.
- Ink can be water soluble.

- Can't print carbon copies.
- Not good with transparencies.
- Fairly high running costs, more for colour.
- No manual feed.
- May need special paper (especially with colour).
- Squeeze the cartridge if it gets blocked.

Colour

With *continuous flow* printing, ink droplets are directed continually towards the paper. If a colour isn't needed, it's directed to a waste tray by an electric charge. Speedy, but wasteful. *Drop-on-demand* printing, on the other hand, only supplies ink when it's required.

You could get a printer that only has one cartridge, in which case blacks will be composed of the colours in it, and therefore a deep muddy brown in reality, but you'd be better off with a separate black cartridge, which can also be used for mono only printing.

Laser Printers

Essentially, a photocopier controlled by a computer. A page of information is assembled in its memory and transferred as a whole to the paper, using a laser beam. The image is fused on with heat, which melts the plastic toner. There are four main types:

- Network lasers, big and hefty, capable of a good throughput, and expensive.
- "Normal" lasers, typically capable of about 6 pages per minute.
- Personal lasers, around 2 ppm. Quite cheap.
- Windows, or GDI, or host based, printers. Specially made with no intelligence inside, relying on Windows to do the work. As such they are of little use in DOS, although some can emulate an HP II.

Pros and cons:

- Mostly cheap to buy and run.
- Can handle various types of media, including envelopes, transparencies, labels and even paper.
- Fairly quiet.
- Good print quality, up to 1200 dpi with the right hardware, though you would be hard put to tell the difference between 600 and 1200, so don't waste the money. 600 dpi does take up resources, up to 4 times as much as 300 dpi.
- A direct network interface can be fitted so the printer can be regarded as a print server.
- Can't do carbon copies.

Personal lasers don't have good paper handling or capacity, even as low as ten sheets at a time.

If printing double sided, either get a proper duplex unit, or get paper with a higher water content to cope with being put through twice. When bringing in new cartridges from a cold environment, let them sit for a short while to get rid of condensation before you print.

Laser printers require proper ventilation and power (they can draw 7 amps). They also have an ozone filter, as air is ionized to make it less of an insulator (see below). Change this about every 50,000 prints in average conditions.

How lasers work

Laser printers are made up of several components:

- **Power supplies**, one for converting the mains, and one for providing the high voltages needed for creating a static charge of electricity.
- **Fusing assembly**, for bonding the toner to the paper.
- **Erase lamp**, to clear the photosensitive drum.
- **Writing mechanism**, using a laser beam to write the image on the drum.
- **Main motor**, for driving all the rotors.
- **Scanner motor**, for moving the laser beam
- **Paper control**
- **Main logic**, containing all the programming.
- **Toner cartridge**, containing the “ink”
- **Control panel**, where you tell the printer what to do.

The drum is made of extruded aluminium, coated with a photosensitive nontoxic organic compound. The print drum is cleaned first, to get rid of the previous image (the drum is light sensitive, so don't open the flap if taking the cartridge out). Quite simply, a rubber blade is gently scraped across it (which is one good reason for changing it properly), to get rid of toner, followed by a red erase light and a negative charge of around -600 volts to condition the drum.

The charge comes from a corona wire near the drum; both share the same ground. Actually, a charge of around -6000v is initially used to break down the natural insulation properties of air, and it's regulated with a grid.

Once the negative charge has been applied to the drum, it's photosensitive again, so when the laser beam touches the surface, a small amount (say, –100v, of electricity) is discharged, so this spot becomes less negatively charged than its surroundings. In other words, the new image is painted by discharging the points where the image is to appear, horizontally and progressively (like a TV picture) with a laser, so surface becomes electrostatically charged with characters (the -600 charge is neutralised to -100). 300 dpi actually means 1/300 of an inch rotation, with the laser changing states 300 times per inch.

After the writing, you have a negatively charged drum with some parts relatively positive. The toner cylinder turns constantly in the powder, and there is a current to negatively charge the toner. Toner is attracted to the less negatively charged areas on the drum, like filling in holes in a field, and transferred to paper with the help of a *transfer corona wire*, which makes the page attractive to the toner, with a +600 charge, and heat sealed on to the paper with a fuser roller at about 180 degrees (this is what takes the time to warm up). It is a quartz heating lamp inside a roller tube above a rubber pressure roller. Consequently some areas get hot, particularly the fuser roller. Toner is half plastic, half oxide, so a magnet is good for picking up any spilt.

Remember that the primary corona wire charges the drum, and the secondary charges the paper. The most common cause of a paper jam is the paper separation pad, or more than one page going through. Usually, this is down to the wrong type of paper.

Toner should be *superfine* if 600 dpi.

Problems

Vertical white streaks	Corona wires may have toner caked on them
Smeared pages	Toner is not being fused on the page. Clean the fuser when it's cold and change the scraper. Also caused by printing double sided on a printer not designed for the purpose—the paper grips smear the printing already on the paper.
Horizontal streaks	Measure the distance between them to get the circumference of one of the rollers—a good clue as to where the problem is. These are for the HP II, and are measured from the first appearance of the problem: 5" Registration Assembly Transfer Roller 1.5" Upper Registration Roller 1.75" Lower Registration Roller 2" Cartridge Developer Roller 2.56" Lower Fusing Assembly Roller 3.16" Upper Fusing Assembly Roller 3.75" Photo Drum
Cloudy or faded output	Clean coronas. Could be low toner, but you will get an error message as well.
Black vertical line	Low toner

The button on the side of an HPII forces a print directly from the engine. Keep a print from the menu handy for comparison purposes.

To turn the printer into Service Mode:

- Turn the printer on with the *On Line*, *Continue* and *Return* keys down.
- Release the keys when the screen is blank, press *Continue* followed by *Return*.
- Press and hold the test key until the 05 SELF TEST message appears. This gives you an advanced test print.

Other tips:

- Clean the mirror in the lid assembly.
- Don't ship a printer with the cartridge inside. Watch out coming from a cold storeroom.
- Don't use a vacuum to pick up toner, as it's both iron and plastic. It will screw up the motor and clog it up.

Colour

There are two types of output:

- **Spot Colour**. Uses custom inks of the colours chosen by you. Expensive if you use more than one colour, as you must have a separate plate for each one (overprinting may give you a surprise or two, so you have to be able to get rid of the underlying colour). It cannot cope with full colour, so is best used for leaflets, etc.

- **Process Colour**. Makes up colours from a standard set of four inks; used in most magazines, etc. Often called CMYK, after Cyan, Magenta, Yellow and Black. Dots of different variations of them are placed so close together on the printed page, the eye is fooled into seeing them together, like the way impressionist paintings work.

There are reasons why it's difficult to match what you see on the screen with what you get on the page. One is that the colour on your monitor (using RGB) is *emitted*, whereas that on the page is *reflected*.

The former process *adds together* proportions of red, green and blue; black is the absence of colour. The latter works the other way round, and is known as *subtractive*. The CMY colours are secondary colours and made up of varying proportions of the primary RGB; cyan from green and blue, magenta from red and blue, and yellow from red and green. It is known as subtractive because some colours are absorbed, and the reflection of what's left is what we detect. Combining two colours on screen therefore makes the image brighter; on paper it would be darker.

One or two other definitions are useful; *hue*, *saturation* and *lightness*, which describe the basic colour, intensity and amplitude of light waves, respectively.

Colour Lasers

CMYB toner is applied in successive passes and mixed on the drum surface before being transferred to paper, by which time they've had time to blend. Nearly as good as thermal dye printers.

Thermal Wax Transfer

Ink in the form of wax on a roll is heated and pressed onto special paper. The roll is split into separate pages of colours and all are used to print one page, so there is a lot of wastage. As a result, running costs are high, and the rolls and paper aren't cheap to begin with! As each colour is printed individually, it can be slow as well.

The output quality can be outstanding, certainly better than most inkjets; typically 300 dpi or less, but can be expensive in running costs. The surface can also be scraped off.

Phase Change

Heaters melt colour sticks into ink reservoirs, whose contents are squirted on to a page, where they solidify again. The inks change phase from solid to liquid and back. Good with transparencies.

Dye Sublimation

A high-end technique, similar to thermal wax, but the temperature is higher so the wax on the ribbon is heated to the point of sublimation (that is, goes directly from solid to gas) and the gases diffuse into specially coated paper (wax is coated on top of the paper). You can control the amount of wax placed on the paper by controlling the temperature around the print head, so you can vary the intensity of the colour.

Pros and cons:

- ❏ As near to photorealistic quality as possible.
- ❏ Relatively low initial cost, but high running costs (£2-£3 per page).
- ❏ Limited paper size. Paper is relatively thick.
- ❏ Not fast; sometimes up to ten minutes.

Windows

Mostly, applications don't print; they tell Windows what to print and the Windows printer drivers take over, often in graphics mode, even with text (Wordperfect and Autocad, amongst others can print directly).

However, better performance is obtained if applications know how to talk to the printer driver properly; these expect to receive data in bands an inch or so in height, roughly corresponding to buffer size, starting at the top of the page and working downwards.

Guess what? The most popular printers don't work that way, including Laserjets and Postscript printers! Laserjets use a single text band covering the whole page, then the graphic bands. If an application is not aware of this, it will get two print requests per page and print every one twice. Postscript printers have one band only, which is the whole page for everything. That takes care of portrait! Landscape printing is different again. Some printers fill up the bands from left to right, whilst others (e.g. Laserjet) request bands from right to left, but not in the same way as portrait. Postscript, not to be outdone, presents the whole page. Inkjet printers print as they receive information.

Windows' imaging tool is **gdi**, which uses text, bitmaps and graphic objects to do its work, including printing.

For text, bitmap fonts or outline typefaces are available. Bitmap fonts come in particular sizes, specially tuned to screens and printers, as they both have different resolutions. The problem is that if you want more sizes, you get more font files, which take up hard disk space, as making a single font bigger just makes it more jagged in appearance. Outline typefaces are device-independent, and are mathematical descriptions of the font required which any device (screen or printer) resolves to its best abilities.

See *Fonts* for more.

Bitmaps

These are simply grids of dots, also known as *pixels*, or *picture elements*. The size, or resolution, of the grid is normally referred to in dots per inch (dpi), say 300 dpi for a laser printer. Bitmap graphics therefore consist of a fixed number of pixels, or picture elements, so if you want a bigger version of the graphic, each pixel just gets larger and the whole thing looks worse. The effect is similar to bitmap fonts. Each pixel carries a certain number of bits, which define how many colours the pixel can display. 1 bit gives you black and white, 4 bits give you 16 colours, 8 bits 256 and so on.

The problem with bitmaps is that anything other than straight vertical or horizontal lines has to be approximated by steps, which become painfully more obvious as the picture gets enlarged, to the point where all you see is blocks. Another is size; as an example of just how big bitmaps can get, an A4 image in 24-bit full colour at 400 dpi needs a 45 Mb bitmap because it contains all information about the image, including blank backgrounds. The only way you can reduce the space taken up by bitmaps is to use compression, or something similar.

Anti-aliasing is designed to get around the jaggies, which puts paler dots in between the gaps to give the appearance of a smoother outline, similar to the RET (*Resolution Enhancement Technology*) used in HP Laserjet III printers.

Vectors

Graphic objects are similar in operation to outline typefaces, in that they describe a picture (or object) as a series of mathematical instructions, so look better when they are enlarged. As there is no requirement to describe each pixel, they don't take up so much space, either in memory or on the hard disk, so where, for example, a bitmap would describe a black disk as *x* quantity of black pixels with some white ones round them, a vector format would draw a circle of that particular size in the middle of the image and colour it black.

Windows uses internal resolution space, defined by the current application, to store the above elements. The resolution space is an internal grid of pixels that marks the location of each element, rather like graph paper. Varying methods are used to convert this grid to that required by the output device.

Speeding things up

- ❑ Add as much memory to your printer as possible, and make sure Windows knows about it (through Control Panel), otherwise it will use the hard disk excessively. If there is more memory than needed, Windows doesn't need to clear it after every print job, and later print jobs are faster if the fonts required are already there.

- ❑ Use printer fonts.

- ❑ Don't use serial printing.

- ❑ Try and use a spooler that prints from RAM, but also be aware that some Print Manager files can be large; 15 Mb is not uncommon with Ventura Publisher. Make sure your temp location is big enough for your print job (at least 8 Mb and empty).

- ❑ Consider sending the Postscript header only once to the printer (you can copy it through the LPT port with a batch file when Windows starts). The header is part of a Postscript print job sent before the document. If you've got a network of PCs only, this can be sent at the start of the day to initialise the printer, and it doesn't need to be sent continually. Send it as part of the autoexec.bat file of the first PC to be turned on. If you're sharing a network with Macs, you will be safer sending it with every print job.

- ❑ Use draft printing for text, or 150 dpi for graphics.

- ❑ Turn off Print Manager (for single applications), but refer to 2 above. On a network, select Options | Network Settings and Print Net Jobs Direct.

- ❑ Use a Windows printer; also known as a GDI printer, which doesn’t have to convert a print stream.

Although Windows can connect directly to a NetWare queue, and thereby shorten the print time, it also lengthens the time taken to get back to your application. If you have a fast processor and a lot of RAM, it may be more productive to use Print Manager, even though you're spooling twice.

Print Manager

Print Manager controls printing while you're getting on with something more useful. Typically a file is passed on by an application to Print Manager, which writes it to disk and feeds it to the printer in its own time, so you get back to work quickly and the printer gets data at a speed it can cope with.

You can change Print Manager's priority in the system to Low, Medium or High, effectively controlling the speed of printing by specifying how much attention Windows gives to it. If you have a Windows printer, this will be particularly appropriate. See **Options|Background Printing**.

PM will bypass DOS interrupts by sending data directly to the port, which is fastest, but some software works best if you use DOS interrupts (under **Options|Setup**). DOS applications don't use Print Manager, but print directly to the port, so be careful about them not releasing (check timeouts).

Windows '95 and NT use an Enhanced MetaFile (EMF) for spooling purposes.

If Windows won't print

There is much useful information in the **printers.wri** file. You might also:

- Check the printer works in DOS (copy a file to LPT1:).
- Make sure the page is ejected after a spreadsheet.
- Make sure you're not trying to print Letter size on an A4 printer.
- Does the **temp** variable point to a valid drive/directory with enough space? Make sure it doesn't have a trailing space at the end.
- Check the right RS232 parameters are set for a serial printer.
- Download the Error Handler File to the printer if using Postscript.
- Make sure the printer is the active printer.
- With printer sharers, Don't select *Fast Printing Direct to Port*. Also, don't use a non-HP sharer with an HP printer if you want them to service it!
- Increase the *Transmission Timeout* setting. A timeout is a period of inactivity after which the job is assumed to be complete. If your timeout is too long, each job will be delayed until the timeout has expired. If your timeout is too short, you'll have print jobs released before they're complete. Try 45 seconds as a minimum, but be prepared to go to 360

Page Description Languages

These are needed to specify fonts, graphics, and their positioning on the page. They were written to save programmers the bother of coping with all the printers on the market when they wrote their software. There were many others in the beginning, but HPs became adopted very quickly, soon overtaking Postscript, which was previously the most popular.

PCL

PCL, provided by Hewlett Packard, now in version 6, based on the language of the Laserjet. PCL 6 is designed for complex documents and is very close to GDI, so is faster.

Postscript

Developed by Adobe Systems a year after the original PCL. It consists of a written description of a page, or instructions sent as a text file to a printer which responds to them and produces the page, as opposed to the computer sending it as bitmaps.

Some software is able to convert the page into the text instructions understood by Postscript printers; this was why Postscript became popular so quickly in the graphics industry.

So—if you have a text editor, you can talk directly to a Postscript printer, which makes it easy to send files for long distance printing. In theory, anyway; *Portable Document Format* makes this more foolproof.

The page starts at the bottom left hand corner, and coordinates are issued on an *x,y* basis; *x* is horizontal and *y* is vertical.

Postscript printers have an error-handler mode which tells it to print a page with information on it rather than just stop when there's a problem. They don't accept **prtscrn** instructions, by the way; an ASCII data stream so produced should be wrapped in Postscript language to get results.

The Windows Postscript printer driver is pretty limited; for example, you cannot reset the printer or change resolution. You will be better off with a third party one, preferably the one that comes with your printer. Windows '95 doesn't have a generic Postscript printer driver, you have to nominate a specific printer, such as the Apple Laserwriter.

Encapsulated Postscript

This is simply where the whole code for a page is encapsulated into an ASCII text file. It will contain its own dictionary so the image can be transported around and print the same everywhere, although you won't see it on screen.

Fonts

Once upon a time, you would have to push buttons on your printer to get the effects you wanted; software just sent ASCII numbers, and you either used fonts embedded in your printer, or that came with a cartridge. Then software, particularly Wordperfect, got clever enough to send signals to the printer to activate the fonts inside, so you didn't have to rush to the printer—they had (and still have) a reputation for covering just about every printer there is. The next step was to realise that the printer had memory as well as the computer, and that you could send (download) fonts to it and keep them there all day, ready to be used.

Raster fonts Stored as bitmaps and rendered as an array of dots for printing or display. These cannot be scaled or rotated. Windows uses them for menus, captions, messages etc. If you try to scale raster fonts too far from their original size, they become jagged. Aside from taking up huge amounts of disk space, they are also device dependent, which means that you need a separate set for each printer *and* the screen, *and* for each size!

Vector fonts Mathematically based, where each character is viewed as a set of lines drawn between two points, which can be scaled to any size or aspect ratio. They don't look as good as raster fonts when correctly sized, but are useful for plotters and other devices that can't use bitmaps.

Vectors are therefore device-independent, and can get the best possible result out of any device, regardless of its resolution capability. In other words, vector instructions describe what's required, and the device is left to draw it as best it can. Postscript uses vectors.

True Type Developed in conjunction with Apple and shipped with Windows 3.1, so it's compatible with the two platforms. They can be scaled and rotated, and sent to the printer so what you see is very likely what you'll get. You can include text in Windows metafiles (wmf), used for graphics, so anyone with the same fonts can get the full range. **wmf** files don't need specialised devices as Postscript does.

Windows can also use Postscript fonts, but that's cumbersome, and you need *Adobe Type Manager* to represent them properly on screen and rasterise them for non-Postscript printers.

Microsoft and Adobe have come up with yet another universal font technology that will support both True Type and Postscript Type 1 called *Open Type*, which is actually an extension of a development of True Type anyway. However, it also includes compression, which will allow higher resolutions and quicker transmission times.

Fonts can also be classified as to whether they are for screen displays or for printing. The trick, of course, is to get them as much the same as possible, to get true WYSIWYG. However, since you generally read screens from further away than you do printed copy, text is displayed in Windows as a larger size than you would get on paper (known as *logical resolution*). You may get problems with this when trying to keep the relative size of pasted objects.

Believe it or not, printer fonts are further subdivided into three types; *device fonts*, *downloadable soft fonts* and *printable screen fonts*.

- ❑ Device fonts are those that come preinstalled on your printer, so you might call them printer-resident, in a ROM or on a hard drive. As you only have to send the codes to activate them, printing can be quicker, but WYSIWYG is not guaranteed. It's also difficult to print on someone else's printer unless they have exactly the same model. Postscript printers normally come with about 35 resident fonts.

- Downloadable fonts are sent to the printer before being used, where they become memory-resident. These do take up disk space, however, and are still device dependent, aside from taking up network bandwidth when they are sent.

Postscript

These fonts are scalable outlines that can be printed and rotated at any size. Screen display does not always match what comes out. They were designed by Adobe and used as part of their *Page Description Language* (PDL), which is now used within the Graphic industry as a standard for file transmission, rather in the same way as ASCII is used in wordprocessing. This is why it's a good idea to install a Postscript printer as standard.

True Type fonts can be printed on a Postscript printer; they are treated as downloadable soft fonts. They can be sent as bitmaps, or in Adobe Type 1 format (check *Send To Printer As* in *Printer Setup*).

You can test the virtual memory required for your Postscript printer by copying the **testps.txt** file to LPT1:

Adobe Type Manager

This is a program that handles Postscript Type 1 fonts under Windows; equal to the *Fonts* section of Control Panel. It also renders Adobe fonts on screen and Windows compatible printers, so you don't need a Postscript printer.

It provides scalable font technology, in the shape of an outline screen font that can be adjusted on the fly. It comes with 13 fonts, but you can use any Postscript font with it, provided you buy it first. Remove it from the system by replacing the **system.drv=atmsys.drv** line in the **[boot]** section of **system.ini** with **system.drv=system.drv**.

Use at least v2.5, and set FontCache to 256K or higher. Also, set **TMSRMN=Times** in the **[Aliases]** section of **atm.ini**. Make sure *pre-built or resident bitmap fonts* is checked to help speed up printing.

Bitstream FaceLift

As with ATM, this offers on-the-fly font generation, for screen and printer. You can use its own fonts or Postscript ones.

True Type

When Microsoft wanted to create good font technology for Windows, they invited Adobe to provide the facilities, but were turned down, so they created True Type in league with Apple. The idea is that what you see on the screen is likely to come out of your printer; previously, an approximation had to be created. **gdi** reads the character from the corresponding **.ttf** file on disk, and displays the resulting bitmap at the size requested.

True Type fonts are outline fonts, like Postscript, with many benefits:

- They come with Windows.
- They are high quality.
- They are cheap.
- They are available (there's even a *Ransom Note* font!)
- Screen and printer fonts are the same.
- Scalable and rotatable.
- Documents look good on different printers and/or platforms (e.g. Mac/PC).

Only two files are needed to create a font, whereas raster fonts need separate files for each variation. If the font size is small enough, a complete line will be sent as a bitmap. Fonts are stored as a collection of points and "hints" that define the character outlines. Hinting is the reshaping of an outline for a given character at a specific size so the right pixels are included within its outline; that is, you don't get odd ones sticking out where a curve should be. This is important for screens, which have lower resolution than printers. Hints are more important at smaller point sizes and lower resolutions because fewer pixels are available to represent the character.

When an application asks for a font, a bitmap is rendered according to the details requested. Initial font generation is therefore relatively slow, but Windows uses a font cache to store the rendered bitmaps; each character of the font and its size is stored in it. If you use a lot of fonts in the same document, you may well overload it, and force swapping to the hard disk, which will in turn mean less performance.

Managing Fonts

The more fonts you have, the longer Windows takes to load and perform tasks, aside from the overhead you get in terms of system resources and memory. More fonts means more files to open and close, and scaling of fonts can also be intensive. More than 150 in memory (in 3.x) really starts to slow things down, so you need to keep the font list small and manageable (adjust through Control Panel). In fact, to ensure True Type remains stable, you need at least 2 Mb of memory for the fonts. 100 fonts also needs 4 Mb of disk space, so for 100 users, you will be getting on for 50 Mb.

How much memory is consumed depends on what a program does with a font. Only the Global and GDI Heaps are concerned, and GDI has only 64K to play with in Windows 3.x. The GDI heap gets used up as you load more fonts, particularly as True Type has to create a screen and printer version of each one you load. However, the bitmap created comes from the Global Heap. The font limit for Windows 9x varies, depending on the length of the font filenames and the name of the font itself, but generally it's about 1000. In 9x, the Registry and GDI both store font data. The problem is that the font names are kept in a Registry key, which may not be more than 64K in length. It gets worse if the font is not where it should be and you have to include the pathname as well. In GDI, 10k is reserved for font filenames.

Each True Type font needs three elements:

- .**TTF file**, in whatever directory you choose.
- .**FOT file**, in \system. This is a resource file, created when you install a font, telling Windows where to find it.
- The **[fonts]** section in **win.ini**, which explains which of the above two go together. It's worth commenting out fonts in this section that you don't normally use, or even having a batch file that copies various win.inis containing different fonts:

```
CD \WINDOWS
REN win.ini WIN.SAV
REN WIN.TTF win.ini
WIN
REN win.ini WIN.TTF
REN WIN.SAV win.ini
```

Arial and Times New Roman are expected by some packages; be wary when deleting them.

To speed True Type rendering, try setting a setting of 300 (default 256) in the *HeadlineThreshold* line in the **[TrueType]** section of **win.ini**.

Font Embedding

If you want your report to look the same on other peoples' computers as it does on yours, you generally have to make sure they have the same equipment as you, which will include fonts. If not, then all your work will likely be wasted, unless you stick to the old standbys, like Times or Arial, and merely having font substitutions set up in **win.ini** will not be enough.
Font embedding is a way of packaging fonts in the same way as objects, in encrypted form, but it hasn't really been developed properly as yet (that is, True Type has the technology, applications don't), although the fonts that come with Windows are enabled as well.

The idea is that you can send a document to someone with the fonts required in it, so they don't need to be installed on the other machine. The system was devised to get round limitations on certain Postscript devices, which often had to have exactly the same typeface on board as you had included in your document; this was not often the case, with obvious consequences.
There are 4 levels:

- None.
- Print and preview.
- Print, preview and edit; once the file is closed, the font is deleted from memory, i.e. editable.
- Print, preview, edit, install the document and own the font, otherwise known as installable. The real problem with owning the font is copyright and ending up with fonts you don't pay for.

Epson FX Printer Codes

Printer Operation

Decimal	ASCII	Description
7	BEL	Beeper
17	DC1	Select printer
19	DC3	Deselect printer
27 25 48	ESC EM 0	Turn cut sheet feeder control off
27 25 52	ESC EM 4	Turn cut sheet feeder control on
27 56	ESC 8	Disable paper out sensor
27 57	ESC 9	Enable paper out sensor
27 60	ESC <	Select unidirectional mode for one line
27 64	ESC @	Initialize printer
27 85 48	ESC U 0	Cancel unidirectional mode
27 85 49	ESC U 1	Select unidirectional mode
27 115 48	ESC s 0	Turn half speed mode off
27 115 49	ESC s 1	Turn half speed mode on

Vertical/Horizontal Motion:

Decimal	ASCII	Description
8	BS	Backspace
9	HT	Horizontal tab
10	LF	Line Feed
11	VT	Vertical Tab
12	FF	Form Feed
27 47 c	ESC / c	Select vertical tab channel (c=0..7)
27 48	ESC 0	Select 8 lines per inch
27 49	ESC 1	Select 7/72 inch line spacing
27 50	ESC 2	Select 6 lines per inch
27 51 n	ESC 3 n	Select n/216 inch line spacing (n=0..255)
27 65 n	ESC A n	Select n/72 inch line spacing (n=0..85)
27 66 0	ESC B NUL	Clear Vertical tabs
27 66 tabs	ESC B tabs	Select up to 16 vertical tabs where tabs are ascending values from 1..255 ending with NUL
27 67 n	ESC C n	Select page length in lines (n=1..127)
27 67 48 n	ESC C 0 n	Select page length in inches (n=1..22)
27 68 0	ESC D NUL	Clears all horizontal tables
27 68 tabs 0	ESC D tabs NUL	Sets up to 32 horizontal tabs with ascending values 1-137. NUL or a value less than previous tab ends command.
27 74 n	ESC J n	Immediate n/216 inch line feed (n=0..255)
27 78 n	ESC N n	Select skip over perforation (n=1..127)

Decimal	ASCII	Description
27 79	ESC O	Cancel skip over perforation
27 81 n	ESC Q n	Set right margin (n=column)
27 98 b c 0	ESC b c NUL	Clear vertical tabs in channel (c=0..7)
27 98 c tabs	ESC b c tabs	Select up to 16 vertical tabs in channels (c=0..7) where tabs are ascending values from 1..255 ending with NUL
27 101 48 s	ESC e 0 s	Set horizontal tab to increments of 's'
27 101 49 s	ESC e 1 s	Set vertical tab to increments of 's'
27 102 48 s	ESC f 0 s	Set horizontal skip to increments of 's'
27 102 49 s	ESC f 1 s	Set vertical skip to increments of 's'
27 106 n	ESC j n	Reverse linefeed (n/216 inch after buffer)
27 108 n	ESC l n	Set left margin (n=column)

Printing Style

Decimal	ASCII	Description
27 33 n	ESC ! n	Master select where n is a combination of: 0 Pica 16 Double Strike 1 Elite 32 Double Wide 4 Condensed 64 Italic 8 Emphasized 128 Underline Pica & Elite and Condensed/Emphasized are mutually exclusive
27 107 48	ESC k 0	Select NLQ Roman font
27 107 49	ESC k 1	Select NLQ Sans Serif font
27 120 48	ESC x 0	Select draft mode
27 120 49	ESC x 1	Select NLQ mode

Print Size and Character Width

Decimal	ASCII	Description
14	SO	Select double width for one line
15	SI	Select condensed mode
18	DC2	Cancel condensed mode
20	DC4	Cancel one line double width mode
27 14	ESC SO	Double width for one line (duplicate)
27 15	ESC SI	Select condensed mode (duplicate)
27 77	ESC M	Select elite width (12 cpi)
27 80	ESC P	Select pica width (10 cpi)
27 87 48	ESC W 0	Cancel double width mode
27 87 49	ESC W 1	Select double width mode

Print Enhancement

Decimal	ASCII	Description
27 45 48	ESC – 0	Cancel underlining
27 45 49	ESC – 1	Select underlining
27 69	ESC E	Select emphasized mode
27 70	ESC F	Cancel emphasized mode
27 71	ESC G	Select double strike mode
27 72	ESC H	Cancel double strike mode
27 83 48	ESC S 0	Select superscript
27 83 49	ESC S 1	Select subscript
27 84	ESC T	Cancel superscript/subscript

Character Sets

Decimal	ASCII	Description
27 52	ESC 4	Select italic mode
27 53	ESC 5	Cancel italic mode
27 54	ESC 6	Enable printing of characters (128-159,255)
27 55	ESC 7	Cancel [ESC 6] command
27 82 n	ESC R n	Select International character set where numeric 'n' is: 0 USA, 7 Spain I 1 France, 8 Japan 2 Germany, 9 Norway 3 United Kingdom, 10 Denmark II 4 Denmark I, 11 Spain II 5 Sweden, 12 Latin America 6 Italy
27 116 0	ESC t NUL	Select italic character set
27 116 1	ESC t SOH	Select Epson character set

User Defined Characters:

Decimal	ASCII	Description
27 37 0	ESC % NUL	Selects normal character set
27 37 1	ESC % SOH	Selects user defined set
27 38 0	ESC & NUL ?	Select user defined chars (see manual)
27 58 0 0 0	ESC : NUL NUL NUL	Copy ROM into RAM

Graphics Character Sets

Decimal	ASCII	Description
27 42 0 n1 n2	ESC * NUL n1 n2	Select single density graphics
27 42 1 n1 n2	ESC * SOH n1 n2	Select double density graphics

Decimal	ASCII	Description
27 63 s n	ESC ? s n	Reassign graphics mode 's'=(K,L,Y or Z) to mode 'n'=(0..6)
27 75 n1 n2	ESC K n1 n2	Single density graphics (60 dpi)
27 76 n1 n2	ESC L n1 n2	Double density graphics (120 dpi)
27 89 n1 n2	ESC Y n1 n2	Hi-speed double den graphics (120 dpi)
27 90 n1 n2	ESC Z n1 n2	Quad density graphics (240 dpi)
27 94 m n1 n2	ESC ^ m n1 n2	Select 9 pin graphics mode number of columns = n1 + (n2 * 256)

Other

Decimal	ASCII	Description
13	CR	Carriage Return
24	CAN	Cancel text in line (but not control codes)
127	DEL	Delete character (but not control codes)
27 32 n	ESC SP n	Space in n/72 inch following each NLQ char
27 35	ESC #	MSB control sequence cancel
27 36	ESC $	Select absolute dot position
27 61	ESC =	MSB = 0
27 62	ESC >	MSB = 1
27 73 48	ESC I 0	Cancel above [ESC I 1]
27 73 49	ESC I 1	Printable codes expansion (0-31,128-159)
27 92	ESC \	Select relative dot position
27 97 n	ESC a n	NLQ justification where numeric 'n' is: 0 left justification (default) 1 center 2 right justification 3 full justification
27 112	ESC p	Select/cancel proportional mode

Codes listed relate to the LX 800 - where a numeric value of zero or one is required, the ASCII value of the number can be substituted.

HP Laserjet II Codes

Printer Control and Orientation

ESC E	Reset printer
ESC z	Self Test
ESC &l0O	Portrait orientation
ESC &l1O	Landscape orientation
ESC (s0P	Select fixed space font
ESC (s1P	Select proportional font
ESC (s0S	Set upright character orientation
ESC (s1S	Set Italic character orientation
ESC &l#X	Select '#' number of copies

ESC &l0H	Eject page
ESC &l1H	Feed paper from tray
ESC &l2H	Feed paper manually
ESC &l3H	Feed envelope
ESC &l0T	Default stacking position
ESC &l1T	Togglestacking position

8 Bit Symbol Set

ESC (8U	Roman 8 symbol set
ESC (8K	Kana 8 symbol set
ESC (8M	Math 8 symbol set

7 Bit Symbol Set

ESC (0U	USASCII symbol set
ESC (0B	Line Draw symbol set
ESC (0A	Math symbol set
ESC (0M	Math 7 symbol set
ESC (0Q	Math 8a symbol set
ESC (1Q	Math 8b symbol set
ESC (1U	US Legal symbol set
ESC (0E	Roman Extension symbol set
ESC (0D	ISO Denmark/Norway symbol set
ESC (1E	ISO United Kingdom symbol set
ESC (0F	ISO France symbol set
ESC (0G	ISO German symbol set
ESC (0I	ISO Italy symbol set
ESC (0S	ISO Sweden/Finland symbol set
ESC (1S	ISO Spain symbol set
ESC (15U	PiFont symbol set
ESC (2Q	PiFonta symbol set

Font Management

ESC (s3T	Courier font
ESC (s0T	Line Printer font
ESC (s1T	Pica font
ESC (s2T	Elite font
ESC (s4T	Helvetica font
ESC (s5T	Times Roman (TMS RMN) font
ESC (s6T	Gothic font
ESC (s7T	Script font
ESC (s8T	Prestige font
ESC *c#D	font ID '#'
ESC *c#E	character code '#'
ESC *c0F	Delete all fonts, including permanent

ESC *c1F	Delete all temporary fonts
ESC *c2F	Delete last font ID specified
ESC *c3F	Delete last character code and font ID specified
ESC *c4F	Make last font ID temporary
ESC *c5F	Make last font ID permanent
ESC *c6F	Copy or assign last font ID specified
ESC *c7F	Reestablish ROM
ESC *c8F	Set primary font
ESC *c9F	Set secondary font
ESC *c10F	Set primary and secondary font default
ESC)s#W <data>	Create font header
ESC (s#W <data>	Download character
ESC (#X <data>	Designate downloaded font as primary
ESC)#X <data>	Designate downloaded font as secondary
ESC (#@	Primary font default (see printer manual)
ESC)#@	Secondary font default(see printer manual)

Pitch and Point Selection

ESC (s10H	10 pitch
ESC (s12H	12 pitch
ESC (s16.6H	16.66 pitch
ESC (s7V	point size to 7
ESC (s8V	point size to 8
ESC (s8.5V	point size to 8.5
ESC (s10V	point size to 10
ESC (s12V	point size to 12
ESC (s14.4V	point size to 14.4

Page Dimensions

ESC &l#P	Set page length to '#' lines
ESC &l#E	Set top margin to '#' lines
ESC &l#F	Set text length to '#' lines
ESC 9	Clear margins
ESC &a#L	Set left margin to column '#'
ESC &a#M	Set right margin to column '#'
ESC &l#C	Set vertical motion index to '#' 1/48" increments
ESC &l#D	Set lines per inch to '#', valid values are: 1, 2, 3, 4, 6, 8, 12, 16 or 24
ESC &k#H	Set horizontal motion index where # is derived using # = (120.0/cpi) (1/10 precision)

Cursor Positioning

ESC &a#R	Move to row '#'
ESC &a#C	Move to col '#'
ESC &a#H	Move to horizontal position '#' in decipoints

ESC &a#V	Move to vertical position '#' in decipoints
ESC *p#X	Move to horizontal position '#' in dots
ESC *p#Y	Move to vertical position '#' in dots
ESC &f0S	Push cursor position
ESC &f1	Pop cursor position

Raster Graphics

ESC *t75R	Select 75 dots per inch graphics mode
ESC *t100R	Select 100 dots per inch graphics mode
ESC *t150R	Select 150 dots per inch graphics mode
ESC *t300R	Select 300 dots per inch graphics mode
ESC *r0A	Start graphics at left most position
ESC *r1A	Start graphics at current cursor
ESC *b#W <data>	Transfer '#' byte raster image as stream "<data>"
ESC *rB	End graphics

Advanced Graphics

ESC *c#A	Set horizontal rule/pattern size in dots
ESC *c#H	Set horizontal rule/pattern size in decipoints
ESC *c#B	Set vertical rule/pattern size in dots
ESC *c#V	Set vertical rule/pattern size in decipoints
ESC *c0P	Select black rule
ESC *c2P	Select gray scale pattern
ESC *c3P	Select HP-Defined pattern
ESC *c#G	Set grey scale pattern, where # is a value between [0..6] for HP defined patterns and [0..100] to specify percentage gray scaling. The mode depends on the rule/pattern selected using ESC *c?P
ESC *c1G	Vertical lines pattern
ESC *c2G	Horizontal lines pattern
ESC *c3G	Diagonal lines pattern (upward left to right)
ESC *c4G	Diagonal lines pattern (downward left to right)
ESC *c5G	Horizontal/vertical grid lines pattern
ESC *c6G	Diagonal grid pattern
ESC *c#G	Set gray scaling to '#' percent

Macro commands

ESC &f#Y	Identify macro as ID "#'
ESC &f0X	Start macro definition
ESC &f1X	Stop macro definition
ESC &f2X	Execute macro
ESC &f3X	Call macro
ESC &f4X	Enable auto macro overlay
ESC &f5X	Disable auto macro overlay
ESC &f6X	Delete all macros

ESC &f7X	Delete all temporary macros
ESC &f8X	Delete macro ID
ESC &f9X	Make macro temporary
ESC &f10X	Make macro permanent

Miscellaneous

ESC (s#B	Set stroke weight '#'=(7..-7), 7=bold, -7=light
ESC &dD	Set underline on
ESC &d@	Set underline off
ESC =	Half line feed
ESC Y	Turn display functions mode on
ESC Z	Turn display functions mode off (default)
ESC &p#X <data>	Disable command interpretation for the '#' bytes following this command
ESC &l0L	Disable perforation skip
ESC &l1L	Enable perforation skip
ESC &k0G	Set line terminators to CR=CR, LF=LF, FF=FF
ESC &k1G	Set line terminators to CR=CR+LF, LF=LF, FF=FF
ESC &k2G	Set line terminators to CR=CR, LF=CR+LF, FF=CR+FF
ESC &k3G	Set line terminators to CR=CR+LF, LF=CR+LF, FF=CR+FF
ESC &s0C	Enable end of line wrap
ESC &s1C	Disable end of line wrap

Escape sequence combination rules:

- The first 2 characters following the ESC must be the same
- The final character in a sequence other than the last must be changed to lower case
- The last character in the complete sequence must be changed to upper case
- Escape sequences must be specified in the order in which they should be performed
- The space following ESC is not included in the string

Communications

There are two types of signal traffic:

- **low volume**, and interactive, where you might control another computer from your keyboard (you can do this over the telephone system or a network).
- **high volume**, where you just transfer data from point to point, with no need for feedback.

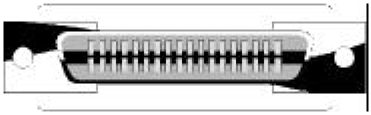
The former would tend to come and go in short bursts, and the latter, more predictably, in a continuous stream. Luckily, there are only two ways of sending either:

- eight bits at a time at a given signal, down eight or more wires at once (rather like a horse race), or
- one after the other down a single cable.

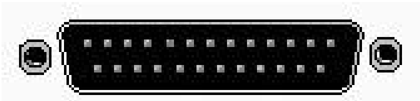
The first method is known as *parallel* communications and the second *serial*. Each has its own pros and cons, but the most common for our purposes is serial, so let's dispose of the other first.

Parallel

Parallel communications are used over very short distances; typically inside the computer itself and to printers. This method, together with the connector:



was developed by *Centronics* and used by IBM in its first PC. As a result, it has become relatively standardised. It is fast-ish, and distance-limited. The connector on the PC is female, with 25 holes, and looks like this:



The original design was one way only, but *bi-directional ports* have been developed, a side benefit being the ability to control a printer directly with suitable software. *Enhanced parallel ports* (EPP) are bidirectional high speed data buses that can transfer data at ten times the speed of standard ones, making them useful for attaching tape streamers or extra hard drives.
The wires are very close together, and because the strength of any signal diminishes the further it goes down the line (due to the work it has to do to get past the resistance of the wire itself), there is a chance they could be interfered with when they become weak enough, giving the possibility of *crosstalk*, on top of normal attenuation, where signals from one wire will be reflected in the next. This is why parallel communications are generally restricted to short distances unless boosters are used.

Just to send the data, we need a minimum of eight wires, so a complete character can be sent at a time. However, that's not all. What if the receiving computer wasn't able to take everything at once (perhaps because it ran out of memory) or detected an error and wanted to tell the sender to stop and send that last bit again?

There will be other connections between the computers with another conversation going on, telling each other when to stop and start sending, and giving themselves progress reports. As you can imagine, we now begin to collect quite a few wires, usually about 15 in all, depending on the equipment. The parallel port is actually controlled by two chips, one for information and the other for control signals. Both are linked to a decoder which sorts out to which pins in the connector the relevant bits are sent. When the printer (for example) is *on line*, it sends a *Ready* signal to the computer, whose response is *Initialisation*, sent on another wire, which clears the *buffer* (a bit of memory that stores data so it can be sorted out before printing).

Once the printer is initialised, the data is lined up, one bit per wire (like the start of a race) and, assuming the printer hasn't sent a *Busy* signal, a low voltage signal (*DataStrobe*) is sent to the printer. This acts like a starting gun to send the data down the lines, at the other end of which it assembles in the buffer ready for printing, after it's had a coffee.

As soon as the data arrives, the printer acknowledges receipt with another low voltage signal (*Acknowledge*) sent on yet another wire. Then the whole process starts again. Anytime it needs to, the printer can send a *Busy* signal which tells the computer to hold everything until given the all clear. There is also a fault signal which stops the process if unhealthy conditions exist, such as lack of paper or a stuck ribbon. Or cold coffee.

As you can send all the bits at once rather than one after the other, parallel communications are fast and accurate, because it's easy to identify which bit is which by knowing what wire it came in on, and when. Thus, because you're not carrying overheads for error checking, as with serial (below), it's possible to transfer data very efficiently, but only for short distances, as noise and signal deterioration increase rapidly with distance.

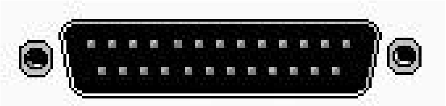
This is fortunate, because trying to arrange long cables of the thicknesses needed for parallel communications around corners is very frustrating—and more so if a separate ground wire is twisted with each signal wire to reduce interference. If you couple this with switching arrangements for each one, you can see that parallel transmission has the potential for being impractical and horrendously expensive. Printers still use the old DOS device name of LPT, the numbers 1, 2 and 3 referring to which one.

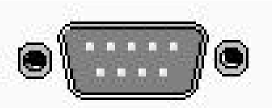
Serial

Serial transmission involves sending data bits one after the other, down one cable. This is not as standard a method as parallel, and is slower, but it is more flexible in terms of distance, and is ideally suited for the telephone, since they're not likely to change the system to suit computers. It's quite possible to get away with just three wires—one to transmit, one to receive and another being a ground return path but, in practice, you need others for the same reasons as you need them for parallel; the computers have to talk to each other and co-ordinate their activities. Having said that, you very rarely need more than five, and eight at the most.

Of the various standards that were laid down to straighten things out, the best known one relating to serial is **R**ecommended **S**tandard **232** revision C— you've probably already seen the term RS232C used somewhere (see the chapter on it, if not). In Europe, another standard exists (V.24) which is actually based on RS232C, so to all intents and purposes they can be regarded as the same. The problem is that they were hashed out when equipment was relatively primitive, and were meant to allow you to use the computer with the telephone lines. In later years, serial transmission has been used for something it was never designed to do, such as drive a printer, or a terminal. Earlier computer manufacturers also adapted unused pins for their own purposes, allowing many incompatibilities to creep in.

Although the original serial plugs catered for 25 connections (see left, below), the 9-pin version (on the right) has more or less taken over, as some of the connections in the larger plug are only backups in case the main ones don't work, and many aren't used anyway.





The keyboard and PS/2 mouse connectors are serial ports as well (a mouse using its own card is known as a bus mouse). COM ports use the old DOS names of COM1, COM2, etc. AUX refers to the 1st COM port.

UART

The *Universal Asynchronous Receiver/Transmitter* is the device inside your computer that turns the internal parallel data stream into serial for transmission down one cable. It receives a character, generates an interrupt and stores it in a buffer till the next character comes, assuming the CPU is able to take it before then.

The original design supplied with the IBM PC was the *8250*, shortly to replaced with the one for the AT, the *16450*. The 8250 took 1000ns to reset after dealing with an interrupt, which wasn't a problem initially, as the PC itself took twice as long to access it. However, when faster machines came along, their access time was the same, and eventually less than the UART's reset time. The 16450 was able to reset inside 200ns, so the problem went away for a while. It is capable of transmitting/receiving up to around 9600 bits per second without framing errors, which occur when the amount of information received does not match what is indicated between the first and last bits of a frame.

When transmitting at 9600 bps, you are interrupting the CPU around 1000 times a second, so with a standard UART you will lose characters if the CPU can't take up the stored characters in time. At 19200 bps, the interrupt frequency is approx 1920 times a second; if you compress your data (say with V.42), and get an effective speed of 115,200, the CPU must rescue a byte every .000087 seconds! To get higher performance, the *16550AN* was invented, which had a 16-byte buffer and was therefore able to store more characters until its interrupt was able to be serviced. The 16550AFN had a few bug fixes, and the 16650 has a 32-bit buffer.

The amount of characters stored before an interrupt is generated is programmable, and is known as the *trigger level*. Windows starts at 14, which unfortunately gives you only one better byte's leeway than the 8250! As the 16550 is pin-compatible with the 16450, and is therefore a straight swap, some applications may not automatically recognize it.

Here are the maximum speeds you can expect under different UARTs:

CPU	16650	16550A	8250/16450
386SX		38400	19200
386DX		57600	19200
486SX		115200	38400
486DX	46080	115200	38400

Unfortunately, the UART isn't the whole story, being only one element in the chain of components inside and outside your computer, including modems, software and overall speed of hardware. **Multi-sector disk I/O** (set in your *Advanced CMOS*) will disable interrupts until any hard disk transfers are complete, so you could lose characters. Smartdrive delayed writes also take priority. Interrupt Latency is discussed under *Performance*.

Telephone Lines

Unless the computers that need to talk are sitting next to each other, there needs to be some way of connecting them over long distances which, for practical purposes, means the telephone system, commonly called the PSTN in the computer industry, or *Public Switched Telephone Network*. Other people call it POTS, or *Plain Old Telephone System*.

Depending on your requirements, that is, the amount of information you want to send (and how well you want it received), together with the equipment you want to use, there are two main categories of available lines:

- **Standard Telephone Connection**. Otherwise known as a dial-up line, this has a theoretical capacity of 20,640 bps (bits per second) if analogue, although this is generally unavailable without special procedures and equipment. A digital line can give around 24,000, but most connections to digital exchanges are analogue (except ISDN—see the end of this chapter).

- **Dedicated Line**. Also known as a leased line, this is a permanent sole-use connection usually rented out to commercial organisations, because they are the only ones who can afford them, with a better signal-to-noise ratio. A flat monthly fee is paid, based on speed and distance, and should be considered if you expect to connect to the same place more than 4-6 hours a day, or want continuous two-way Internet access. One example is the type of lines allocated to the emergency services, or those connecting cash machines in the street to a central bank. At least you won't have to dial any numbers, as the line will look just like another part of your equipment.

Typical services available over leased lines include:

- **Kilostream**, which is a digital leased line providing high speed links between terminals and computers up to 48-64,000 bps, and

- **Megastream**, which is as above, but up to 140 mbps for data or PABX links, so you can include the telephone exchanges in each building. A 2 Mb link can carry up to 30 voice channels, which can be multiplexed as required.

At least you won't have to dial any numbers, as the line will look just like another part of your equipment. Dialup lines come in various types:

1. Basic Voice
2. Voice, with quality control
3. Voice/Radio with tone conditioning
4. Data below 1200 bps
5. Basic Data
6. Voice/data over trunk circuits
7. Voice/data over private lines
8. Voice/data over trunks between computers
9. Voice and video
10. Application relays

Sometimes leased lines are referred to in terms of capacity. Originally, a POTS line carried one conversation, but several with multiplexing. A T1 line is digital (99% error free) and contains 24 x 64 Kbps channels, plus another one of 8 Kbps for control, giving a total bandwidth of 1.5 Mbps (similar to 23B+D with ISDN, or about a sixth of Ethernet). A T3 line is equal to 28 T1 lines (see below). *Fractional T1* is a smaller version which is upgradeable. With this, you can start with a few channels and build up. A Switched T1 line is not dedicated, so you can make calls to other T1 lines. For all, you need a router and a multiplexer if using voice and data.

System	T1 channels	Voice channels	Data Rate (Mbps)
T1	1	24	1.544
T2	4	96	6.312
T3	28	672	44.736
T4	168	4032	274.760

A *Switched 56* line can be paid for on a usage basis, and is a switched line delivering 56 Kbps. It requires a CSU/DSU for dialling up other switched sites.

Both standard or leased lines, however, are unable to carry computer signals as they stand, so you need translation facilities at each end to make them talk properly. For translation on a "normal" line, you need two pieces of equipment; a *modulator* (which converts the computer's digital signals into sounds of varying pitch) at the sending station and a *demodulator* (which swaps them round again) at the receiver. As most data transmission is two way, the same equipment is needed at each end.

Modems

Modem is short for *Mo*dulator/*Dem*odulator. It's a device that combines the two functions described above; that is, converting the on/off signals that a computer uses into audio tones so they can be sent down a telephone line and *vice versa*. This conversion is known as *changing the modulation*, hence the name; a carrier wave is modulated (varied) with the information, which is extracted (demodulated) at the destination, which is actually only a short distance away, at the exchange! This is all repeated later, of course, when the call comes off the digital link. The process is similar to radio.

All this conversion causes losses, and bottlenecks, but there are other tricks the phone company can use to get the most out of the lines which don't help, such as compression.

Sometimes lines are combined together into one digital signal—if the people you are calling have a digital connection to the service (that is, a digital local loop), you could cut out one conversion from exchange to modem, by using a special (x2) modem, giving up to 56 K, albeit one way only. A digital line would have a *Digital Service Unit*, or *Digital Modem* (if you're wondering why, it's because you still need protocol conversion, even though the signals are similar).

56 K signals are delicate, and will not stand multiple conversions, especially through switchboards, so the standards are half duplex; you can download at that speed, but uploading and connections to other modems are done at 33.6 Kbps, because an analogue-digital conversion takes place at your end and at the ISP, giving rise to noise in the shape of Quantisation errors.

A modem plugs directly into a normal telephone socket, and to your PC's serial port (or parallel port for some more powerful types), so it sits between your computer and the telephone socket. Some are internal, so you can keep the desk tidy, but then you can't watch the indicator lights to see what's going on.

As they're connected to the telephone system, modems in the UK must also be approved by the *British Approvals Board for Telecommunications* (look for the green label). This "approval", however, is only to check that it doesn't muck up the system as far as BABT is concerned—it's not a consumer test of facilities and performance. Part of what governs the speed of a modem is the DSP, or *Digital Signal Processor*, which does all the modulating, but how it is programmed is also a factor. The firmware can either come from the DSP manufacturer or be written in-house by whoever makes the modem.

In UK it is illegal to connect anything to the telephone system that hasn't gone through the official approval procedures (and passed!). It isn't illegal to buy or sell it—only to connect it.

There are PCI modems designed to run under Windows and use the CPU to do most of their processing. This produces an obvious performance hit, although they are very cheap. Such modems will not work with Linux or DOS, so it's best to get a real modem, or a "hardware" modem, that is totally self-sufficient, and preferably uses a real IRQ rather than the Plug and Play system. This assumes that you have an ISA slot on your motherboard, since these modems are usually ISA-based.

Note some modems require a line voltage with which to modulate their signals, which is why joining together two computers with just a telephone cable often doesn't work. A device called a *phone line simulator* will help here.

Amplitude Shift Keying

The simplest way of representing binary information with tones is to have one volume equal to 1 and another equal to 0 but, as with AM radio, this is susceptible to noise and will only allow a rate of about 1200 signals per second over the cable.

Frequency Shift Keying

FSK is similar to ASK, except that the *frequency* of the signal is changed rather than the *amplitude* (e.g. volume), giving the same comparison as FM radio against AM. As there is less noise, the system is more robust and you can get up to 2400 signals per second. A distant cousin of this is used on cable modems.

Phase Shift Keying

PSK changes the *position* of a signal relative to another, so a change in phase of 180 degrees will signify a 1; no change represents a 0, producing twice the signalling rate of FSK. *Differential PSK* allows 2 or more bits to be encoded per signal (see also *QAM*, below).

Acoustic Couplers

Very early types of modem were acoustic couplers which had rubber cups into which you placed your telephone handset.

They are modems to which are attached a loudspeaker and a microphone that are held near the handset's mouthpiece and earpiece respectively. This can be cheap and convenient, but the variety of strange shaped handsets around has effectively ruled out their use on anything but the old-fashioned type. Having said that, modern ones are still available because of the different types of phone sockets (or lack of) around the world!

Their main disadvantage lies in their acoustic and not electrical connection—it's always possible for odd noises to get in around the seals and ruin the signal, but 28,800 bits per second is possible with newer ones.

Operating Speeds

A modem's direct connection eliminates outside noise, but the characteristics of the telephone line will also limit your speeds (it only has 2700 Hz bandwidth), which will get less as the quality of the lines deteriorates; this will change from moment to moment, what with routing through sub-standard lines, etc.

The slowest practical speed is 300 bits per second; the fastest with analogue transmissions is 2400, without special treatment. If you go any faster, you will need more bandwidth, which is simply not available, so techniques have been developed that will allow you send more signals, if you can't actually make the signals go faster, such as *Differential PSK*, mentioned previously. With a digital exchange, however, you get a better signal to noise ratio, together with a much increased bandwidth (up to 3429 Hz), so faster speeds are possible, but not necessarily between your computer and the exchange; the improvements are averaged over the whole connection.

We've mentioned *bits per second* already, but the term *baud* (named after Baudot) is sometimes loosely used in place of it—the "baud" rate is actually the frequency of the modem tone, and therefore the number of *signal changes a second* (as opposed to the *amount of data transmitted*, represented by bits per second). In the case of early modems, the terms coincide, because one bit will be represented by one change in the signal. However, where more than one bit is sent for each change of signal (as you would get when more information is squeezed on to the tone), the two terms part company. For all practical purposes, though, any modem below 2400 baud is customarily regarded as operating at a corresponding rate of bits per second.

A "9600 baud modem", by the way, is actually a 2400 baud one using *Quadrature Amplitude Modulation*, which transmits 4 bits per baud, so it should actually be called a "9600 bps modem". QAM modifies the carrier wave to be in one of four states, each 90 degrees removed from each other. 14,400 modems are still 2400 baud, but use *Trellis Coded Modulation* on top, giving six bits per baud. You can get twelve bits per baud with *Multidimensional TCM*, giving you 28,800 bps, but the lines have to be spot-on for this; 24,000 would be more typical.

Unfortunately, software doesn't recognise such terms, and you will always get an average speed of around 1000 characters per second unless you use data compression as well, to boost your *effective* speed. For example, if you have a 14,400 bps modem running V.42*bis* (see below), you will probably be able to connect at 38,400—see *Performance*, shortly.

Data compression reduces the size of what is sent without damaging it, so more can be moved in a given time (cheaper phone bills!). One method is *Run Length Encoding*, which takes the first one of a sequence of the same characters and attaches a note to it, saying how many more there are. Another way is to vary the number of bits representing a character, according to its frequency of use. Your final transmission rate will therefore depend upon the ability of the data to be compressed, as well as the capabilities of the computers at each end (more in *Performance*, shortly).

Modem speeds used to be written: 2400/2400 or 1200/75. The slash is used because modems transmit as well as receive; the first number denotes the receiving speed and the second that used for transmitting. In Europe, the standards relating to computer communications by telephone come under the V series, where V is short for the French *Vitesse*, meaning speed. On the other hand, it could mean *Study Group 5* (of CCITT). It's mostly called *Veedot*, though, by those in the know.

Here are some modem standards you may come across:

Std	Contents
V.19/20	Relates to parallel modems.
V.21	300/300 Old FSK Full Duplex asynchronous. Really out of date.
V.22	1200/1200 PSK Half Duplex asynchronous. Out of date.
V.22 bis	2400/2400 Full Duplex asynchronous
V.23	1200/75 FSK Full Duplex asynchronous.
V.24	Definitions for circuits between equipment (e.g. RS232).
V.25	Control language that lost out to Hayes, but is being regenerated.
V.32	9600/9600 Full Duplex asynchronous.
V.32 bis	14400/14400.
V.32 ter	Unofficial V.32 extension to 19200.
V.34	Originally 28800/28800 (V.Fast was the unofficial version of this). Actually up to 115kbps with V42 bis (i.e. compression) giving 1 Mb every 2 minutes or so. Now officially 33.6 kbps due to more efficient coding mechanisms.
V.42	Error correction using LAP-M but superseded by MNP4.
V.42 bis	Error correction with compression, superseding MNP5. Can autodetect compressed files and turn off compression automatically. Compresses at 4-1.
V.90	56K
V.FC	An interim standard for 28.8K put forward by Rockwell and Hayes whilst waiting for V.34 to be sorted out.

Performance

Unfortunately, a modem using V.42*bis* (i.e. compression) will need data sent to it at three to four times its transmission rate to keep throughput up; in other words, you need to run the serial port at 115K if you have a 28.8K modem.

What performance you finally get will depend on many factors, including your BIOS, other hardware and the software you use to communicate. The "other hardware" will most likely be

Network Interface Cards, which can hog interrupts and therefore interfere with serial communications, or inefficient hard disk controllers, which will do the same thing. Also check out *IDE MultiSector Block Mode* in your Advanced BIOS settings. The data you wish to send, and its compressibility, has a bearing, as well. With compression at 28,800 bps, you can expect to send around 6000 characters per second.

Then there's the technical side. 56K modems send digital signals down an analogue phone line, which need to be reconstructed in the modem after some degradation. It can't be done the other way round, so the reverse channel runs at only 33Kbits/sec.

Windows

Windows doesn't help, either. Aside from the fact that you may not have a 16550 UART in your machine, and you can only load one comms driver anyway, a 286-based computer will typically take about 1 ms to change from protected to real mode, as interrupts are serviced to process data transmissions (this is called *interrupt latency*). Thus, the fastest transmission rate is 4800 or 9600 bps, depending on the time taken for switching.

Although 386- and 486-based machines switch faster (1000 times per second at 9600 bps, and over 11,000 for 115,200 bps), Windows' virtualisation of the COM port means you could still get problems when running faster than 19,200 bps. In addition, Windows doesn't make use of the transmit buffer or, rather, by default, only the receive buffer is enabled. The trigger level also defaults to 14, leaving 2 bytes for the buffer, which is only one better than the original 8250! You must insert extra commands into the **[386enh]** section of **system.ini**, which are detailed overleaf. It's not all bad news, though—third party comms drivers are available, and many programs can handle this themselves.

So, with a 16450/8250 on a 486DX2-66, standard Windows communications can only support up to 38.4 Kbps during a file transfer, possibly smaller, depending on disk access times, etc. It's not that much better with a 16550, so it's always possible to get data overruns and lose characters, especially if you're communicating in the background and using a DOS-based application that accesses the hard disk frequently (more protected mode switching). Even if you don't lose characters, the retransmissions needed to keep them all intact will slow things down.

The above has led to parallel port modems. As they receive 8 bits at a time, instead of one, data can be delivered in bursts (up to 64 characters), thus making better use of interrupts available. Fewer interrupts mean that the CPU can get on with other things; parallel modems can reduce the interrupt rate to just 360 per second (compare with 5,500 even with a 16550).

There are also enhanced serial ports, such as the *Hayes ESP-II*, that have 1K buffers and use DMA, but they need their own software to run properly (works fine with Windows). The interrupt count can be reduced to 11 per second with these, giving you much smoother processing.

Windows for Workgroups 3.11

By default, only the *receive* FIFO is enabled on a 16550A UART, and then not properly; you have to add certain entries (below) to the **[386 Enh]** section of **system.ini** for correct operation.

According to Delrina Corp, Microsoft's technical reference documentation on FIFO settings continues is incorrect. Apparently they examined the Windows For Workgroups 3.11 **serial.386** source code and verified FIFO operation with a hardware monitor. Here are the settings, assuming the use of **vcomm.386**:

- **COMxFifo=2** — Can be omitted but, if present, MUST be set to 2.
- **COMxTXFifo=1** — 1 activates 16 byte (non configurable) transmit FIFO, the default of 0 deactivates it.
- **COMxRXTrigger=8** — Receive FIFO IRQ threshold; must be 1, 4, 8, or 14 (default is 8).

Hayes

Once upon a time, an American company called *Hayes Microcomputer Products* made the *Smartmodem*—"smart" meaning that it was intelligent, and able to be controlled by commands from the computer rather than having its buttons pushed on the front. A Hayes modem has a microprocessor inside, which is fed instructions from the software you use on your PC.
For this, Hayes developed their own programming language which has become a standard, at least for the basic commands (see below, and also Appendix A); their software commands are known as the *Hayes Command Set*, which can program a modem to do all sorts of things in quick succession, including dialling a number, changing speed, hanging up—in fact anything others usually do with switches.

All you do is prefix the commands with the letters AT, which were chosen because their bit pattern makes it easier for the modem to detect what sort of data is coming from the computer, and at what speed (in other words, the modem sets its own speed according to how the letters AT are sent). For convenience, you could think of them as being short for "Attention".
Each time it sees **AT**, the modem sends back a result code to tell the software what went on. You can have up to 40 more characters after AT, but this may vary between manufacturers.

As an example, to dial someone, just key in (from your keyboard when your communications software's in *terminal mode*):

```
ATDT
```

followed by the number—the full phrase:

```
ATDT01818368876
```

(you can put spaces in for readability) tells it to take the phone off the hook (AT), wait for the dial tone and dial (D) with tones (T) the number that follows. If the line is engaged, the response:

```
BUSY
```

would appear on the computer screen, but you can change the phraseology if you want to. You may get

```
NO CARRIER
```

if it can't connect, or the word

```
CONNECT
```

followed by the speed, when it does. If you have software that can recognise such things, you can use numbers instead, and maybe get some more automation.

Pulse and Tone Dialling

Pulse Dialling is that used with old rotary telephones—as the dial spins round, it generates a small pulse of electricity which is recognised at the exchange; each digit is represented by the same number of pulses. Now, *Dual-Tone Multifrequency Dialling* (DTMF, or just MF) is used, where each digit is represented by an audio tone.

A Hayes modem also has a small amount of memory (in the shape of *Registers*), so that frequently used numbers can be stored and accessed with a code consisting of considerably fewer keystrokes than normal. You can pre-program it to change speeds and other parameters as may be required, although this will be handled by your software.

Default instructions, that is, those you use all the time, are contained in the *S registers*, the number of which depends on the make. For example, *S0* stores the number of rings the modem will wait until it answers the telephone. *S6* will set the wait time for a dial tone.

Types of AT Command

The modem itself can be in two operational states—*command* or *on-line* (e.g. *data mode*). While it's in the command state you can set it up and give it all the instructions you want to; no transmission is taking place. The on-line state is when it's doing its real work.

Once you're on-line, you can issue instructions as if you were in Command mode by issuing an *Escape code* consisting of plus signs that enables you to change any parameters you want on the run; the modem temporarily stops sending while you do so. Otherwise, the modem will assume that everything issued from the computer is data.

Standard AT commands are those you will find in any Hayes-compatible modem; there are about 20. They consist of AT plus a letter and an option relating to that letter (0 is assumed if nothing is given).

Extended AT commands are thought up by different manufacturers according to what they think is useful. They generally come with a symbol, such as & or %, between AT and the command letter:

AT command	Action
A	Autoanswer.
B	Bell or CCITT mode.
C	Enables carrier transmission.
D	Dial a number (add P or T).
E	Concerns echo. 0=Do not echo back AT commands 1=Echo back
Q	Quiet mode; or reports sent 0=Send OK (or other) 1=Quiet; no responses given.
V	Verbose responses if Q is enabled.
Z	Software reset.

Letters can be combined in any order. If you need to insert a pause (you might be on an exchange which needs a couple of seconds to think to itself), simply use a comma, as with:

```
9,
```

if you need to dial 9 to get an outside line before sending the proper number.

An example of a full dialling command could be:

```
ATDT9,37747777789
```

The first letters, AT, get the modem's attention, D means Dial, T means *Tone* (you would use P for *Pulse*), the 9 gets you an outside line and the comma inserts a pause. After that, just add the number you wish to dial. You can change the length of the pause through one of the registers.

You can put in spaces for readability, which is why they are ignored. A full list of commands should come with your modem (you did get a manual?), but are included at Appendix A.

Modem Initialisation String

Sometimes a special set of commands is sent to the modem to wake it up properly when the software loads, which commands stay in force until either the modem is turned off, or new commands are issued. They concern whether the speaker should be on and various other housekeeping settings (your own favourite commands, in other words). It could look something like this:

```
ATZ S=1 &F&C&D G=0
```

Don't try that one, by the way; I made it up. Ideally, a modem initialisation string should be no more than ATZ (reset to default), with the remainder of the instructions obtained from the default settings kept in the modem's memory, but you get better security if you issue a string every time, which helps if you run your own Bulletin Board.

Specialised modems

Of special interest to Bulletin Boards are *scanning modems*, where a number of attached lines are read in rotation several times a second to find the first one used. Where software cannot handle split speeds, a *buffered modem* speaks to the computer at one speed (1200/1200) and the outside world at something else (1200/75). This is sometimes known as a *constant speed interface* modem which, in addition, will use the buffer in the same way a printer does; a fast computer can send data immediately while the modem sends at its own pace. These are still used in Europe for Viewdata.

Fax modems are looked at more closely in the *Fax* section. MFTAM stands for *Modem, Fax, Telephone Answering Machine* all in one. They are sometimes referred to as *Voice Fax Modems*, because they can act as a front end for a message centre, distinguish between voice, fax and modem calls and route them accordingly. This makes your computer able to take messages and faxes, and send them to you automatically wherever you are.

Being In Control

On the front of the average modem, you should see lights indicating the operation of the following functions. The more automated the equipment is, the less there will be, but these are the most common:

Light	Action
Power	Whether power is getting to the modem.
HS	High Speed; i.e. operating at maximum speed.
AA	AutoAnswer (where your modem answers the phone for you).
SD or Txd	Send Data or Transmit Data; data is transmitted when on.
RD or Rxd	Receive Data; data is being received when this is on.
OH	Off Hook; your modem is using the phone line.
TR or DTR	Terminal Ready or Data Terminal Ready; this is normally controlled by the computer or terminal and indicates that the computer is talking to the modem. It may be marked "Ready".
CD or DCD	Indicates that the modem has detected the remote modem's carrier signal and is happy with the quality.
RI	Ring indicator. Flashes in time with the ringing current on the line, usually used with auto-answer.
DC	Data Compression.
EC	Error Correction.

The power light should always be on, but watch for the *low power* light if your modem is battery powered. When you tell the software to connect, the DTR light will come on as the computer takes control of the line, between it and the modem.

Then the number is dialled. The incoming ringing current is recognised by the answering modem, which goes off-hook and issues a series of tones (defined by V.25) which are meant to disable echo suppression and cancellation on the line, so the modem can use its own. The originating modem sends a signal that tells the other side what speed its running at, so it can cycle through the speeds available until connection is made, or it gets bored waiting.

The modem will inform the computer that a link has been established, and the DCD light will come on. This signal is continually monitored by the computer to check the connection hasn"t broken.

You will see the TXD and RXD lights flash in sympathy with the data as it's transmitted and received.

Originate/Answer

When transferring information, modems use two frequencies—a high one for zeros and a low one for 1-bits; if the two modems involved in a communications session used the same frequencies, you can see there would be some confusion over who sent what. To sort this out, two other sets of frequencies are used by the receiving modem, but it must be decided at the start which role the particular modems will take.

Some modems have an *Originate/Answer* switch, which is set according to what your activity is—those that don't have one set themselves automatically. The modem starting everything off is known as the *originator*. All services (such as CIX or Compuserve) are answerers.

Note that the speed sensing circuitry in some V.22*bis* modems doesn't like the (½-second) phase reversals in the answer tones of a V.32*bis* one; in other words, they might have trouble connecting; this includes V.22*bis* ones masquerading as V.32*bis* (see *Troubleshooting).*

The following items will connect your PC to the telephone system:

- ❑ The PC, with a serial port based on RS232, or a parallel port if your modem is more powerful.
- ❑ A modem, which for simplicity should be Hayes compatible (that is, follows the standards laid down by Hayes). The modem needs to be connected to the PC with a cable, but you can get internal ones.

  What you buy really depends on what you want to do. If you mainly transfer files, a fast modem will pay for itself quickly, in terms of lower telephone costs and boredom.

  If most of your time is spent on-line, though, just wondering what to say next in an on-line conference, you won't really appreciate the benefits, and a 28.8 modem is still viable (with compression, it will connect at a higher effective speed anyway).

  There are no official figures to tell you how good each modem is (and brochures tell lies anyway), so the best advice is to carry out your own field trials. While it's true you only get what you pay for, it's equally true that price is not necessarily a reflection of quality or features. Several high-end products are outperformed by less expensive competitors. As manuals are usually incomprehensible and get lost anyway, look for considerate manufacturers that print useful stuff like DIP switch settings and commands on their products.

- Communications software to send and receive data and save it to disk when necessary. More about software later.

- A telephone line!

Installing A Modem

Most modems come pre-switched to use COM 2, or COM 3, but they may surprise you, so don't assume anything—check with the documentation (the settings may also be marked on the card itself, in which case believe them before you believe the manuals). If you have a *winmodem*, there will be no switches – it talks to the PnP system and sets itself up. A winmodem is one that lets the CPU do most of the work, which is why they're cheap, and why they're not all that good. Get a so-called hardware modem, which actually does the work by itself.

For a hard-wired modem, it's best to use COM 2, as 3 and 4 are often a kludge, so you will need to disable the serial port which is likely already set up in the PC. On a modern machine, this will be done through the *Peripheral Setup* section of the CMOS Setup, or by setting jumpers or switches on the motherboard or expansion card the port is on. An external modem will use the COM Port already active on the machine.

Having done all that, select your wall socket and unplug any phones already there. Make sure your system power is off, and insert the card. Generally, a modem will have two sockets, one marked *Wall, Telco* or *Line,* and the other marked *Phone.*

Insert one end of the modem cable into the wall socket and the other into the *Wall* or *Line* socket on the modem, and the telephone connector in the other, so the phone is connected to the wall socket through the modem. If you have only one hole, plug a splitter into the wall socket and connect the phone and the modem to it (you can do this with modems that have two holes as well, using the *Wall* socket).

Make sure the plugs click properly into place. To test the physical connection, lift the receiver and listen for a dial tone.

Finally, connect an external modem to the power supply.

Verifying The Connection

When Windows '95 starts, it should automatically detect the new modem. It's first choice will be *Standard Modem*, which should work fine, but if you get problems see if the modem has its own software, which you should only really use if you need some of the special commands that different manufacturers add to the standard set. When installing a winmodem, it may at some stage ask you for the Windows installation CD, and moan repeatedly when it can't find certain files. The files you need are on the accompanying floppy or CD.

- ❑ Windows 95. Click on the Start button on the task bar, highlight Settings in the menu and click on Control Panel in the next menu. Double-click on the System icon, then click on the Device Manager tab. Choose Modems—Properties. It should say "The device is working properly". You can also go to Modems in Control Panel, click on the Diagnostics tab, then the More Info.. button. The modem will be interrogated and its details displayed.

- ❑ Windows 3.1. Click on the Terminal icon (in the Accessories group after you turn on the computer. Open the Settings menu, click on the Communications option and specify the serial port used by your modem, such as COM1 or COM2, etc.

  Type AT or at, followed by Enter.

  If the modem is working properly, you should see:

  ```
  OK
  ```

  on the screen. If not, turn off your system and check the connections. If no typing appears at all, you probably have a resource clash, in which case check what COM port your modem is set to, and whether you have disabled the corresponding one on the machine.

For a final check, you need to dial out somewhere.

Alternatives

ISDN

ISDN, or the *Integrated Services Digital Network*, is an international program for the digitisation of telephone systems in Western Europe, Japan and North America. It accepts digital data directly, and has the potential to allow voice, data, fax and video signals to be transmitted over the ordinary telephone system at the same time—you can send 150,000 or so digital words (in the form of bits) in the same time it takes to send 6 analogue ones (as a voice conversation). There is more to ISDN than speed; having two channels allows you use a modem and talk at the same time. You can also have up to ten numbers attached to different devices on the same line, for a small fee, of course (known as *Multiple Subscriber Numbering*). Actually, ISDN's raw speed doesn't compare favourably with the maximum speed (with compression) of POTS, at 115 Kbps –64 Kbps per channel, gives a total of 128. However, compression over ISDN can produce over 400 Kbps.

Up to 23 or 30 channels of varying types of information can go out on an ISDN cable simultaneously, at 56 or 64 Kbps, respectively, depending on which side of the Atlantic you're on (it's higher in Europe). The cable itself is the standard, two wire connection, so time multiplexing is used to do the work, with reassembly into channels at the destination.

There are two services available, *Basic* or *Primary*, and the difference lies in the number of B channels (e.g. digital communications lines) available; 2 for Basic and 23/30 for Primary. BRI is often referred to as 2B+D, Generic Data M or S (Standard), and PRI as 23B+D (same as T1). BRI is meant for home or small business, and PRI for large organisations.

There is a D channel with each type of line that is used to set up the call, which also has a bandwidth of 64 Kbps, with 16 of it used for call connection services, and the remainder reserved for management functions. You would normally expect to use Basic for LAN communications; the Primary service is for the service providers themselves, between exchanges. The 64K bandwidth arises from the sampling rate of an Analogue-Digital Converter (ADC) which ISDN has to emulate for the tones, of 8 bits by 8K.

Each B channel should have a bandwidth of 64Kbps, but line quality might drop this to 56 or so; each can work independently of the other, as each has a different telephone, or directory, number. B channels can be merged for double throughput one way (called *reverse multiplexing*), which *aggregation* is quite useful when your leased line goes down; if you have them available, you can combine 10 ISDN channels to take its place (ISDN was originally marketed as a backup to leased lines). A *backup unit* will automatically do the switching for you.

A feature called *Bandwidth On Demand* (BOND) allows you to aggregate lines till you want to speak, whereupon the bandwidth used drops to allow the conversation to take place. Both your TA and the router you dial into must support the same bonding protocol, usually *Multilink Point-to-Point Protocol*, which can handle up to 6 B channels at once.

Another feature is automatically dropping the line when it's not being used, which is useful when networking over distance. It connects quickly, but can be relatively expensive per user.

ISDN is already used at digital exchanges, but the connection to your telephone socket is, more often than not, analogue. With ISDN you can connect to the outside world without modems, although you still need a connection point, in the shape of a TA (*Terminal Adapter*). There is a difference in performance between internal and external adapters, simply because the latter will use the serial port (though there are parallel versions). There are two types of TA, active or passive. An active one has an onboard processor, and a passive one has all its drivers handled by the PC. The latter are usually internal devices

ISDN allows people to work from home and use the company network facilities directly, with little loss in performance, although I wouldn't like to try and run Windows over any telephone line! Make sure your Internet Provider has ISDN as well, and note that you might have to pay for it. Transmission is virtually error free, you don't need compression (yet, although it is available), connection is almost instantaneous (.2 seconds or so) and you get Full Duplex operation.

ISDN equipment won't work if the power goes, although the line will, so you might want a UPS, or you won't be able to use voice. Modern equipment can take analogue equipment and convert the signals (you once needed an S/T interface to do this, that is, allow eight devices to be used on one U interface, which was the connection provided by the phone company).

ISDN channels need an SPID, or *Service Profile Identifier*, which incorporates the directory number; this must be typed correctly when setting up. It performs a similar function to the address burnt into an Ethernet card, and contains codes that tell the phone company what type of connection you need and the type of routing, which can be different for voice and data. Switches have varying requirements for SPIDs; some can cope with one for both channels, others need one for each channel. Some don't need an SPID!

You (and your TA, or PC Card) also need to know the type of switch at the exchange. A *Terminal End Identifier* (TEI) tells the phone company what type of equipment you have, but this is usually handled automatically.
Expect to set up parameters for:

- CO Switch type (e.g. AT&T 5ESS) and software version.
- ISDN type (e.g. Custom or National ISDN-1).
- Callback (on, or off)
- Line speed (64K)
- Compression (turned on through Protocol)
- Protocol filters, for passing to WAN, if any.
- Security (for remote access, like password protection).

Your local phone company should be able to tell you what they are.

ISDN uses an RJ45 connector, which has 8 wires; you can get away with 6. The POTS, on the other hand, in North America and Ireland, anyway, uses a RJ11 with 6 wires; you can get away with 2, the ones in the middle.

Tip: In UK, a POTS connector with 6 wires is used, but the relevant pair are the second ones in on each side. Tandy converters don’t work, so don’t bother buying one.

Tip: Deselect "wait for dial tone" in software as ISDN doesn't use one.

ADSL

This means *Asymmetric Digital Subscriber Line*, and is one variation on a theme of using existing phone lines for digital transmissions. Like others, it multiplexes channels over the cable; three, to be precise, so you can talk while transmitting (filters are used for separation between voice, which uses 0-4KHz, and data, between 4KHz-2.2.MHz), so, essentially, you’re piggybacking fast RF signals onto the voice line. One set carries the normal POTS signals, another transmits an upstream data signal, and the third a high capacity downstream one, since you will be receiving more data than otherwise. This channel has a higher speed, or bandwidth, than T1; in fact, ADSL has been tested at over 6 Mbps when downloading, and 640 Kbps when uploading, the latter being considerably faster than ISDN at 128 Kbps!

Of fairly short range (that is, up to about 2 miles), it was originally designed for Interactive TV, but has been dusted off again to counter the threat from cable modems. ADSL "modems" use Frequency Division Multiplexing, and the system needs to be asynchronous because the amount of connections involved in a typical long distance call would reduce the throughput a lot more if it were otherwise. At the moment, ADSL cannot provide switching, but then, neither can cable systems. It naturally needs two modems, but you can only dial in to the one at the other end of the line, not to other ADSL-equipped lines.

ADSL data goes through four devices en route to your PC. A splitter filters out the audio signal, which is otherwise unaffected. The remaining high frequency signal goes on to an ADSL modem which takes out the data, which is then passed on by a router as TCP/IP to an Ethernet card on your PC.

Cable Modems

These are "modems" that use the copper wiring for cable TV transmission, so are more likely to be used in a home situation, as businesses tend not to be wired for it. Each channel uses a bandwidth of 6 KHz for NTSC or 8 KHz for PAL, and there are as many of those that can be crammed into a cable. Amplifiers and splitters are used as well. The *head end* is where signals are collected before proceeding along the cable to the destination. Fibre would also need a translation point for the conversion to copper.

On older one-way installations, the cable is only used for receiving, and an ordinary modem is needed for transmitting. HFC cable modems (*Hybrid Fibre Coax*) are two-way devices, but both receive data faster than it's sent. Otherwise, you need encryption, and the cable company needs to monitor what's going on. You also need a tuner to get the right channel, and elements from network equipment as a lot of sharing goes on when your neighbours start downloading as well.

You need an Ethernet connection in your PC, as a serial port couldn't cope with the throughput. Ethernet packets are sent to the modem, which modulates the signals for the phone line, on which something like ATM could be used, but there are other ways. Eventually, all this would be combined into one card. USB and Firewire versions are available.

Satellites

A communications satellite is a large solar-powered repeater in space which uses microwaves to get messages to and from it—an incoming signal is regenerated and retransmitted by repeater units, which are called *transponders* (as many as 46 or more is not uncommon). Separate frequencies are assigned for transmission to the satellite (the *uplink*) and from it (the *downlink*). As all terminals are listening, if the original transmitter receives its own message correctly, it can assume everyone else did, so a formal receipt/acknowledgement procedure is not required.

Some advantages of using satellites are that the link can't be cut by someone digging up the road, weather affects transmissions very little and they are line-of-sight.

On the other hand, it's a lot of money up front to get the thing up there in the first place, it's risky and the distances involved mean delays throughout the whole process. The distances are in fact about 22,000 miles, where the satellite is said to be in *geostationary orbit*; that is, it stays in the same location over the Earth.

Because of this height and the spread of the signals, the coverage area of one satellite (known as the *footprint*) can be as large as Africa, and as one satellite can be in contact with two or more earth stations at the same time (because of its line-of-sight coverage), two continents can be put in touch with each other very easily.

However, the height also means that an average station to station path over the Earth could well be 60,000 miles, which will take about 1.2 seconds for a message to get through. This is not much of a problem when the transmission is one way only, but a two-way conversation with delays can be frustrating.

Where computers are concerned, a "one-way" transmission is actually two-way, because of the error checking and acknowledgement of message receipts, so the total time on the system could be increased by as much as 80 percent. Sometimes the operating software is modified for the delays, but they can be better handled by a higher quality system, which in turn will allow larger block sizes for fewer retransmissions.

You could send the data without waiting for acknowledgements and ensure the blocks contain a code to identify the larger block to which they refer. Any offending blocks could be found and retransmitted later. This is called a *sliding window* response, where an acknowledgement may come after several blocks have been sent, coming back through another window in the transmission process. These are further mentioned under *Protocols*.

You can get Internet access through satellites, but you still need a modem, phone line and a coaxial cable from a PC expansion card to the dish to get running, as you can only receive. In this respect, connection is similar to using a cable modem. If you thought one IP address was enough, you now need 2! Setting up needs to be done *very* accurately, and can take a whole day to do it! There's a voltage of about 50 on a phone line, and a satellite signal is amplified about 50,000 times so it can be detected; if you get a spike in the signal, you could fry something (rare, but possible) so a surge suppressor should be high on your list of priorities.

Fax

Technically, *Facsimile Transmission* (to give fax its full name) is the electronic transfer of a copy of a document from one point to another over some sort of transmission link, cable or otherwise (to you and me, it's just like using a long-range photocopier over the telephone line, except that the quality is not so good). The original document is scanned and the different light and dark patches are converted into electrical signals that are transmitted.

It can therefore send complete pages of information (including pictures) through the telephone system as a series of scan lines arriving in exactly the same form as they were sent.

Whether it's cost-effective or not depends on what you send; it can be extremely cheap if you only need to send a couple of pages round the world quickly—certainly better than a courier. However, sending a 400 page book would take anything up to 3½ hours.
A normal fax is a scanner which lays out the page into small areas (between .005 and .01") and notes where it detects dark patches (or not). This information is converted into what is called *modified Huffman code* and passed as a stream of on/off signals to an internal high speed auto-dial, auto-answer modem which sends the results down the telephone line.

Everything is reversed at the receiving end and date stamped, together with the identifying telephone numbers, which may give it some business credibility in opposition to Telex (some Government Departments accept faxed forms, but not necessarily signatures on them).

As it needs to make incoming data presentable, a fax machine will also contain a printer, unfortunately one that produces rather cheap-looking photostatic results, which sometimes requires special paper. A plain paper fax, on the other hand, has output similar to a laser or inkjet printer. The whole story started off around 1863, when the first fax transmission took place over the telegraph between Paris and Le Havre. It was invented by a Catholic priest named Caselli. The main problem was that the telephone hadn't been invented, so fax development had to wait before things could really get going! Even when things did get serious, there was a total absence of standards, which meant that transmission was safe only between identical machines.

As usual, though, somebody somewhere (in this case the ITU-T) has laid something down:

- **Group 1**. Roughly equivalent to a 300 baud modem. Obsolete.
- **Group 2**. Twice as fast, but still out of date. The resolution with 1 and 2 meant that anything smaller than 6 point type was illegible. Being analogue systems, they were able to show the results in varying shades of grey (like slow scan TV).
- **Group 3**. A standard for digital communications created in 1983 for machines that use data compression techniques and transmit at 9600 bits per second, which means a full page can be sent in 30 seconds. Group 3 offers two resolutions as well, but the higher one doubles transmission time. As Group 3 operates on digital signals, marks on the paper are treated as black or white only.
- **Group 4**. Designed for ISDN lines; you can send eight pages per minute at 400 dpi with 64 shades of grey.
- **Class 1**. For fax/modems. An extension to the Hayes command set that defines how fax software will control a modem; the bulk of the work is done by the software. Works sometimes.
- **Class 2**. As above, but the bulk of the work is done by the fax. It is more complex and therefore less reliable. Sometimes works.

Like modems, faxes have extra facilities you may find useful. Some machines carry a spare RS232 socket for use as a scanner, or they may use a proprietary interface.

There are memory stores for numbers, timed retries (for engaged signals), pretimed sending, group sending, speed changes according to line quality, identification of sender and receiver stamped on the copy, transaction reports, self checking at predetermined intervals, talk mode, repeat printing, error correction, page reduction and expansion...... As you can see, the list is endless.

However, not all fax machines are those you see around the office; there are other users with far higher standards to maintain, and for whom cost is less of an object. The machines they use don't come under the standard recommendations and are not often heard of at all. Some are used on news services, where the received document actually becomes the print master; similar machines are also used for fingerprints, but these are outside the scope of this book.

Fax (/Modem) Cards

These are expansion cards that take up a slot inside the computer; most modems now have fax capability built in, and these are no exception. They are useful, in that you don't have to print something, fax it, then throw it away. A document can be sent directly from your screen, as if it were being printed. In fact, to your software, the fax modem is a printer. You print, it asks you for the fax number, and it goes.

One reason for using a fax/modem card is that the end results are better, because one (or two) of the scanning stages are bypassed.

Tip: If you need to scan something, fax it to your fax/modem card from a normal fax machine.

You may need *Optical Character Recognition* software, because all fax files are sent in a graphic format; they will be needed in ASCII if you actually want to work on them. Legal documentation does need 100% accuracy, though, so make sure your OCR software is good enough. However, Windows for Workgroups 3.11 can send fax files as text, which saves a bit of work, but only if both machines are using the same system.

You need a reasonably powerful PC, in terms of the amount of memory and disk space that may be required—one page at only 200 dots per inch resolution still requires half a megabyte of memory.

Using a fax

There are certain procedures when using fax of whatever type that help the system along for everybody. A fax machine will just churn the paper out as it arrives, and is typically left unattended in the office corner, so the first person in the office gets the job of sorting out who gets what.
One trick that will help you get your paperwork where you want it is to attach a *cover sheet*. At its simplest, it could just be a short message saying who it's from and who it's bound for but, more importantly, containing the number of sheets sent. The time and date of transmission is not so important as the machine will probably take care of this anyway.

Not only is this a standard business practice, but it's a small courtesy for the person who has to sort the whole lot out while they're trying to make the coffee as well.

Alternatives

Try one of the commercial email systems which will undertake to send your uploaded files to any fax machine you care to nominate.

Summary

Although fax has overtaken telex as a means of exchanging documents between companies, there do remain one or two disadvantages.

The main one is authenticity. A normal fax machine stamps the time and date of transmission and the sending and receiving telephone numbers on each sheet that goes through. A fax card may not provide that sort of credibility, since anyone with a copy of a certain set of disk utilities could easily interfere with the data. Minor niggles include using special paper on some machines, the printing on which will fade away after a short time.

One area where fax cards fall short is ease of use, where you would normally expect just to turn the machine on, dial a number and shove the paper into a slot when prompted. With a fax card, you need at least to know how to boot up a computer. For short jobs, where you have to wind the machine up specially, this could be quite time-consuming. Thus, not only could you end up spending lots more money, you could also take four times as long to do what you could with a dedicated machine!

Also, to receive incoming faxes unattended, you have to leave the computer and everything else switched on. In the same way that a microwave, while close, is not a replacement for a real oven, a converted computer is no replacement for a real fax. Unless you have good reasons for doing things otherwise, a PC Fax card should really be regarded as a complement to a proper fax machine.

RS232

We mentioned before that the telephone side of a modem only needs two wires. The wiring to the computer, on the other hand, is much more complex, but luckily not all the connections are used—a product that is "RS232 compatible" just means that where they are used, they meet the specifications laid down.

DTE and DCE

The RS232 and V.24 standards refer specifically to connections between modems and computers. In doing this, they describe two types of equipment which are a mirror image of each other, as far as wiring between them goes, anyway. The terminal (i.e. a computer or printer) is known as *Data Terminal Equipment* (DTE), as in a terminal off a minicomputer, for example, and almost everything else, like a modem, as *Data Circuit-terminating Equipment* (DCE). The DTE includes the equivalent of a UART.

The difference is that DCE equipment terminates a line; it collects the information and passes it on to a DTE, which actually does something with it, such as put it on the screen, save it to disk or print it. In other words, a DCE will convert a DTE's signals into something suitable for whatever it wants to transmit over, and *vice versa*.

How you wire everything up depends on whether you're connecting DTE to DCE (computer to modem) or DTE to DTE (computer to computer, terminal or printer), and whether you use a male or female connector sometimes rests on the same premise (this also depends on the manufacturer of your equipment). However, if you connect a DTE to a DTE which is expecting to talk to a DCE, then there will be some confusion as transmission will try to go both ways down the same wire. Pin connections mentioned in the standards refer to DTE equipment and must be viewed from this standpoint.

Handshaking

Although in theory you could just use the **mode** command on each computer to set them to the same speeds and then just copy a file to one computer's serial port (from where it will go to the other's screen), this is a very limited way of doing things, if only because you won't be able to save the contents into a file.

If the incoming file is too long to fit into the memory available, there needs to be some way of coordinating both computers so that everything is stopped while the memory contents are saved to disk and the rest is delivered properly. Usually, any communications program reserves a small space in memory (a *circular buffer*) where incoming or outgoing information is stored temporarily whilst everything is synchronised.

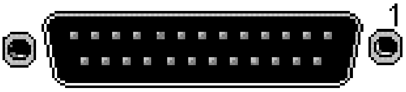
Conversations between devices to do with flow control are sometimes known as *handshaking*, and there are several systems to deal with this. Hardware handshaking, or the lack of it, is discussed under *RS232 Limitations*, below.

Xon/Xoff is one form of software handshaking using two special characters that are not (usually) used in ordinary text files, ASCII codes 17 (**Ctrl-Q**) and 19 (**Ctrl-S**), which mean *start* and *stop* transmitting respectively. These are sent with the data, as only one cable is used, but it's possible that a program file may contain either as part of its operating code, and you can imagine the confusion that would cause if they were misinterpreted, so special arrangements are made for transmitting binary files (see *File Transfer*). It works from *end-to-end*, which means between the extreme ends of the connection, or the computers concerned, ignoring the bits in the middle.

Xmodem, which is another handshaking method that doubles as a *file transfer protocol*, uses 8 bit words regardless. You will find this (and others) fully described later in *File Transfer*.

Connectors

These have been mentioned earlier. At this stage, we only need to note that Pin 1, looking at the front of a female connector (the one with holes), is at the *top right*:



Pins

RS232 signals are numbered and named with three standard systems, plus another that isn't standard but in common use. One is by pin number (used by most people) and another is by abbreviations of the signal description (that's the non-standard one, which we saw when looking at the modem lights). In describing the activities of the serial port, we will use both of these. The other two are boring, using technical definitions in the standards themselves, so we won't bother with them.

Here's a list of what's on the larger 25-pin connector:

Pin No	Symbol	Purpose
1	PG	**Protective Ground**. If used, for connecting the cable shielding to, but only at one end, to prevent spurious voltages between pin 7 and this one. If the two terminals are at different ground potentials, the resistance to current flow along wire 7 (a ground return path) could cause a potential difference between pins 1 and 7 at both ends. As Potential Difference is another name for Voltage, it could be mistaken for a real signal. This is particularly important for terminals—it could stop them working at all.
2	TD	**Transmit Data**. Data is transmitted from this pin to the DCE (modem).
3	RD	**Receive Data**. As above, but in reverse, i.e. to the DTE.
4	RTS	**Request To Send**. Used to initialise the modem and goes from the DTE. With half-duplex, also used to turn the direction of transmission around.
5	CTS	**Clear To Send**. The modem's reply to the above.
6	DSR	**Data Set Ready**. Indicates the modem's readiness for action (Data Set, meaning the modem, is a term used in the same way as Radio Set).
7	SG	**Signal Ground**. The reference ground for all other signals, so it must be connected at both ends of the cable (but see also Pin 1).
8	DCD	**Data Carrier Detect**. The modem activates this when it's happy with the quality of the line.
9		**Data Set Test**.
10		**Data Set Test**.
11		Unassigned
12	SCDC	**Secondary DCD** (Pin 8). Sometimes used as a speed indicator where a modem senses it automatically. It goes to the DTE.
13	SCTS	**Secondary CTS** (Pin 5).
14	STD	**Secondary TD** (Pin 2).
15		**Transmit Clock** (for synchronous DCE operations).
16	SRD	**Secondary RD** (pin 3).
17		**Receive Clock** (synchronous DCE, but known to be used on some laptops for asynchronous chat with IBM PCs. It depends on the software).
18		Unassigned.
19	SRTS	**Secondary RTS** (Pin 4.)
20	DTR	**Data Terminal Ready**—to the modem.
21		**Signal Quality Detect** (synchronous operations).
22	RI	**Ring Indicator**. Current flows in sympathy with the ringing tone on the line.
23		**Data Signal Rate Select**. Used when a modem is able to switch speeds.
24		**Transmit Clock** (for synchronous DTE operations, the same as pin 17).
25		Unassigned.

Wiring

The above pins fall into 3 distinct groups—data, control and timing. Pins 2-8 and 20 are the most relevant.

Data Pins

It's possible to get by with 2 (Tx), 3 (Rx) and 7 (Gd) when used at slow speeds, but you may need others for flow control above 300 baud (having said that, some software used for file transfer between laptops and PCs, e.g. LapLink, uses clever programming to get around this, and still only use these three).

Control Pins

Pin 20, *Data Terminal Ready*, is used by the computer to tell the modem when it's ready for action, with a high voltage condition. Pin 6, *Data Set Ready*, is the complementary signal that says the modem is ready. If either goes low (or off) for any reason, then communications will stop. If pin 20 is left on permanently, an auto-answer modem will answer immediately current is detected on pin 22 which, if you remember, flows in sympathy with the bell ringing. If not, when the modem detects ringing, it turns on pin 22 (RI) to indicate that it has done so. The computer responds by sending a signal on pin 20 to indicate Data Terminal Ready (DTR). The modem will then answer the phone.

When it detects the voltage level change that signifies the receiver being lifted, the terminal ringing in will turn on its pin 4 (RTS) which turns on the modem's transmitter. The answer CTS is given by the receiving modem on pin 5. On receipt of that, the calling modem will go on-line (automatically or by being switched), which will cause it to produce its own tone.

When the receiving modem hears this, it informs its own terminal by turning on pin 8 (DCD) to indicate detection and capture of the line. Data will then flow up and down pins 2 and 3.

Data is not transmitted from the DTE (pin 2) unless the following 4 circuits are on (where implemented, but you can tell your software to ignore them):

```
Pin 4 (RTS)
Pin 5 (CTS)
Pin 6 (DSR)
Pin 20 (DTR)
```

At the end of the session, the computer will turn off pin 4 (RTS), which in turn will cause its modem to stop its carrier signal. This makes the receiving computer drop pin 20, causing its modem to hangup. At this point pin 8 goes off, completing the whole sequence. Otherwise, pins 12, 13, 14, 16 and 19 are secondary versions of all the above.

Timing Pins

Pins 15, 17, 21 and 24 are used for timing on synchronous modems (with occasional exceptions).

Secondary Pins

Secondary ones, when used, handle lower data rates than the primaries, but in the reverse direction. The officially unassigned pins are for manufacturers' own preferences and for the cleverer modems.

9 pin vs 25

The difference between 9- and 25-pin plugs is that the traditional function of pin 1 is left out and 22 added (Ring Indicator). Here are the assignments for the 9-pin connector, with 25-pin equivalents:

DB-9		DB-25
1	DCD Data Carrier Detect	8
2	RD Receive Data	3
3	TD Transmit Data	2
4	DTR Data Terminal Ready	20
5	SG Signal Ground	7
6	DSR Data Set Ready	6
7	RTS Request To Send	4
8	CTS Clear To Send	5
9	RI Ring Indicator	22

And just in case you ever need it, here's one conversion between the two. It's valid where you want to connect a modem with a DB-25 to a computer with a DB-9 (but don't forget that male and female connectors need their wires connected to the proper pins):

```
DB-25                        DB-9
8    --------------------  1
3    --------------------  2
2    --------------------  3
20   --------------------  4
7    --------------------  5
22   --------------------  6
4    --------------------  7
5    --------------------  8
6    --------------------  9
```

Null Modem Cables

If you connect one computer to another (both DTE), where does each find the DCE it requires in order to work properly?

Attaching anything other than a modem to an RS232 port involves fooling both pieces of equipment into thinking there's a modem between them. Usually, this is done by rewiring the connection cable in such a way that it cancels the modem out, hence *null modem*. One or two pins may also be shorted, but the voltage levels are such that no damage will be caused to equipment (or people) if something is cross-wired by mistake, or otherwise.

All we need to do is find permutations of the eight mentioned above—2 to 8 and 20—that will convince both ends that they are talking through a modem. One of those we can eliminate straight away; number 7 (Ground Return), which is always constant. Next change round pins 2 and 3 so that the receiver of one end gets the transmitted data of the other. You could try transmitting with just these as, up to 300 baud, there would be very little handshaking needed.

However, this is a bare minimum, and only allows for XON/XOFF handshaking provided with software. To use higher speeds, you need at least five wires, so one type of null modem cable could have pins 4 and 5 crossed over the same way as 2 and 3. The same reversal should happen with 6 and 20 with 8 connected to them (short 6 and 8 together on each side):

```
2  TD  --------\/--------  TD  2
3  RD  --------/\--------  RD  3
4  RTS --------\/-------- RTS  4
5  CTS --------/\-------- CTS  5
7  SG  ------------------  SG  7
8  DCD |                | DCD  8
6  DSR |-------\/----- -| DSR  6
20 DTR --------/\-------- DTR 20
```

The reason for a short circuit is nothing to do with control signals, but to allow a voltage from one pin to create a high condition on another; for example, a high voltage is needed on pin 8 to make it think that it's connected to an outside line. As this high voltage is not otherwise available unless this is the case, the same effect is usually achieved by connecting it to one of the handshaking wires (4, 5, 6 or 20) which will have something coming out of it near enough to what's required. MS-DOS (and other software found on IBM types) uses BIOS calls to read the serial port, which were designed to refuse to send or receive without a signal on the CTS, DSR and CD pins. Therefore, pins 4, 6 and 8 on a DB-25 or 1, 6 and 7 on a DB-9 should be connected to ensure the outgoing RTS signal is received back on them (actually, one is sufficient, and CD is really for modems anyway). Sometimes you can feed back wires on the same port to get the same effect as crossing wires.

It helps first of all to know which way information is going along these pins. Viewed from the terminal, pin 4 (RTS) and pin 20 (DTR) *send* and pins 5 (CTS), 6 (DSR) and 8 (DCD) *receive*. When the computer sends RTS (4), it expects a reply on CTS (5). If these pins are connected together, it will get its own signal back straight away and start sending. The same philosophy applies to DTR (20) and DSR (6), so joining these two will have a similar effect.

The arrangement below definitely works between a Victor Vicki and a Zenith 183 laptop (with a DB-9), though definitely not above 600 baud. That's about as weird as you can get!

```
2  TD  --------\/-------- TD  2
3  RD  --------/\-------- RD  3
4  RTS ---|          |--- RTS 4
6  DSR ---|          |--- DSR 6
8  DCD ---|          |--- DCD 8
5  CTS --------\/-------- CTS 5
20  DTR --------/\-------- DTR 20
```

RS232 Limitations

The RS232 and other standards only concern themselves with physical connections—they assume that anything else required for safe transmission is handled through software. As such, there is no *proper* flow control system (fast modems need flow control in their own right).

Flow Control

At first sight, you should be able to use the combination of RTS/CTS, as described above, but there are one or two problems. One is that the receiver is not allowed to stop sending *Clear To Send* (Pin 5) until the sender first drops *Request to Send* (Pin 4).

Although RTS and CTS are now used as hardware handshaking lines, they were meant to indicate other things than the fact that either end is ready to send or receive; they are actually intended to allow the DTE (computer) to request the DCE (modem) to hand over control of the whole line to it.

Thus, the computer assumes that it has the line (bypassing the modem) for as long as it needs it and the receiver (in this case the modem) is not allowed to drop it just as it pleases, otherwise it would play havoc with the telephone lines, which was why the procedures were established in the first place. The real handshaking in such circumstances is between the computer and the line, not between it and the modem, therefore RTS/CTS should not technically be used as flow control, although it is.

Cable Length

Aside from flow control, the principal problem with RS232 is its distance limitation of 50 feet at the highest data transfer rates. This a technical limitation based on the voltages used in the interfaces, and can therefore be calculated. If lower speeds are used, the cable runs can be longer, but not by much. Without experimentation, there is always the danger of data being lost. However, for normal single user communications, which are done either at very short (on the same desk) or long distances (over the telephone, where the real distance is only to the modem anyway), this is not really much of a disadvantage.

This is mostly something to watch out for when joining several computers together with the RS232 port, as mentioned previously, or when using terminals, where you might get problems with cable runs over 100 feet.

Transmission Speed

The maximum transmission speed is 20,000 bits per second.

Grounding methods

All the control and data signals are referenced against pin 7, which works satisfactorily most of the time. However, where there is a difference in ground potential between both ends of the cable or, in other words, have a higher voltage at one end (quite likely over a long run), then the difference between space and mark (or 0 or 1) is narrowed, giving more scope for misinterpretation.

The shielding cable for the *connector* should be connected at *one end only*, to prevent spurious voltages between the connector and pin 7.

Power Requirements

The average PC comes with 2 serial ports, and you can add another 2, although this is a bit of a kludge, as they share interrupts, and don't always work properly.

If you need to use a lot of serial ports (you might have a lot of modems or terminals), you can buy an expansion card (a *multiport* card) that controls up to 64 ports. As the average PC was built for a single user, adding that many serial ports on the back could give it quite a shock! Have a look at the -12v *maximum output current rating* of your power supply, which supports the line drivers for the serial ports. As the -12v rating of most PC power supplies is in the order of .3-.5 amps, it may not be enough for what you want (although it's generally alright for small systems). As a worst case figure, expect to need about .4 amps for 20 terminals, 1 amp for 45, or 2 amps for 100, with cables attached.

If you're getting serial ports locking up or, more seriously, strange system reboots, you may well have an overloaded power supply (you're really in trouble if the system won't boot at all!). For this reason, intelligent multi-port cards will handle their own power.

Other Standards

To overcome limitations, the RS429, 422 and 423 standards have been designed to take care of the defects while applying basic improvements.

RS 449

This was intended to be a successor to RS232, with improved speed and distance specifications (50 feet) and modem testing; it makes reference to RS 422 and RS 423 as part of it. Unfortunately, it specifies a 37-pin connector for RS422 which, not surprisingly, meant that it wasn't taken up by anyone.

RS 422

To allow high data rates, RS422 uses two wires per signal, called *balanced transmission* (as opposed to RS232's *unbalanced transmission*, which uses one ground wire) and it doubles the number of wires in the cable, so some of the more esoteric functions of RS232 have been dropped (RI, secondary functions, etc) to make room. On the other hand, RS422 permits very high data transfer rates without the problems of varying ground potential.

Because of this, the tolerances allowed in the transition region between mark and space can be much closer; .4v instead of the 6v used in RS232.

These values therefore allow the use of the +/-5vpower supply commonly available in computers (RS232 transmitters generate voltages between +5 and +25 volts for space and -5 and -25 volts for mark—this means an extra supply of power is required inside the computer to handle these as computers use +/-12 and +/-5v). See *Power Requirements*, above.

RS422 pins (as supplied on the Macintosh) are:

Pin	Symbol	Purpose
1	PG	Protective Ground
2	+5v	Reference only
3	SG	Signal Ground
4	TD+	Transmit Data (positive voltage)
5	TD-	Transmit Data (negative voltage)
6	+12v	Reference only
7		Handshake
8	RD+	Receive Data (positive voltage)
9	RD-	Receive Data (negative voltage)

The cable length and data rate are related, in that the data rate multiplied by the cable length must be lower than 120 Mbps multiplied by metres, subject to the maximum data rate of 10 Mbps over 1200m (4000 feet).

MAC (DIN-8) to RS422:

```
Pin  DIN-8                DB-9
1    Handshake, output    HSKo (+12v)
2    Handshake, input     HSKi
3    Transmit Data–       TD–(negative)
4    Protective ground    PG
5    Receive Data–        RD–(negative)
6    Transmit Data +      TD–(positive)
7    Not connected
8    Receive Data  +      RD–(positive)
```

MAC (DIN-8) to Modem DB-25

```
DIN-8                        DB-25
4     PG ----------- SG    7
3     TD ----------- TD    2
5     RD ----------- RD    3
1   HSKo ----------- DTR   20
2   HSKi ----------- CTS   5
```

RS 423

RS423 transmits in unbalanced fashion at lower speeds than RS422 and again uses a common return path for signals in a given direction, so it has two one-way return paths.

This standard operates in both RS232 and 422A environments and can act as a bridge between the two, as RS422A transmitters will not drive 232 receivers correctly because of the smaller transition region between space and mark.

There must be a 4v voltage difference (plus or minus) between the signals in RS423A, thus giving an 8v transition region which is compatible with RS232. However, this does present the same power supply problem.

RS 530

Essentially, RS422 using a 25-pin connector.

Bus Types

A bus is a shared connection between devices, of which the PC has several; for example, the processor bus connects the CPU to its support chips, the memory bus connects it to memory, and the I/O (or expansion) bus (where expansion cards go) is an extension of the Central Processor, so when adding cards to it, you are extending the capabilities of the CPU itself. Each bus is made up in turn of an address bus and a data bus; the latter transfers data to a memory address located by the former; they are not necessarily the same size, but often are. CPU signals on them have an A or a D before the number, like A31, or D31, for *Address* and *Data*, respectively.

The I/O bus is what concerns us here, and the relevance of it with regard to the BIOS is that older cards are less able to cope with modern buses running at higher speeds than the original design of 8 or so MHz for the ISA bus. Also, when the bus is accessed, the *whole computer* slows down to the bus speed, so it's often worth altering the speed of the bus or the wait states between it and the CPU to speed things up.

Note: The DMA clock is coupled to the bus clock, and can be damaged if run too fast. If you have problems with your floppies, look here for a possible cause.

ISA

The eight-bit version came on the original PC, and the AT used an extension to make it 16-bit, so there is backwards compatibility – some people call the latter version the AT Bus to make the distinction. It has a *maximum* data transfer rate of about 8 megabits per second on an AT, which is actually well above the capability of disk drives, or most network and video cards. The *average* data throughput is around a quarter of that. Its design makes it difficult to mix 8- and 16-bit RAM or ROM within the same 128K block of upper memory; an 8-bit VGA card could force all other cards in the same (C000-DFFF) range to use 8 bits as well, which was a common source of inexplicable crashes where 16-bit network cards were involved.

Data movement between the ISA bus and memory is done 16 bits at a time with a block I/O instruction, which, even on a 486, involves a slow microcode loop, so the CPU will not use the bus at its maximum rate. With bus mastering, the controller itself takes over the bus, and blocks can be transferred 32 bits at a time, if the BIOS can cope (see *IDE 32-bit Transfer*). Bus masters can also transfer data between devices on the bus, rather than just to memory, like the DMA system. ISA only allows one bus master board, but the gains are not brilliant, and you can only access the first 16 Mb of RAM this way.

EISA

Extended Industry Standard Architecture is an evolution of ISA and (theoretically, anyway) backwards compatible with it, including the speed (8.33 MHz), so the increased data throughput is mainly due to the bus doubling in size—but you must use EISA expansion cards. It has its own DMA arrangements, which can use the complete address space, and supports bus masters. Although EISA can handle up to 33 MB/s (PCI can deliver 132), the peak is 20 MB/s (40 for PCI), so for random access applications, there is not a significant difference between them. One advantage of EISA (and *Micro Channel*) is the relative ease of setting up expansion cards—plug them in and run configuration software which will automatically detect their settings.

Micro Channel Architecture

A proprietary standard established by IBM to take over from ISA when the 386 was introduced, and therefore incompatible with anything else. It comes in two versions, 16- and 32-bit and, in practical terms, is capable of transferring around 20 mbps. It runs at 10 MHz, and is technically well designed, supporting bus mastering.

Local Bus

The local bus is one more directly suited to the CPU, being next door with access to the processor bus (hence local) and memory, with the same bandwidth and running at the same speed, so the bottleneck is less (ISA was local in the early days). Data is therefore moved at processor speeds. The original intention was to deal with graphics only, but other functions got added. Faster processing results from the proximity to the CPU and reduced competition between cards on the expansion bus.

There are two varieties, *VL-Bus* and *PCI*:

VL-BUS

Otherwise known as VESA Local Bus, this is a 32-bit version more or less tied to the 486 which allows bus mastering, using two cycles to transfer a 32-bit word, peaking at 66 Mb/sec. It also supports burst mode, where a single address cycle precedes four data cycles, meaning that 4 32-

bit words can move in only 5 cycles, as opposed to 8, giving 105 Mb/sec at 33 MHz. Up to 33 MHz, write accesses require no wait states, and read accesses require one.

Motherboards will have a switch marked <=33 or >33, which halves the VESA bus speed when switched to > (greater than) 33 MHz. The speed is mainly obtained by allowing VL-Bus adapter cards first choice at intercepting CPU cycles. It's not designed to cope with more than a certain number of cards at particular speeds; e.g. 3 at 33, 2 at 40 and only 1 at 50 MHz, and even that often needs a wait state inserted. VL-Bus 2 is 64-bit, yielding 320 Mb/sec at 50 MHz.

There are two types of slot; Master or Slave. Master boards, such as SCSI controllers, have their own CPUs which can do their own thing; slaves (i.e. video boards) don't. A slave board will work in a master slot, but not *vice versa*.

It is accomplished with an additional slot behind the ISA connector (actually the one now used for PCI, but the other way round). Opti brought a similar idea out for EISA motherboards. The bus is now obsolete, but has now resurfaced as AGP.

VL Bus Signals

CLK. Provides the fundamental timing and internal operating frequency for the 486. External timing parameters are specified with respect to rising edge of CLK.
A31-A4, A2-A3. A31-A2 are the address lines of the CPU. Together with the byte enabler BEO#-BE3#, they define the physical area of memory or input/output space accessed. A31-A4 drive addresses into the CPU to perform cache line invalidations. Input signals must meet setup and hold times t22 and t23. A31-A2 are not driven during bus or address hold.

BEO-3#. The byte enable signals indicate active bytes during read and write cycles. During the first cycle of a cache fill, the external system should assume that all byte enables are active. BE3# applies to D24-D31 BE2# applies to D16-D23, BE1# applies to D8-D15 and BEO# applies to D0-D7. BE0#-BE3# are active.LOW and are not driven during bus hold.

D31-DO. The data lines for the 486. Lines D0-D7 define the least significant byte of the data bus and lines D24-D31 detine the most significant byte. These signals must meet setup and hold times t22 and t23 for proper operation on reads. These pins are driven during the second and subsequent clocks of write cycles.

M/IO#, D/C#,W/R#. The memory/input-output, data/control and write/read lines are the primary bus definition signals. These are driven valid as the ADS# signal is asserted.

Bus Cycle Initiated	M/IO#	D/C#	W/R#
Interrupt Acknowledge	0	0	0
Halt/Special Cycle	0	0	1
I/O Read	0	1	0
I/O Write	0	1	1
Code Read	1	0	0

Bus Cycle Initiated	M/IO#	D/C#	W/R#
Reserved	1	0	1
Memory Read	1	1	0
Memory Write	1	1	1

The bus definition signals are not driven during bus hold and follow the timing of the address bus.

ADS#. The address status output indicates that a valid bus cycle definition and address are available on the cycle definition lines and address bus. ADS# is driven active in the same clock as the addresses are driven. ADS# is active LOW and is not driven during bus hold.

RDY#=. The non-burst ready input indicates that the current bus cycle is complete. RDY# indicates that the external system has presented valid data on the data pins in response to a read or that the external system has accepted data from the 486 in response to a write. RDY# is ignored when the bus is idle and at the end of the first clock of the bus cycle. RDY# is active during address hold. Data can be returned to the processor while AHOLD is active. RDY# is active LOW, and is not provided with an internal pullup resistor. RDY# must satisfy setup and hold times t16 and t17 for proper chip operation.

BRDY#. The burst ready input performs the same function during a burst cycle that RDY# performs during a non-burst cycle. BRDY# indicates that the external system has presented valid data in response to a read or that the external system has accepted data in response to a write. BRDY# is ignored when the bus is idle and at the end of the first clock in a bus cycle.

BRDY# is sampled in the second and subsequent clocks of a burst cycle. The data presented on the data bus will be strobed into the microprocessor when BRDY# is sampled active. If RDY# is returned simultaneously with BRDY#, BRDY# is ignored and the burst cycle is prematurely aborted. BRDY# is active LOW and is provided with a small pullup resistor. BRDY# must satisfy the setup and hold times t16 and t17.

RESET. The reset input forces the 486 to begin execution at a known state. The 486 cannot begin execution of instructions until at least 1 ms after Vcc and CLK have reached their proper DC and AC specifications. The RESET pin should remain active during this time to insure proper microprocessor operation. RESET is active HIGH. RESET is asynchronous but must meet setup and hold times t20 and t21 for recognition in any specific clock.

INTR. The maskable interrupt indicates that an external interrupt has been generated. If the internal interrupt flag is set in EFLAGS, active interrupt processing will be initiated. The 486 will generate two locked interrupt acknowledge bus cycles in response to the INTR pin going active. INTR must remain active until the interrupt acknowledges have been performed to assure that the interrupt is recognized. INTR is active HIGH and is not provided with an internal pulldown resistor. INTR is asynchronous, but must setup and hold t20 and t21 for recognition in any specific clock.

NMI. The non-maskable interrupt request signal indicates that an external nonmaskable interrupt has been generated. NMI is rising edge sensitive. NMI must be held LOW for at least four CLK periods before this rising edge. NMI is not provided with an internal pulldown resistor. NMI is asynchronous, but must meet setup and hold times t20 and t21 for recognition in any specific clock.

BREQ. The internal cycle pending signal indicates that the 486 has internally generated a bus request. BREQ is generated whether or not the 486 is driving the bus. BREQ is active HIGH and is never floated.

HOLD. The bus hold request allows another bus master complete control of the 486 bus. In response to HOLD going active the 486 will float most of its output and input/output pins. HLDA will be asserted after completing the current bus cycle, burst cycle or sequence of locked cycles. The 486 will remain in this state until HOLD is deasserted. HOLD is active high and is not provided with an internal pulldown resistor. HOLD must satisfy setup and hold time t18 and t19 for proper operation.

HLDA. Hold acknowledge goes active in response to a hold request presented on the HOLD pin, indicating that the 486 has given the bus to another local bus master. HLDA is driven active in the same clock that the 486 floats its bus. HLDA is driven inactive when leaving bus hold. HLDA is active HIGH and remains driven during bus hold.

AHOLD. The address hold request allows another bus master access to the 486's address bus for a cache invalidation cycle. The 486 will stop driving its address bus in the clock following AHOLD going active. Only the address bus will be floated during address hold, the remainder of the bus will remain active. AHOLD is active HIGH and is provided with a small internal pulldown resistor. For proper operation AHOLD must meet setup and hold times t18 and t19.

EADS#. This indicates that a valid external address has been driven onto the 486 address pins. This address will be used to perform an internal cache invalidation cycle. EADS# is active LOW and is provided with an internal pullup resistor. EADS# must satisfy setup and hold times t12 and t13 for proper operation.

KEN#. The cache enable pin determines whether the current cycle is cacheable. When the 486 generates a cycle that can be cached and KEN# is active, the cycle will become a cache line fill cycle. Returning KEN# active one clock before ready during the last read in the cache line fill will cause the line to be placed in the on-chip cache. KEN# is active LOW and is provided with a small internal pullup resistor. KEN# must satisfy setup and hold times t14 and t15 for proper operation.

FLUSH. The cache flush input forces the 486 to flush its entire internal cache. FLUSH# is active low and need only be asserted for one clock. FLUSH# is asvnchronous but setup and hold times t20 and t21 must be met for recognition in any specific clock. FLUSH# being sampled low in the clock before the falling edge of RESET causes the 486 to enter the tri-state test mode.

FERR#. The floating point error pin is driven active when a floating point error occurs. FERR# is similar to the EFFOR# pin on the 387. FERR# is included for compatibility with systems using DOS-type floating point error reporting. FERR# is active LOW, and is not floated during bus hold.

IGNNE#. When the ignore numeric error pin is asserted the 486 will ignore a numeric error and continue executing non-control floating point instructions. When IGNNE# is deasserted the 486 will freeze on a non-control floating point instruction, if a previous floating point instruction caused an error. IGNNE# has no effect when the NE bit in control register 0 is set. IGNNE# is active LOW and is provided with a small internal pullup resistor. IGNNE# is asynchronous but setup and hold times t20 and t21 must be met to insure recognition on any specific clock.

BS16#,BS8#. The bus size 16 and bus size 8 pins (bus sizing pins) cause the 486 to run multiple bus cycles to complete a request from devices that cannot provide or accept 32 bits of data in a single cycle. The bus sizing pins are sampled every clock. The state of these pins in the clock before ready is used by the 486 to determine the bus size. These signals are active LOW and are provided with internal pullup resistors. These inputs must satisfy setup and hold times t14 and t15 for proper operation.

PCI

A mezzannine bus (meaning divorced from the CPU) with some independence and the ability to cope with more devices, so it's more suited to cross-platform work (it's used on the Mac as well). It is time multiplexed, meaning that address and data (AD) lines share the same connections. It has its own burst mode that allows 1 address cycle to be followed by as many data cycles as system overheads allow. At nearly 1 word per cycle, the potential is 264 Mb/sec. It can operate *up to* 33 MHz, or 66 MHz with PCI 2.1, and can transfer data at 32 bits per clock cycle so you can get up to 132 Mbyte/sec (264 with 2.1). Being asynchronous, it can run at one speed (33, or 66 MHz) without worrying about coordination with the CPU, but matching them is still a good idea.

Each PCI card can perform up to 8 functions, with more than one busmastering card on the bus. It should be noted, though, that many functions are not available on PCI cards, but are designed into motherboards instead, which is why PCI multi-I/O cards don't exist. Basic PCI bus transactions are controlled with the following signals:

FRAME	Driven by the master to indicate the beginning and end of a transaction.
IRDY	Driven by the master to force (add) wait states to a cycle.
TRDY	Driven by the target to force wait states.
STOP	Driven by the target to initiate retry cycles or disconnect sequences.
C/BE3..0	These determine, during the address phase, the type of bus transaction with a bus command, and during the data phase, which bytes will be transferred.

PCI is part of the *Plug and Play* standard, assuming your operating system and BIOS agree, so is auto configuring (though some cards use jumpers instead of storing information in a chip); it will also share interrupts under the same circumstances. More in *Plug and Play/PCI*.

The PCI chipset handles transactions between cards and the rest of the system, and allows other buses to be bridged to it (typically an ISA bus to allow older cards to be used). Not all of them are equal, though; certain features, such as *byte merging*, may be absent. It has its own internal interrupt system, which can be mapped to IRQs if required. The connector may vary according to the voltage the card uses (3.3 or 5v; some cards can cope with both).

PCMCIA

A 16-bit, 8 MHz *PC Memory Card International Association* standard originally intended (in 1990) for credit-card size flash memory additions to portable computers, as a replacement for floppies, but types 2 and 3 cover modems and hard disks, etc, each getting thicker in turn. The cards are now called *PC-Cards*, and the current standard is 2.1. Most of version 5's standards have been implemented, but many haven't, so it's still not officially in force. It supports 32-bit bus mastering, multiple voltage (5/3.3) and DMA support, amongst others.

PC Cards usually need an area of 4K in upper memory to initialise themselves, which is not used afterwards. D000-D1FF seems to be popular. An enabler program is often supplied, which is better than using the *Card and Socket Service* software that is supposed to provide compatibility, but is very cumbersome, consisting of up to 6 device drivers that take up nearly 60K of memory (Windows '95 has it built in).

The components of a PC Card system consist of:

- **Host Bus Adapter** - interface between a bus and the sockets where the cards go.
- **Sockets**, type I, II, III and IV, each thicker in turn and usually come in pairs. A mechanical key prevents 3.3 volt cards being inserted into 5v sockets. Type IV are unofficial Toshiba hard disks.
- **Cards**. These are credit-card size and have 68-pin connectors.
- **Software**:
  - **Socket Services** tell your PC how to talk to its slots or, in other words, provide an interface between the BIOS and PCMCIA host chips, such as the Intel 82365SL PCIC and the DataBook TCIC-2/N (written for a specific controller). It might configure the socket for an I/O or memory interface and control socket power voltages.
  - **Card Services** tell the operating system or other software how to talk to the card, or provide an interface between the card and the socket.

The two above combine together to handle hot-swapping and resource allocation, and normally come with the computer, to suit the host bus that comes with it.

There may be a *Resource Initialisation Utility* that checks on I/O ports, IRQs and memory addressing and report to Card Services, as well as software to help Windows (3.x) recognise cards after it has started, since it assumes a card is not present if it is not seen at start up. A *Card Installation Utility* detects the insertion and removal of PC Cards and automatically determines the card type so the socket can be configured properly. This is where the beeps come from.

The main suppliers of software are Phoenix, Award, Databook and SystemSoft. *CardSoft* comes from the latter. Here is a table that lists their device drivers:

Device Driver	SystemSoft (CardSoft)	Phoenix	CardWare (Award)	Databook (Cardtalk)
Socket Services	SS365SL.EXE SS365LP.EXE SSCIRRUS.EXE SSDBOOK.EXE SVADEM.EXE SSVLSI.EXE	PCMSS.EXE	SSPCIC.EXE, SSTCIC.EXE, SSTACT.EXE	SNOTEPV2.SYS
Card Services	CS.EXE	PCMCS.EXE	PCCS.EXE	CTALKCS
Resource Initialisation	CSALLOC.EXE	PCMRMAN.SYS	RCRM.EXE	
IDE/ATA Driver	S_IDE.EXE ATADRV.EXE	PCMATA.SYS	PCATA.EXE	
SRAM Card Driver	SRAMDRV.EXE MTSRAM.EXE	PCMFFCS.EXE PCFORMAT.EXE	PCSRAM.EXE	
Flash Card Support (files from Microsoft)	MTAA.EXE MTAB.EXE MTI1.EXE MT12P.EXE	PCMFFCS.EXE PCFORMAT.EXE MEMCARD.EXE	PCFLASH.EXE	
Memory Card Driver	SCARD29.EXE MEMDRV.EXE		PCDISK.EXE	
Card Installer/Client Driver	CIC.EXE CARDID.EXE	PCMSCD.EXE	PCENABLE.EXE	CARDTALK.SYS
Card Services Power Management	CS_APM.EXE		(in PCCS.EXE)	

Cardbus is a new variation offering PCI-capable devices, so bus mastering can take place at 33 MHz to cope with 100 Mbps Ethernet, or later versions of SCSI. It uses the same protocol as PCI, and is 32-bit. *Client drivers* work with the software described above, and tend to like their own cards; their purpose is to cover the card's resource requirements, as there are no switches to set IRQs, etc with. Generic enablers cover a variety of products.

Point enablers are specific; they don't need C&SS, but neither do they support hot swapping, and other facilities. Sometimes, you can only run one point enabler at a time, which is a problem if you have two cards.

USB

The *Universal Serial Bus* is a standard replacement for the antiquated connectors on the back of the average PC; the system actually behaves more like a network, since one host (e.g. a PC) can support up to 127 devices, daisychained to each other, or connected in a star topology from a hub, but this depends on the bandwidth you need. Each device can only access up to about 6 Mbps, at varying speeds to stop any one hogging the bandwidth, so Firewire (below) is a better choice for higher throughput, like DVD.

A hub will have one input connector, from the host or an upstream device, and multiple downstream connectors. Otherwise, each device will have an upstream and downstream connection.

The maximum distance from one device to another is 5m, and the last device must be terminated. There are three types of device:

- **Low power**, bus powered (100 mA).
- **High power**, bus powered (500 mA).
- **Self powered**, but may use bus power when in power save mode.

The bus complies with Plug and Play, so devices are hot-swappable, as they register automatically with the host when connected. More technically, USB is an external 4-wire serial bus with two 90 ohm twisted pairs in a token-based star network. Two lines carry signals based on *Differential Manchester NRZI*, one being for ground, and the other +5v. Zero/half amplitude pulses are used for control. Transmission speed is either 12Mbps with shielded wire or 1.5Mbps for unshielded. Data packets are up to 1023 bits in size, with an 8 bit synch pattern at the start of each frame.

A 1000msec frame is used, whose usage is allocated by the USB controller based on information provided by devices when logging in, which ensures that they all get bandwidth, and frequently. The controller sends data packets to the USB, from where the targeted device responds. A packet can either contain data or device control signals; the latter go one way only. When the transaction is complete, the next one in the *transfer queue* is executed. If more than one millisecond is needed, an extra transaction request is placed in the transfer queue for another time frame.

There is backward compatibility with ISA BIOS Code. The USB software is too much for an EPROM, so some space in the BIOS is used as well, because access to it is needed anyway (during POST, etc) for USB devices. Windows '98 has more robust USB support. Low end USB chipsets have problems switching device speeds and have signal synchronisation problems. Cheap cables don’t help.

USB 2.0 is set to increase the data throughout to at least 120 M/bits per second, possibly higher than 240.

FireWire

A similar idea to USB, but faster, originally developed by Apple, and now called IEEE 1394, or even HPSB (*High performance Serial Bus)*. It clocks in at a minimum speed of 100 Mbps, going up to somewhere near 400. Because it also guarantees bandwidth, isochronous data, that is, needing consistency to be effective, like digital video, can be transferred properly.

There are two more connections than USB, and it only supports up to 63 devices of varying speeds on the bus. It is also complex and expensive, and could be an alternative to SCSI for hard disks, etc.

Expansion Cards

Modern motherboards have the basic peripherals built in. The usual suspects are 2 IDE channels, a floppy, 2 serial ports, a parallel port, IR, PS/2 mouse and USB. SCSI, Video and network interfaces only tend to come built in from major manufacturers. Although the connectors are separate, the circuitry will be in a Super I/O chip, previously found on multi I/O cards. With any luck, you can disable built-in peripherals, but not always – this is useful when you can’t upgrade them and want to add something else. Also be aware that IDE channels, particularly secondary ones, may actually be on the ISA bus, as opposed to the PCI. Expansion cards use four ways of communicating with the rest of the computer; *Direct Memory Access* (DMA), *Base Memory Address*, *I/O address* and *Interrupt Setting* (IRQ).

Direct Memory Access (DMA)

With this, high speed devices on the expansion bus can place data directly into memory over reserved *DMA channels* without having to involve the CPU for more than a minimum time, that is, enough for it to write the destination RAM address in the DMA controller, along with the number of bytes to be transferred, so it can get on with something else. *Third-party DMA* involves the DMA controller as an intermediary between the source and destination, whereas, with *First-party DMA*, the peripheral doing the transfer does it directly. In other words, bus-mastering.

The DMA controller chip will be programmed by whatever software you're running, and is prone to burning out if run too fast (it's linked to bus speed, adjusted through your *Advanced Chipset Setup)*. Typically, a hard drive controller might notify the DMA controller (over its request line) that it wants to move data to memory, whereupon the DMA controller will allocate a priority for that request according to its inbuilt logic and pass it on to the CPU. If the CPU accepts the request, the DMA controller is given control of the bus (the ALE, or *Address Latch Enable* signal helps here) so it can send a start signal to the hard disk controller.

The DMA Controller (8237A or equivalent) activates two lines at once; one to read and one to write. As the write line is open, data, when read, is moved directly to its destination. When DMA transfers are under way, the CPU executes programs, and the DMA Controller moves data, so it's primitive multitasking. DRQ lines, in case you're wondering, are used by the DMA controller to receive requests. You can transfer one byte per request, or a block. DMA Controllers need to know where the data to be moved is, where it has to go, and how much there is.
PCs and XTs use one DMA chip, and the standard setup is:

Channel	Device
0	Refresh (System Memory)
1	Available
2	Floppy controller
3	Hard Disk

ATs use 2 8237As to provide 8 channels, 0-7. Channel 4 joins the two controllers, so is unavailable. 0-3 are eight-bit (64K at a time), and 5-7 are 16-bit (128K); the controller for the former is known as DMA 1, and the one for the latter as DMA 2. Floppies use channel 2. Don't count on channel 0, either, as it may be used for memory refresh (there's no harm in trying, though). PS/2s use 5 for hard disk transfers and XTs use 3.

If two devices try to use a channel at the same time, one or both will not work, though the channel can often be shared if only one uses it.

Channels available in AT compatibles are listed below:

Channel	Device	Notes
0	Memory Refresh	16-bit
1	Available	8-bit
2	Floppy	
3	Available	8-bit
4	DMA controller 1	
5	Available	16-bit
6	Available	16-bit
7	Available	16-bit

DMA transfers must take place within a 64K segment, and in the first 16 Mb, so memory problems can arise when remapping takes place and data is therefore moved around all over the place, particularly in extended memory. This is especially noticeable with ISA systems (you can use more than 16 Mb, provided it's not used or controlled by the operating system).

A program's request for memory access will be redirected by the CPU, but if it's not involved with the transfer (as with DMA), the DMA controller won't know the new location. Memory managers trap the calls so they can be redirected properly; data is redirected to a buffer owned by the memory manager inside the proper address range. Sometimes you can adjust the DMA buffer size (use **d=** with **emm386.exe**), but some systems don't use it, particularly Multiuser DOS (because there's no way of using interrupts to see if DMA transfers have finished, so the controller has to be polled, which is one more thing for the CPU to do when serious multitasking is taking place).

When the AT was made, DMA for hard disk transfers was given up in favour of *Programmed I/O* (PIO), where the CPU oversees the whole job by letting the BIOS tell the controller what it wants through I/O addresses, and letting the controller and CPU talk amongst themselves – that is, a disk (or network) controller places a block of data into a transfer location in low memory, from where it is moved by the CPU to its destination. The reason for this is that the DMA controller had to run at 4.77 MHz for compatibility reasons and was too slow on later machines, and with DOS/Windows, the CPU has to wait for the transfer to finish anyway, so PIO isn't as performance-draining as it sounds.

Now that quicker buses exist, DMA is again used in the shape of *Fast MultiWord DMA*, which transfers multiple sets of data with only one set of overhead commands, for high performance, but PIO (especially with ATA) is still fast enough to give it a run for its money. MultiWord DMA is used in EISA, VLB, and PCI systems, being capable of the very fast transfer rates, utilizing cycle times of 480ns or faster. Once the entire data transfer is complete, the drive issues an interrupt to tell the CPU the data is where it belongs.

The original ATA interface is based on TTL bus interface technology, which in turn uses the old ISA bus protocol, which is asynchronous, where data and command signals are sent along a signal strobe, but are not interconnected. In fact, only one can be sent at a time, meaning a data request must be completed before a command or other type of signal can be sent along the same strobe.

ATA-2 was synchronous, giving faster PIO and DMA modes, where the drive controls the strobe and synchronizes the data and command signals with the rising edge of each pulse, which is regarded as a signal separator. Each pulse can carry a data or command signal, so they can be interspersed along the strobe. Increasing the strobe rate increases performance, but also increases EMI, which can cause data corruption and transfer errors. ATA-2 also introduced ATAPI (*ATA Packet Interface*), for devices like CD-ROMs that use the ordinary ATA (IDE) port. EIDE (*Enhanced IDE*) is WD's version based on them both, and *Fast ATA* is Seagate and Quantum's answer, based on ATA-2 only.

ATA-4 includes *Ultra ATA* which, in trying to avoid EMI, uses both rising and falling edges of the strobe as signal separators, so twice as much data is transferred at the same strobe rate in the same period. It was designed by Quantum, in association with Intel, to better match the Pentium processor, and to take over from PIO Mode 5, which was abandoned because of electrical noise. While ATA-2 and -3 can burst up to 16.6 Mbytes/sec, Ultra ATA gives up to 33.3 Mbytes/sec. ATA-4 also adds Ultra DMA mode 2 (33.3 Mbytes/sec) to the previous PIO modes 0-4 and traditional DMA modes 0-2.

ATA-5 includes *Ultra ATA/66* which doubles the Ultra ATA burst transfer rate by reducing setup times and increasing the strobe rate, which again increases EMI to a point where a special cable is needed, which adds 40 ground lines between each of the original 40 ground and signal lines, so the connector stays the same, except that pin 34 is knocked out to allow for cable section of Master and Slave (it's colour coded, too – the blue connector goes to the motherboard, the grey to the slave and the black to the master device on whichever channel it is used on). ATA-5 adds Ultra DMA modes 3 (44.4 Mbytes/sec) and 4 (66.6 Mbytes/sec) to the previous PIO modes 0-4, DMA modes 0-2, and Ultra DMA mode 2.

Having said all that, Bus Master DMA is available for IDE, which helps with multimedia under a multithreaded operating system. Traditional DMA still uses the CPU, even if only for setting up data transfers in the first place. A Bus Master DMA device can do its own setup and transfer, even between devices on the same bus, leaving the CPU (and the motherboard DMA controller) out of it (it doesn't improve IDE throughput, however).

Many BIOSes support the following DMA transfer *modes*:

- **Single Transfer Mode**, where only one transfer is made per cycle; the bus is released when the transfer is complete.

- **Block Transfer Mode**, where multiple sequential transfers are generated per cycle. A DMA device using ISA compatible timing should not be programmed for this, as it can lock out other devices (including refresh) if the transfer count is programmed to a large number. Block mode can effectively be used with Type A, B or Burst DMA timing since the channel can be interrupted while other devices use the bus.

- **Demand Transfer Mode**, as above, but used for peripherals with limited buffering capacity, where a group of transfers can be initiated and continued until the buffer is empty. DREQ can then be issued again by the peripheral. A DMA device using ISA compatible timing should not be programmed for this unless it releases the bus periodically to allow other devices to use it. It is possible to lock out other devices (including refresh) if the transfer count is programmed to a large number. Demand mode can effectively be used with Type "A," Type "B," or Burst DMA timing since the channel can be interrupted while other devices use the bus.

- **Cascade Mode** is used to connect more than one DMA controller together, for simple system expansion, through DMA Channel 4. As it is always programmed to cascade mode, it cannot be used for internal operations. Also, a 16 bit ISA bus master must use a DMA channel in Cascade Mode for bus arbitration.

You may come across these *types* of DMA *transfer*:

- **Read transfers**, from memory to a peripheral.
- **Write transfers**, from peripherals to memory.
- **Memory-Memory Transfer**. What it says.

- **Verify transfers**. Pseudo transfers, for diagnostics, where memory and I/O control lines remain inactive, so everything happens, except the command signal. Verify transfers are only allowed in ISA compatible timing mode.

Base Memory Address

Expansion cards often contain small amounts of memory as buffers for temporary data storage when the computer is busy. The *Base Memory Address* indicates the starting point of a range of memory used by any card.
The following list indicates what may be used already:

```
A0000-AFFFF          EGA/VGA video memory (buffer)
B0000-B7FFF          Mono video memory (buffers)
B8000-BFFFF          RGB (CGA) and mono video
C0000-C7FFF          EGA/VGA BIOS ROM (EGA to C3FFF)
C8000-CFFFF          XT hard disk BIOS ROM (can vary)
D0000-DFFFF          LIM area (varies)
E0000-EFFFF          Some EISA BIOS/ESCD/32-bit BIOS
F0000-FFFFF          System BIOS-1st page available?
```

What address in Upper Memory to use for your card (that is, the *Lowest Free Address*) initially depends on the video card, e.g.

Video type	LFA
Hercules	C000
EGA	C400
VGA	C800

As an example, the video ROM typically occupies the area C000-C7FF, so the Lowest Free Address for another card is C800. However, C800 is also a good choice for (16K) hard disk controller ROMs in ISA or EISA machines, so if you have a VGA card as well, you wouldn't normally expect to use anything lower than CC00. Using a base address of D0000 as an example, here are the ranges of memory occupied by a ROM or adapter RAM buffer:

ROM size	Range used
8 K	D0000-D1FFF
16 K	D0000-D3FFF
32 K	D0000-D7FFF

Base I/O Address

I/O addresses (I/O = *Input/Output*) act as "mailboxes", where messages or data can be passed between programs and components, typically responses to IN or OUT instructions from the CPU; they are 1-byte wide openings in memory, also expressed in hexadecimal. On a 386, there are 65,536, mostly never used, because the ISA bus, which only implements 1024 of them, usually only decodes the lower 10 bits, thus using 0-3FF. To get more addresses, some boards, such as 8514/A compatible graphics ones, decode the upper 6 bits as well. When they use 2E8 and 2EA, you will get problems with COM 4, as it uses the former. Watch out for 3C0-3DA as well.

The bottom 256 I/O addresses (000-0FF) relate to the system board, so your expansion cards will only be able to use between 100-3FF. Hybrid motherboards (e.g. with EISA/PCI/VESA as well) will support up to address FFFFFFFF, and the ISA part may get confused if you use a card with an address higher than 3FF.

The Base I/O Address is the first of a *range* of addresses rather than a single one; for example, most network adapters use a range of 20h, so 360h really means 360h-37Fh (in which case watch for LPT 1, whose base is 378)—if you suddenly lose your printer when you plug in a network card, this is the reason. Additionally, COM 1 reserves a range of addresses from 3F8h to 3FFh, which are used for various tasks, like setting up speed, parity, etc. The I/O address table is 00-FFFFh.

You can still get a conflict even when addresses appear to be different, because the cards may think in hexadecimal, when their drivers don't! They may resolve them in binary format, and from right to left (we read hex from left to right). Sound cards suffer from this in particular. Don't forget that most I/O cards only decode the lower 10 address lines, and few use all 16, which is why some video cards get confused with COM 4; as far as the lower 10 address lines are concerned, they're the same!

For example, 220h (standard Sound Blaster) converts to 10 0010 0000 in binary. If you have a card at 2A20, the first 10 digits are the same as 220 (10 1010 0010 0000—right to left, remember), so it won't work. The same goes for the following:

Hex	Binary
220	10 0010 0000
0A20	1010 0010 0000
0E20	1110 0010 0000
1A20	1 1010 0010 0000
1E20	1 1110 0010 0000
2A20	10 1010 0010 0000
2E20	10 1110 0010 0000
3A20	11 1010 0010 0000

See also *Extended I/O Decode*. The Windows calculator can be used in binary mode to check this. Addresses can vary, especially COM 3 and COM 4, but "standard" ones are used by convention. Here's a list of the usual ones:

```
000-01F          DMA controller 1
020-03F          Interrupt controller 1
040-05F          System timers
060-063          8042 (keyboard Controller)/PPI (XT)
070-07F          Real Time Clock (AT)
```

080-09F	DMA page registers
0A0-0BF	NMI (in XT to 0AF); PIC 2 (AT & PS/2)
0C0-0DF	DMA controllers (AT & PS/2)
0E0-0EF	Real-time clock (PS/2 30)
0F0-0FF	Maths coprocessor
170-177	2nd IDE/EIDE Controller
1F0-1F8	1st (AT) Hard disk controller
200-20F	Game port
210-217	XT Expansion Unit
220-22F	NetWare Key Card (old)
230-23F	Bus mouse/Soundblaster CD
258-25F	Intel Above Board
270-277	LPT3
278-27F	LPT 2
280-28F	LCD display on Wyse 2108 PC
2E0-2EF	GPIB adapter 0
2E8-2EF	COM 4
2F8-2FF	COM 2
300-30F	Most cards' default setting/MIDI output
320-32F	Hard disk controller (XT)
330-333	Adaptec 154x
350-	WD 7000 FASST
378-37F	LPT 1
3A0-	MDA
3B0-3BF	Mono display/printer adapter
3BC-3BF	LPT
3C0-3CF	EGA/VGA adapter
3D0-3DF	CGA/EGA/VGA adapter
3E8-3EF	COM 3
3F0-3F5	Floppy drive controller
3F6-3F7	Fised Disk Controller
3F8-3FF	COM 1

Interrupt Setting

If any part of the computer needs attention, it will have to interrupt the CPU, which is more efficient than having the CPU poll each device in turn, and wasting cycles when the device(s) are quite happy to be left alone, thank you very much. On a PC, a hardware interrupt, or IRQ, is a convenient way of calling subroutines from DOS or the BIOS, which are unfortunately also called interrupts! In other words, the BIOS (and DOS) contains code which is allocated an *interrupt number* according to the service provided, which can be used by hardware or software. There are 256. Interrupt Vectors are loaded at boot time to create pointers to the appropriate handlers, in a table that is loaded into base memory. This is so programs can use facilities whose actual address is unknown, so devices can be used regardless of where the software that drives them is located in memory.

Hardware interrupts (described more fully below), or IRQs, are translated into software interrupts, and they should naturally not be called by software. For example, IRQ 1 is used by the keyboard, which is translated to INT 09h. In fact, IRQs 0-7 relate to 08h-0Fh, and 8-15 (on ATs and above) to 70h-77h.

Each IRQ has a different priority, and each device must use a unique one. Classic symptoms of (hardware) interrupt conflicts include colour screens turning black and white, machines hanging up when certain programs load, and mouse problems.

In fact, there are three types of interrupt:

- **Internal**, generated by the CPU.
- **External**, generated by hardware other than the CPU, of which there are two variations; NMI (Non-Maskable Interrupt), which informs the CPU of catastrophic events, like memory parity errors or power failure, and IRQ, or Interrupt ReQuest, which is used by a device to grab the CPU's attention. IRQs are maskable, which means they can be turned off, or ignored by the CPU. NMIs need immediate attention and cannot be turned off, or worked around. XTs have eight IRQ levels; ATs and PS/2s have two sets of eight. A device will send an Interrupt Request (IRQ) to the 8259 PIC, which allocates priorities and passes interrupts on for translation one at a time, as the CPU only has one interrupt line. Hardware interrupts can be edge triggered, by a sudden change in voltage, or level triggered, by a small change in voltage (which means they can be shared). ISA buses are edge triggered; EISA can be level triggered.
- **Software**, initiated by INT and INTO instructions, and not the same as the above. An example is INT 13, used by Windows 32-bit Disk Access, which is an access point inside the BIOS code used for disk related requests. An operating system will hook into that point and run the code sitting there, rather than run its own; 32-bit disk access, of course, does run its own, hence the speed. These can be shared, otherwise the PC wouldn't run as fast. The clock tick, for instance, at 1Ch, is passed on from program to program in turn, known as being chainable.

Whereas an interrupt handles asynchronous external events, an *exception* handles instruction faults - software interrupts are treated as exceptions. The lower the IRQ level, the higher the priority the associated device is given, but where a system has a dual interrupt controller (e.g. ATs, PS/2s, 386 and 486 machines) IRQ levels 8 to 15 have priority over levels 3 to 7, because the second controller's single output line is wired to IRQ 2 on the first chip. This makes IRQ 2 more complex to service and should be avoided for that reason. If you're using an EISA or Micro Channel machine, you may come across *arbitration levels*, which work in a similar way.

This table shows IRQ lines assigned (in the AT), in order of priority:

```
0      System timer
1      Keyboard Controller
2      Slave (from IRQ 9 – leave alone!)
8      Real-time clock
9      Redirected to IRQ 2
```

```
10
11     SCSI cards
12     PS/2 Mouse
13     Maths coprocessor
14     Hard disk controller/Primary IDE
15     Secondary IDE
3      COM 2/COM 4
4      COM 1/COM 3
5      LPT 2
6      Floppy controller
7      LPT 1
```

Many cards use IRQ 5 as a default (it's usually used for LPT 2:). As printing isn't interrupt-driven (in DOS, at least), you may be able to use IRQ 7, provided nothing strange is hanging off the parallel port (like a tape streamer). Also, your VGA card may not need IRQ 9, and if you use SCSI you can reclaim IRQs 14 & 15 from the IDE controllers.

Boards with 8-bit edge connectors are limited to IRQ 3-7 or 9 (in ATs) only.

With PCI machines, IRQs are allocated to ISA, Plug and Play and PCI cards in that order. The BIOS will automatically allocate an IRQ to a PCI card that requires one, mapping it to a PCI INT#. Leave all PCI INT assignments on A. PCI slot 1 automatically starts with A, 2 starts with B, 3 with C and so on. More in *PCI Slot Configuration*.

Notes

Hard Disk Controllers

Standard Addresses

AHA 152x	340
AHA 154x	330
AHA 174x	CC0
Buslogic	330
EATA/DPT	1F0
IN 2000	220
PAS 16	388
QLogic	230
Ultrastor	330
WD 7000 FASST	350
FD TMC 16x0	140
FD TMC 8x0	1C0

Adaptec

ACB 1540B/42B

SCSI-2 Bus mastering. The 42 supports 2 floppies.

J5	1	Out	Synchronous Negotiation disabled*
	2	Out	Diagnostics (factory only) disabled*
	3	Out	Parity Bit enabled*

	4,5,6	ID	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
		4*	x	-	x	-	x	-	x	-
		5	x	x	-	-	x	x	-	-
		6	x	x	x	x	-	-	-	-
	7,8	**DMA Ch**	**0**	**5***	**6**	**7**				
		7	x	-	x	-				
		8	x	x	-	-				
	9,10,11	IRQ	9	10	11*	12	14	15		
		9	-	x	-	x	-	x		
		10			x	x				
		11					x	x		
	12,13	**DMA Txfer**	**5.0**	**5.7***	**6.7**	**8.0**				
		12		x		x				
		13			x	x				
J 6	1	In	BIOS Enable							
	2,3,4		Not used							
	5		Auto Sense disable							
J 7	1	Out*	Floppy Secondary Address							
	2,3,4	**AT I/O Port Address**		**334**	**330***	**230**	**134**	**130**		
			2	-	x	-	x	-		
			3	-	-	x	x	-		
			4	-	-	-	x	x		
	5,6	**BIOS Wait State** (ns)		**0**	**100**	**200**	**300**			
			5	-	x	-	x			
			6	-	-	x	x			
	7,8	**BIOS Address**		**DC000***	**CC000**	**D8000**	**C8000**			
			7	-	x	-	x			
			8			x	x			
J 8	1	In	Floppy Enable (1542B only). If removed, remove jumpers J8.							
	2,3		DMA REQ (2/3)2=2							
	4,5		DMA ACK (2/3)4=2							
	6,7		IRQ (6/10)6=6							
	8	In	Dual Speed Enable							
J 9	1,2,3,4		DMA REQ. (0,5,6,7) 2=5							
	5,6,7,8		DMA ACK (0,5,6,7)6=5							
	9,10		IRQ (9,10,11, 12,14,15) 11=11							
	11,12									
	13,14									

ACB 2070

RLL. 16-bit full size. Built around the ST 238. M-N/O-P and Q-R/S-T (below) are ignored if you use your own parameters.

A-B	All	Factory use only
C-D	All	Factory use only
E-F	In	Drive 0 is removeable cartridge
	Out	Drive 0 is soft-sectored, ST 506

G-H	In	Drive 1 is removeable cartridge
	Out	Drive 1 is soft-sectored, ST 506
I-J	In	Connections J0 and J1 are reserved
	Out	Connections J0 and J1 are normal
K-L	In	Self diagnostics on

Parameter Tables and Jumper Selection

Table	Cap	Step Rate	Hds	Cyls	Drive 0 In	Drive 1 In
0	30	3	4	612	MN+OP	Q-R+S-T
1	15	3	2	612	M-N	Q-R
2	60	3	5	981	O-P	S-T
3	30	3	4	615		

ACB 2072

RLL. 8-bit half size; 2:1 interleave. See 2070A for Parameter Tables and Jumper Selection for Jumpers M-T.

A-B	In	Drive 0 is a Syquest
C-D	In	Drive 1 is a Syquest
E-F		Reserved
G-H		Reserved
I-J		Reserved
K-L	In	Self diagnostics enabled
BD	In	BIOS Disabled
324	In	Alternate I/O Address
U-V+W-X	Out	BIOS Address C800
U-V	In	BIOS Address CA00
W-X	In	BIOS Address F400
U-V+W-X	In	BIOS Address CC00

ACB 2310/12

MFM. 16-bit Full Size; 1:1 interleave (with low level format). Default is no jumpers installed. No BIOS, so no DEBUG option. 2312 controls floppy.

J10	E4-E5	Out	Primary Hard disk address 1F0-1F7h
	E4-E5	In	Secondary Hard Disk address 170-177h
	E1-E2	Out	Primary Floppy Address 3F0-3F7h
	E1-E2	In	Secondary Floppy Address 370-377h
J9	1	In	Disable I/O Wait State
	2	In	TRK-1 Recal, Step=35uSec

	3		Not used
	4	In	Serial Monitor Mode.
	5	In	Diagnostics Enable
	6		Reserved

ACB 2320

ESDI. 1:1 interleave. 10 MHz.

J5	1	Out	Primary Hard disk address 1F0-1F7h
		In	Secondary Hard Disk address 170-177h
	2		Not used
	3	Out	Bus wait state enabled
		In	Bus wait state disabled
	4		Not used
	5		Not used
	6	Out	Serial Monitor disabled
		In	Serial Monitor enabled (2400 baud)
	7		Test point
J6			Test point
J7			Serial Monitor output
J8			Test point
J10			Not used
J11			Not used
J12	1-2		IRQ 14
	2-3		IRQ 15
	3-4		Do not use
J13	1-2		BIOS Address C8000-CBFFF
	2-3		BIOS Address CC000-CFFFF
	None		BIOS disabled

ACB 2322

ESDI

J2	1	Out	Primary Hard disk address 1F0-1F7h
		In	Secondary Hard Disk address 170-177h
	2	Out	Primary Floppy Address 3F0-3F7h
		In	Secondary Floppy Address 370-377h
	3	In	Bus Wait State disabled
	4		Not used
	5	In	Read ahead cache disabled
	6		Not used
	7		Not used

J 7	All	Out	BIOS Disabled
	1-2	In	C800-CBFF
	2-3	In	CC00-CFFF
J 13	1-2		IRQ 14
	2-3		IRQ 15
J20	1-2	In	Floppy DMA DREQ 3
	2-3	In	Floppy DMA DREQ 2
J21	1-2	In	Floppy DACK 2
	2-3	In	Floppy DACK 3
J22	1-2	In	Floppy IRQ 6
	2-3	In	Floppy IRQ 10

ACB 2322A

ESDI. Supports 2 floppies. –8 is 15 MHz.

J 6			Test Point
J 7			Test Point
J 8			Test Point
J 9			Test Point
J 10			Test Point
J 11	All	Out	BIOS Disabled
	1-2	In	C800-CBFF
	2-3	In	CC00-CFFF
J 12	1	Out	Primary HD Address 1F0-1F7h
		In	Secondary HD Address 170-177h
	2	Out	Primary Floppy Address 3F0-3F7h
		In	Secondary Floppy Address 370-377h
	3	In	Bus wait state disabled
	4		Not used
	5		Not used
	6	In	Serial Monitor enabled (2400 baud)
	7		Test Point
J 13			Serial Monitor output
J 14			Test Point
J 15			Test Point
J 16			Not used
J 17			Not used
J 18	1-2	In	IRQ 14
	2-3	In	IRQ 15
	3-4		Reserved
J 19	1-2	In	Floppy DACK 2
	2-3	In	Floppy DACK 3
J 20	1-2	In	Floppy IRQ 6

	2-3	In	Floppy IRQ 10
J 21	1-2	In	Floppy DMA DREQ 3
	2-3	In	Floppy DMA DREQ 2

ACB 2322B

ESDI. 64K cache; 1:1 interleave.

J 2	1	Out	Primary HD Address 1F0-1F7h
		In	Secondary HD Address 170-177h
	2	Out	Primary Floppy Address 3F0-3F7h
		In	Secondary Floppy Address 370-377h
	3	In	Wait state enabled
	4		Not used
	5	Out	Read ahead cache enabled
	6		Not used
	7		Not used
JP 7	All	Out	BIOS Disabled
	1-2	In	C800-CBFF
	2-3	In	CC00-CFFF
J P 13	1-2	In	HD IRQ 14
	2-3	In	HD IRQ 15
JP 20	1-2	In	Floppy DMA DREQ 2
	2-3	In	Floppy DMA DREQ 3
J P 21	1-2	In	Floppy DMA DACK 2
	2-3	In	Floppy DMA DACK 3
J P 22	1-2	In	Floppy IRQ 6
	2-3	In	Floppy IRQ 10

ACB 2370

RLL

J 6	1	Out	Primary Hard disk address 1F0-1F7h
		In	Secondary Hard Disk address 170-177h
	2		Not used
	3	In	Wait State (C&T) enabled
	4	Out	Drive recal to Trck 0 -1 enabled (ST 238)
		In	Disabled (ST 4144R)
	5		Not used
	6	In	Serial Monitor Mode enabled (2400 bd)
J 7			Test Point
J 8			Test Point
J 9			Test Point

J 10			Serial Monitor Output
J 13	1-2	In	IRQ 14
	2-3	In	IRQ 15
	3-4		Not used
J 14	1-2	In	C8000-CBFFF
	2-3	In	CC000-CFFFF
	None		BIOS Disabled
J 15	6		Test Points

ACB 2372A

J 6			Test Point
J 7			Test Point
J 8			Test Point
J 9			Test Point
J 10			Test Point
J 11			Test Points
J 12	1-2	In	C8000-CBFFF
	2-3	In	CC000-CFFFF
	None		BIOS Disabled
J 13			Test Point
J 14	1	Out	Primary Hard disk address 1F0-1F7h
		In	Secondary Hard Disk address 170-177h
	2	Out	Primary Floppy address 3F0-3F7h
		In	Secondary Floppy address 370-377h
	3	Out	Wait State enabled
	4	Out	Drive recal to Trck 0 -1 enabled (ST 238)
		In	Disabled (ST 4144R)
	5		Not used
	6	In	Serial Monitor Mode enabled (2400 bd)
	7		Test Point
J 15			Serial Monitor output
J 16			Test Points
J 17			Not used
J 18			Not used
J 19	1-2	In	IRQ 14
	2-3	In	IRQ 15
	3-4		Not used
J P 20	1-2	In	FloppyDMA DACK 2*
	2-3	In	Floppy DMA DACK 3
J P 21	1-2	In	Floppy IRQ 10
	2-3	In	Floppy IRQ 6*
JP 22	1-2	In	Floppy DMA DREQ 3

2-3	In	Floppy DMA DREQ 3*

ACB 2372D

RLL. 1:1 interleave

J4			Manufacturing test points			
J 7	1		Not used			
	2	Out	Drive uses physical parameters			
		In	Drive split if > 1024 cyls.			
	3		Reserved			
	4		Not used			
	5	In	Read ahead cache disabled			
	6		Reserved			
	7		Reserved			
J 10	1	Out	Primary Hard disk address 1F0-1F7h			
		In	Secondary Hard Disk address 170-177h			
	2	Out	Primary Floppy Address 3F0-3F7h			
		In	Secondary Floppy Address 370-377h			
	3	In	Floppy Disabled			
J 11		Out	Single speed floppy			
		In	Dual speed floppy			
J 12			**1**	**2**	**3**	**BIOS Address**
			Out	Out	Out	C8000
			In	Out	Out	CC000
			Out	In	Out	D0000
			In	In	Out	D4000
			Out	Out	In	Disable
			In	Out	In	D8000

ACB 4000(A)/4070

SCSI

Controller 1	None
Controller 2	A-B
Controller 3	C-D
Controller 4	A-B, C-D
Controller 5	E-F
Controller 6	A-B, E-F
Controller 7	A-B, C-D, E-F

AHA 1510

J9	2	IRQ 12

11	IRQ 11 (Default)
10	IRQ 10
19	IRQ 9
AL	Primary/Secondary Address; def 340H (no jumper); otherwise it's 140H.

AHA 1520/22

16-bit SCSI-2. 1522 supports 2 floppies.

J 5	1	Out	Enables data txfer on host bus with second party DMA.			
	2	In	Boot enable (BIOS intercepts INT 19)			
	3, 4	Out	Display Adaptec header and Error messages (default).			
		In	Display Error messages only			
		4 In	Display Adaptec header, Boot progress report, Error msgs.			
		3 In	Display above plus jumper and SCSI device info.			
	5	In	Synchronous negotiation enable (initiated by board).			
	6	In	Disconnect/Reconnect enable for target.			
	7,8	Out	Reserved			
J 6	1, 2, 3	**SCSI ID**		**1**	**2**	**3**
			0	00	00	00
			1	11	00	00
			2	00	11	00
			3	11	11	00
			4	00	00	11
			5	11	00	11
			6	00	11	11
			7*	11	11	11
	4,5	**IRQ**		**4**	**5**	
		select	9	00	00	
			10	11	00	
			11	00	11	
			12	11	11	
	6,7	**DMA**		**6**	**7**	
		Channel	0*	00	00	
		Select 0	5	11	00	
		(8-bit)	6	00	11	
			7	11	11	
	8	Out	SCSI Parity Disable			
J 7 (1522)	1	In	Floppy enable			
	2	In	Floppy DMA DREQ 2			
	3	Out	Floppy DMA DREQ 3			
	4	In	Floppy DMA DACK 2			
	5	Out	Floppy DMA DACK 3			
	6	In	Floppy IRQ 6			
	7	Out	Floppy IRQ 10			

	8	Out	Dual Speed Enable
J 8	1	Out	DMA DREQ 7
	2	Out	DMA DREQ 6
	3	Out	DMA DREQ 5
	4	In	DMA DREQ 4 (Default)
	5	Out	DMA DACK 7
	6	Out	DMA DACK 6
	7	Out	DMA DACK 5
	8	In	DMA DACK 4 (Default)
J 9	1234	Out	IRQ 12
		In	IRQ 11
		Out	IRQ 10
		Out	IRQ 9
	5	In	Primary address (140h)
		Out	Secondary Address (340h)
	6, 7		BIOS Addr. Need special BIOS for alt address while BIOS enabled.
			00 00 C8000
			00 11 CC000
			11 00 D8000
			11 11 DC000
	8	In	BIOS active

AHA 1540CF/42CF

SCSI-2 Bus mastering.

SW1	On			Enable Termination
	Off			Disable (software controlled)
SW2-4	**SW2**	**SW3**	**SW4**	**I/O Port**
	Off	Off	Off	330-333h
	On	Off	Off	334-337h
	Off	On	Off	230-233h
	On	On	Off	234-237h
	Of	Off	On	130-133h
	On	Off	On	134-137h
	Off	On	On	Reserved
	On	On	On	Reserved
SW5	On			Disable Floppy
	Off			Enable
SW6-8	**SW2**	**SW3**	**SW4**	**BIOS Address**
	Off	Off	Off	DC000h
	On	Off	Off	D8000h
	Off	On	Off	D4000h
	On	On	Off	D0000h
	Of	Off	On	CC000h

On	Off	On	C8000h
Off	On	On	Reserved
On	On	On	Disable

ALR

Dart

RLL

W 1	Out	Reserved
W 2	Out	Pri Addresses 1F0-1F7, 3F2-3F7
W 3	Out	Sec Addresses 170-177, 372-377
W 4	Out	Init Data Rate Control 500-KHz
W 5	In	Hardware Select Mode Installed
W 6	In	2-3 and 5-6 Installed
W 7	Out	Floppy Precompensation Control
W 8	In	16K PROM Installed
W 9	Out	PROM Address C800:0000
W 10	In	PROM Enabled

CMS

F 150AT-WCA

MFM

BIOS Address	*W1*	*W2*	*W3*
C8000-C9FFF	2-3	2-3	Jumpered*
CA000-CBFFF	2-3	1-2	Jumpered
CC000-CDFFF	1-2	2-3	Jumpered
CE000-CFFFF	1-2	1-2	Jumpered
Disabled			Not Jumpered

W 4	Out	Floppy Controller Enabled
W 6	1-2	Floppy Address 37x
	2-3	Floppy Address 3Fx*
W 7	1-2	5.25" 1.2 Mb*
	2-3	3.25" 1.44 Mb
W 8	Out	WD 1007 Mode
	In	WD 1005 Mode
W 11	Out	Without FDC Option
	In	With FDC Option

W 12	In	HD Address 17x
	Out	HD Address 1Fx*
W 13 Etch	Cut	Floppy Disabled
W 14	In*	Sector Translation Disabled
W 15	Out	ECC Enabled
W 10	In	PROM Enabled

Compaq

957 IDE

Sw 1	Off	Primary Diskette Addresses
	On	Secondary Diskette Addresses
Sw 2	Off	Disable high speed transfer rates from systems w/out 1.2 Mb drive/40 Mb tape.
	On	Enable high speed transfer rates for systems with 1.2 Mb drive or 40 Mb tape.
Sw 3	Off	Enable HD
	On	Disable HD
Sw 4	Off	Serial interface as Com1, IRQ4
	On	Serial interface as Com2, IRQ3
Sw 5	Off	Enable Serial Interface
	On	Disable Serial Interface
Sw 6	Off	Enable Parallel Interface
	On	Disable Parallel Interface

996—ESDI

Sw 1	Off	Primary Diskette Addresses
	On	Secondary Diskette Addresses
Sw 2	Off	ESDI enabled

Datacare

DC-1234

SCSI

JP2	Out	2 drives connected
	In	1 drive connected
JP3	Out	Primary I/O address 3F0-3F7, 1F0-1F7
	In	Secondary I/O address 370-377, 170-177

DPT

PM 2001/9x

SCSI

Y8,Y9	**HD IRQ**		**Y8**	**Y9**	**Y10**	**Y22**
Y10,Y22		14*	1	0	0	0
		7	0	1	0	0
		15	0	0	1	0
		12	0	0	0	1
Y1,Y2,Y4	**SCSI ID**		**Y1**	**Y2**	**Y4**	
		0	0	0	0	
		1	1	0	0	
		2	0	1	0	
		3	1	1	0	
		4	0	0	1	
		5	1	0	1	
		6	0	1	1	
		7*	1	1	1	
Y5		I/O Address				
Y17	In	170-177h				
	Out	1F0-1F7h				
Y7	Out	ROM disabled				
Y18	In	ROM Address D8000				
	Out	ROM Address C8000*				
Y20	Out	Floppy enabled				
Y21	Out	Head load disabled*				

PM 2012A/B

SCSI; EISA

Y7	Out	ROM disabled
Y19	In	ROM Address D8000
	Out	ROM Address C8000*
Y20	Out	Floppy enabled

PM 301A/60

SCSI

Y1-Y3		DPT use only
Y4	Out	SCSI I/O address disabled

Y5,Y6	**8K ROM**			**Y5**	**Y6**	
		Disabled	0	0		
		Enabled		1	1	
Y7,8,16	**HD IRQ**		**Y7**	**Y8**	**Y16**	
		14*	1	0	0	
		5	0	0	1	
		7	0	1	0	
Y9,10	**SCSI IRQ**		**Y9**	**Y10**		
		None*	0	0		
		5	1	0		
		7	0	1		
Y11	In	HD I/O Address 170-177				
	Out	HD I/O Address 1F0-1F7*				
Y12,13	**DMA**		**Y12**	**Y13**	**Y14**	**Y15**
14,15		None*	0	0	0	0
		1	1	0	1	0
		3	0	1	0	1
Y17	In	Floppy I/O Address 370-377				
	Out	HD I/O Address 3F0-3F7*				

PM 3011A/50/60

SCSI

Y1-Y4		DPT use only				
Y5	In	Floppy address 370-377h				
	Out	Floppy address 3F0-3F7h				
Y6	Out	SCSI I/O address disabled				
Y7	Out	8K ROM disabled				
Y8		DPT use only				
Y9,10,11	**HD IRQ**		**Y9**	**Y10**	**Y11**	
		14*	1	0	0	
		5	0	0	1	
		7	0	1	0	
Y12,13	**SCSI IRQ**		**Y12**	**Y13**		
		None*	0	0		
		5	1	0		
		7	0	1		
Y14,15	**DMA**		**Y14**	**Y15**	**Y16**	**Y17**
16,17		None*	0	0	0	0
		1	1	0	1	0
		3	0	1	0	1
Y18	In	HD I/O Address 170-177				
	Out	HD I/O Address 1F0-1F7*				
Y19,20	**SCSI I/O**			**Y19**	**Y20**	

		C8000*	0	0	
		D8000	1	0	
		E8000	0	1	
		F1000	1	1	
Y21	Out	Floppy enabled			
Y22	Out	Head load disabled*			

PM 3011A/70

SCSI

Y1-Y4		DPT use only				
Y5	In	Floppy address 370-377h				
	Out	Floppy address 3F0-3F7h				
Y6	Out	SCSI I/O address disabled				
Y7	Out	8K ROM disabled				
Y8,9,10	**HD IRQ**		**Y8**	**Y9**	**Y10**	
		14*	1	0	0	
		5	0	0	1	
		7	0	1	0	
Y11,12	**SCSI IRQ**		**Y11**	**Y12**		
		None*	0	0		
		5	1	0		
		7	0	1		
Y13,14	**DMA**		**Y13**	**Y14**	**Y15**	**Y16**
15,16		None*	0	0	0	0
		1	1	0	1	0
		3	0	1	0	1
Y17	In	HD I/O Address 170-177				
	Out	HD I/O Address 1F0-1F7*				
Y18,19	**SCSI I/O**		**Y18**	**Y19**		
		C8000*	0	0		
		D8000	1	0		

PM3011E/55/65

SCSI

Y1-Y4		DPT use only
Y5	In	Floppy address 370-377h
	Out	Floppy address 3F0-3F7h
Y6	Out	SCSI I/O address disabled
Y7	Out	8K ROM disabled
Y8		DPT use only

Y9,10,11	**HD IRQ**		**Y9**	**Y10**	**Y11**	
		14*	1	0	0	
		12	0	0	1	
		7	0	1	0	
Y12,13	**SCSI IRQ**		**Y12**	**Y13**		
		None*	0	0		
		12	1	0		
		7	0	1		
Y14,15	**DMA**		**Y14**	**Y15**	**Y16**	**Y17**
16,17		None*	0	0	0	0
		1	1	0	1	0
		3	0	1	0	1
Y18	In	HD I/O Address 170-177				
	Out	HD I/O Address 1F0-1F7*				
Y19	In	Boot PROM address D8000				
	Out	Boot PROM address C8000				
Y20	In	SCSI I/O address D8000				
	Out	SCSI I/O address C8000				
Y21	Out	Floppy enabled				
Y22	Out	Head load disabled*				

PM 3011E/75

SCSI

Y1-Y4		DPT use only				
Y5	In	Floppy address 370-377h				
	Out	Floppy address 3F0-3F7h				
Y6	Out	SCSI I/O address disabled				
Y7	Out	8K ROM disabled				
Y8,9,10	**HD IRQ**		**Y9**	**Y10**	**Y11**	
		14*	1	0	0	
		12	0	0	1	
		7	0	1	0	
Y11,12	**SCSI IRQ**		**Y12**	**Y13**		
		None*	0	0		
		12	1	0		
		7	0	1		
Y13,14	**DMA**		**Y14**	**Y15**	**Y16**	**Y17**
15,16		None*	0	0	0	0
		1	1	0	1	0
		3	0	1	0	1
Y17	In	HD I/O Address 170-177				
	Out	HD I/O Address 1F0-1F7*				

Y18	In	Boot PROM address D8000
	Out	Boot PROM address C8000
Y19	In	SCSI I/O address D8000
	Out	SCSI I/O address C8000
Y20	Out	Floppy enabled
Y21	Out	Head load disabled*

Data Technology (DTC)

31/3280A

SCSI

W1	1-2	8K SRAM							
	2-3	2K SRAM							
Sw 1	1-4	**B IRQ**		**1**	**2**	**3**	**4**		
		Disabled		0	0	0	0		
		15		1	0	0	0		
		12		0	1	0	0		
		11*		0	0	1	0		
		10		0	0	0	0		
Sw 1/7	Out	Dual speed floppies not supported							
	In	Dual speed floppies supported							
Sw 1/8	Out	PS/2 drive as #2							
	In	AT drive as #2							
Sw 1/9	Out	Precomp depends on floppy data rate							
		500KHz	125 ns						
		300KHz	208 ns						
		250KHz	250 ns						
	In	Floppy precomp 125 ns							
Sw 1/10	Out	Disable floppy interface							
	In	Enable floppy interface							
Sw 2	1-2	**A Interrupt**		**Sw 2/1**		**Sw 2/2**			
		15		0		0			
		12		1		0			
Sw 2/5	Out	Enable parity on SCSI bus							
Sw 2	6-8	**ID0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
		1	0	1	0	1	0	1	0
		1	1	0	0	1	1	0	0
		1	1	1	1	0	0	0	0
W2	1-2	Primary Floppy Address (3F2-3F7)							
	2-3	Secondary Floppy Address (372-377)							

5150 BX

MFM. With BXD-6 ROM, IBM 0,1,2 become:

IBM 0	35 Mb 512x8
IBM 1	10Mb 612x2
IBM 2	20Mb 612x4

Drive	*No*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
IBM 05 Mb306 x 2	1			1	1			1	1
	2	1	1			1	1		
IBM 126 Mb 375x8	1			0	1			1	1
	2	0	1			1	1		
IBM 215 Mb306x6	1			1	0			1	1
	2	1	0			1	1		
IBM 310 Mb306x4	1			0	0			1	1
	2	0	0			1	1		
DTC 45 Mb306x2	1			1	1			0	1
	2	1	1			0	1		
DTC 528 Mb640x5	1			0	1			0	1
	2	0	1			0	1		
DTC 620 Mb306x8	1			1	0			0	1
	2	1	0			0	1		
DTC 7Non-StdDrives	1			0	0			0	1
	2	0	0			0	1		
DTC 818 Mb512x4	1			1	1			1	0
	2	1	1			1	0		
DTC 927 Mb512x6	1			0	1			1	0
	2	0	1			1	0		
DTC A10 Mb612x2	1			1	0			1	0
	2	1	0			1	0		
DTC B22 Mb640x4	1			0	0			1	0
	2	0	0			1	0		
DTC C18 Mb697x3	1			1	1			0	0
	2	1	1			0	0		
DTC D30 Mb697x5	1			0	1			0	0
	2	0	1			0	0		
DTC E33 Mb640x6	1			1	0			0	0
	2	1	0			0	0		
DTC FSpecial	1								
	2	0	0			0	0		

5150/60 CR(H)

RLL

W1	1-2	8K ROM			
	2-3	16K ROM			
W2	**PROM**		**3-4**	**2-5**	**1-6**
		Disabled	0		
		C800	1	0	0
		CA00	1	0	1
		D800	1	1	0
		F400	1	1	1
W3	1-2	DACK 1			
	2-3	DACK 3*			
W4	1-2	DREQ 3*			
	2-3	DREQ 1			
W5	1-2	IRQ 2			
	2-3	IRQ 5			
W6		An 8-position jumper readable from hard disk port 2, used for drive type. Its meaning is defined by the BIOS in use (the standard one doesn't use this).			
W7	In	Primary Floppy Address (320-323)			
	Out	Secondary Floppy Address (324-327)			

5150 X

MFM

5160 X

RLL

W2	**PROM**		**3-4**	**2-5**	**1-6**
		Disabled	0		
		C800	1	0	0
		CA00	1	0	1
		D800	1	1	0
		F400	1	1	1
	7-8	Factory use only			
W3	In	ST 225 or equivalent			
	Out	Drive type defined by menu			

5180I

MFM - See 5187I

5187i

RLL

W2, W3	Out	Primary Addresses 1F0-1F7, 3F0-3F7*
	In	Secondary Addresses 170-177, 370-377
W 4	Out	Floppy Drive Transfer Rate 500 KHz*
	In	Floppy Drive Transfer Rate 250 KHz
W 5	In	Hardware Select Mode*
	Out	Firmware Select Mode
W 6	In	Auto-Deselect Mode Enabled*
W 7	In	Floppy Precompensation at 125nSec
	Out	Prec Scaled/Freq (125nS@500KHz, 208nS@300KHz, 250nS@250KHz)*

5187-1

RLL

W1	In	Floppy disk changed signal low when accessed				
	Out	Floppy disk changed signal not driven				
W2	In	BIOS enabled				
	Out	BIOS disabled				
W3	In	BIOS address D800				
	Out	BIOS address C800				
W4	In	BIOS is 27128				
	Out	BIOS is 2746				
W5 & W6	In	Secondary port address (170-177, 376-377)				
	Out	Primary port address (1F0-1F7, 3F6-3F7)				
W7	**IRQ**		**1-2**	**3-4**	**5-6**	**7-8**
		14	0	0	0	1
		13	0	0	1	0
		12	0	1	0	0
		11	1	0	0	0

5287CR

RLL

W1	In	Floppy disk changed signal low when accessed
	Out	Floppy disk changed signal not driven
W2 & W3	In	Secondary port address (170-177, 376-377)
	Out	Primary port address (1F0-1F7, 3F6-3F7)
W4	1-2	Initial Interrupt disabled after reset
	2-3	Initial Interrupt enabled after reset
W5	In	Drive select controlled by system reset
	Out	Drive select controlled by firmware
W6 & W7		Factory use only—must be installed
W8	In	Enable PROM

	Out	Disable PROM
W9	In	PROM address D800
	Out	PROM address C800
W11		Factory use only—must not be installed

5280CZ

MFM

W2 & W3	In	Secondary port address
	Out	Primary port address
W5		Factory use only; must be installed
W6		Factory use only; 2-3/5-6 must be installed—all others must be off.

5280i

RLL; OS/2 compatible with 1:1 interleave running at zero wait states up to a bus speed of 16MHz. No embedded Low Level Format routine, so third party software required.

W2 W3	Out	Primary Addresses 1F0-1F7; 3F0-3F7*
	In	Secondary Addresses 170-177; 370-377
W4	Out	Floppy Drive Transfer Rate 500 KHz*
	In	Floppy Drive Transfer Rate 250 KHz
W5	In	Hardware Select Mode*
	Out	Firmware Select Mode
W6	In	Auto-Deselect Mode Enabled*
W7	In	Floppy Precompensation at 125nSec
	Out	Prec Scaled by floppy data rate: 125nS@500KHz 208nS@300KHz 250nS@250KHz*

5287

RLL; OS/2 compatible with 1:1 interleave, running at zero wait states up to a bus speed of 16MHz. No embedded Low Level Format routine, so third party software required.

W2, W3	Out	Primary Addresses 1F0-1F7, 3F0-3F7*
	In	Secondary Addresses 170-177, 370-377
W4	Out	Floppy Drive Transfer Rate 500 KHz*
	In	Floppy Drive Transfer Rate 250 KHz
W5	In	Hardware Select Mode*
	Out	Firmware Select Mode
W6	In	Auto-Deselect Mode Enabled*
W7	In	Floppy Precompensation at 125nSec
	Out	Precompensation Scaled by floppy data rate:

		125nS@500KHz 208nS@300KHz 250nS@250KHz*
W8		Reserved - must be installed for correct operation
W9	In Out	BIOS Address (16KB) D800-DC00 BIOS Address C800-CC00*
W10	In	BIOS enabled

6280

W1	In	Auto-Deselect Mode Enabled*
W2, W3	In, Out Out, In	Floppy enabled Floppy disabled
SW1,SW3	Out In	Primary I/O port Address 1F0-1F7, 3F0-3F7* Secondary Address
SW3	In Out	BIOS Address D800-DC00 BIOS Address C800-CC00*
SW4	In	BIOS enabled

7180

MFM

W1	In Out	Floppy disk changed signal low when accessed Floppy disk changed signal not driven
W2 & W3	In Out	Secondary port address (170-177, 376-377) Primary port address (1F0-1F7, 3F6-3F7)
W4	1-2 2-3	Interrupt disabled after reset Interrupt enabled after reset
W6	In Out	Auto-deselect enabled Auto-deselect disabled

7187

RLL

W1	In Out	Floppy disk changed signal low when accessed Floppy disk changed signal not driven
W2 & W3	In Out	Secondary port address Primary port address
W4	1-2 2-3	Interrupt disabled after reset Interrupt enabled after reset
W6	In Out	LED auto-deselect on LED auto-deselect off

W7			Factory use only
W8		In	Enable PROM
		Out	Disable PROM
W9		In	PROM address D800
		Out	PROM address C800

7280

MFM. See 5280i.

7287

See 5287.

Everex

EV-346

MFM

W5	1-2	Out	Disable floppy DACK2
		In	Enable floppy DACK2
W6		Out	HD primary address 1F0-1F7
		In	HD secondary address 170-177
W9		Out	Floppy primary address 3F4-3F7
		In	Floppy secondary address 375-377
W10	1-2	In	Floppy disable (also W5 out)
W11	1-2	Out	Disable HD

Konan

TenTime

S1,S2,S3		**Memory address**	**S1**	**S2**	**S3**
		C000	On	On	On
		C800	Off	On	Off
		CC00	Off	Off	Off
		D000*	On	On	Off
		D400	On	Off	Off
		D800	Off	On	On
		DC00	Off	Off	On
		Disable	On	Off	On
S4	In	Disable floppy			

S5,S6,S7			**IRQ**	**S5**	**S6**	**S7**
			14*	On	Off	Off
			15	Off	On	Off
			5	Off	Off	On
		In	HD secondary address 170-177			
W9		Out	Floppy primary address 3F4-3F7			
		In	Floppy secondary address 375-377			
W10	1-2	In	Floppy disable (also W5 out)			
W11	1-2	Out	Disable HD			

Longshine

LCS 6210D

MFM

JP1	1-2	Out	Drives with 9-16 heads
		In	Drives with less than 8 heads
JP2		Out	BIOS address C8000
		In	BIOS address E8000

6610HX

MFM

JP2		Out	DTK BIOS in system
		In	Other BIOS than DTK in system
JP3	1-2	In	HD primary address 1F0-1F7
	2-3	In	HD secondary address 170-177
JP4	1-2	In	C & T chipset
		In	Other chipset

OMTI

5520

1	*2*	*3*	*4*	*Cyls*	*Hds*	*WP*
0	0	0	0	306	4	128
0	0	0	1	640	6	256
0	0	1	0	612	6	128
0	1	0	0	697	5	256
0	1	0	0	612	4	256
0	1	0	1	977	5	300
0	1	1	0	512	8	256

0	1	1	1	612	4	128
1	0	0	0	612	2	256
1	0	0	1	733	5	300
1	0	1	0	612	2	400
1	0	1	1	987	7	
1	1	0	0	615	4	300
1	1	0	1	306	4	
1	1	1	0	640	4	256
1	1	1	1	918	15	

5527

1	*2*	*3*	*4*	*Cyls*	*Hds*	*WP*
0	0	0	0	615	4	
0	0	0	1	987	5	
0	0	1	0	612	4	
0	1	0	0	640	8	
0	1	0	0	306	4	128
0	1	0	1	612	8	
0	1	1	0	830	10	
0	1	1	1	640	6	
1	0	0	0	306	4	
1	0	0	1	830	7	
1	0	1	0	612	4	128
1	0	1	1	918	15	
1	1	0	0	615	2	
1	1	0	1	980	5	700
1	1	1	0	1024	8	
1	1	1	1	640	4	

8150

MFM
See 8157.

8157

RLL

W7	1-2	Selects SYSCLK to 5098C*
W8		Not used
W9		Not used
W10		Reserved—do not use
W11	Out	Primary HD address 1F0-1F7
	In	Secondary HD address 170-177

W12		Not used
W13	In	Connects bracket to board ground
	Out	Bracket ground option not used
J6		HD LED

8240

MFM

W1	Out	Primary HD address 1F0-1F7
	In	Secondary HD address 170-177
W2	Out	Primary floppy address 3F0-3F7
	In	Secondary floppy address 370-377
J6		HD LED

8250

MFM. See 8257.

8257

RLL**

W7	1-2	In	Selects SYSCLK to 5098C*
W8	1-2	In	Single speed floppies
	2-3	In	Dual speed floppies
W9	2-3	In	Floppy precompensation
W10			Reserved. Do not use
W11		Out	HD primary address 1F0-1F7
		In	HD secondary address 170-177
W12	2-3	In	Floppy primary address 3F0-3F7
		Out	Floppy secondary address 370-377
W12**	2-3	In	Floppy primary address 3F0-3F7
	1-2	In	Floppy secondary address 370-377
W13		Out	Bracket ground option not used
		In	Connects bracket to board ground

Perstor

PS 180-16FN

RLL. Does not work with WD 1002-FOX floppy controller (16 bit version controls its own floppies).

Promise

DC 100/100M

IDE. Add minimum .5Mb to DC-100; the 100M has .5Mb on board. Will not co-exist.

JP2	Parallel Port (CN2) Output Options	Output Only: Jumpered* Bi-Directional:(no jumper; OS/2)
JP3	Port Configurations	**Serial Port 1** (CN1) COM1 (3F8, IRQ4): 1-2, 5-6* COM3 (3E8, IRQ4): 2-3, 4-5 Disabled:2-3, 5-6 **Serial Port 2** (JP1) COM2 (2F8, IRQ3): 7-8, 11-12* COM4 (2E8, IRQ3): 8-9, 10-11 Disabled:8-9, 11-12 **Parallel Port** (CN2) (3BC, IRQ7): 13-14, 16-17, 20-21 (378, IRQ7): 13-14, 17-18, 20-21* (278, IRQ5): 14-15, 16-17, 19-20 Disabled:14-15, 17-18
	Floppy Disk (J1)	Enable:22-23* Disable: 23-24

DC 2030

J 1, J 2	DC-2010 Expansion Memory Board				
J 4	IDE "Pass Through" connector. For motherboard controller w/2030 IDE disabled (W2 off).				
W 2	In - IDE enabled				
W 3,4,5	Reserved				
W 6	In - Floppy enabled				
W7	**BIOS address**	**1-2**	**3-4**	**5-6**	**7-8**
	C000	1	1	1	1
	C200	1	1	1	0
	C400	1	1	0	1
	C600	1	1	0	0
	C800	1	0	1	1
	CA00	1	0	1	0
	CC00	1	0	0	1
	CE00	1	0	0	0
	D000	0	1	1	1
	D200	0	1	1	0
	D400	0	1	0	1
	D600	0	1	0	0
	D800*	0	0	1	1
	DA00	0	0	1	0
	DC00	0	0	0	1
	DE00	0	0	0	0

Rancho Technology Inc

RT 1000A

SCSI

X1		In	Floppy Disk Write Precomp 125 ns			
		Out	Floppy Disk Write Precomp 187 ns			
X2		In	Single speed floppies			
		Out	Dual speed floppies			
X3		In	Alternate Floppy Address 3F7			
		Out	Standard XT/AT Floppy Address 377H			
X4,X5,X6		**HD Mem Addr**		**X4**	**X5**	**X6**
			D4000	On	On	On
			CC000	Off	On	On
			D0000	On	Off	On
			C8000	Off	Off	On
			E4000	On	On	Off
			DC000*	Off	On	Off
			E0000	On	Off	Off
			D8000	Off	Off	Off
X7		In	Remote terminator power			
X8		In	IRQ 7			
X9		In	IRQ 5			
X10		In	IRQ 4			
X11		In	IRQ 3			
X12		In	Enable zero wait state logic			
X13		Out	Disable Floppy			
X14		Out*	PS/2 MicroChannel only			
X15		Out*	Add for Syquest and some removeable drives			
X16		Out*	SCSI passthrough only			
X17		Out*	Factory use only			
X18		Out	No additional delay (e.g. 5 sec) after BUS RESET during initialisation			
JMP 4	1-2	In*	Floppy Primary/Enable (3F0-3F7)			
	2-3	In	Floppy Secondary/Disable (370-377)			
JMP 13	1-2	In*	Floppy Enable			
	2-3	In	Floppy Disable (and JMP 4 2-3 In)			
JMP 8	1-2	In	HD Primary Address (1F0-1F7)*			
	2-3	In	HD Secondary Address (170-177)			

Seagate

ST 01(-A)(-B)(-E50)

SCSI. Early versions have 8K ROM and no aux drive power connector; recognized by absence of notch in upper left corner. The16K version has an aux drive power connector and ROM Version 2.0 or higher.

W1	All	Out	8K BIOS Address CA000*
	A-B	In	8K BIOS Address C8000
	C-D	In	8K BIOS Address CE000
	All	In	8K BIOS Address DE000
	All	Out	16K BIOS Address C800*
	A-B	In	16K BIOS Address Invalid
	C-D	In	16K BIOS Address CC00
	All	In	16K BIOS Address DC00
W2	H-I	Out	Zero wait state disabled
		In	Zero wait state enabled (for optimum performance if PC can cope).
W3	All	Out	Disable interrupts*
	E-F	In	IRQ 3
	F-G	In	IRQ 5

ST 02(-E50)

SCSI

W1	All	Out	8K BIOS Address CA000*
	A-B	In	8K BIOS Address C8000
	C-D	In	8K BIOS Address CE000
	All	In	8K BIOS Address DE000
	All	Out	16K BIOS Address C800*
	A-B	In	16K BIOS Address Invalid
	C-D	In	16K BIOS Address CC00
	All	In	16K BIOS Address DC00
W2	H-I	Out	Zero wait state disabled
		In	Zero wait state enabled (for best performance if PC can cope).
W3	All	Out	Disable interrupts*
	E-F	In	IRQ 3
	F-G	In	IRQ 5
IP5	M-N	In	360/720K floppies only
	N-O	In	360/720K & 1.2/1.4Mb floppies supported*
JP6	Q-R	In	Register 01F4 emulation enabled for XT
	P-Q	In	Register 01F4 emulation disabled for XT

ST 05X (XT) ST 02(-E50)

SCSI

JP1	*A-B*	*C-D*	*BIOS ROM*	*BIOS RAM*
	Out	Out	C8000-CBF7F	CBF80-CBFFF
	Out	In	D8000-DBF7F	DBF80-DBFFF
	In	Out	D0000-D3F7F	D3F80-D3FFF
	Out	Out	E0000-E3F7F	E3F80-E3FFF

ST 07A/08A

IDE. Half-slot.

JP2	1-2	Out*	HD Primary Address 1F0-1F7, 3F6-3F7
		In	HD Secondary Address 170-177, 376-377
JP2 (ST 08A)	1-2	Out*	Floppy Primary Address 3F0-3F5, 3F7
		In	Floppy Secondary Address 370-375, 377
JP4	1-2	Out	Floppy Disabled
		In*	Floppy Enabled
JP5	1-2		IRQ 14 status to host is cleared when hard drive is busy; for systems which do not read status following an interrupt.
	2-3		Hard drive interrupt connected directly to IRQ 14 line of the AT bus*.
JP6	1-2	Out*	I/O channel READY from hard drive is not connected to the host.
		In	I/O channel READY from the hard drive is connected to the host.

ST 10

MFM

W2	3-4	In	BIOS address C8000
	3-4	Out	BIOS disabled
	3-4/1-6	In	BIOS address D0000
	3-4/2-5	In	BIOS address D8000
	All	In	BIOS address F4000

ST 11M/R

MFM/RLL. 8-bit. Unique recording format; can recognize Paired Program software.

W1	All	Out	BIOS address C8000 (I/O 320-323)
	A-B	In	BIOS address D0000 ((I/O 324-327)
	C-D	In	BIOS address D8000 (I/O 328-32B)
	A-BC-D	In	BIOS address E0000 (I/O 32C-32F)

ST 21/22/M/R

MFM/RLL. Apparently has unique recording format. When installing in a system already containing a hard disk controller, the ST 21M/R must be jumpered at a higher BIOS address.

JP1	Out*	HD I/O Address 1F0-1F7, 3F6-3F7
JP2	Out	Floppy I/O Address 3F0-3F5, 3F7 BIOS Address C8000-CBFFF
	Out	HD I/O Address 1F0-1F7, 3F6-3F7
	In	Floppy I/O Address 3F0-3F5, 3F7 BIOS Address CC000-CFFFF
	In	HD I/O Address 170-177, 376-377
	Out	Floppy I/O Address 370-375, 377 BIOS Address D8000-DBFFF
	In	HD I/O Address 170-177, 376-377
	In	Floppy I/O Address 370-375, 377 BIOS Address DC000-DFFFF
JP3	Out	BIOS Disabled
	In*	BIOS Enabled
JP4*	Out	Floppy Disabled (ST 22)
	In	Floppy Enabled (ST 22)

ST 21M/R Error Codes (LED flashes)

1 Normal completion of controller diagnostics.
2 Failure of HD interface.
3 Sector Buffer error.
4 Controller task file interface failure.
5 Microcode ROM checksum error.
6 ECC circuits failure.

Silicon Valley Computers

ADP 20

IDE

E1, E4	In	Floppy Drive Enable (cut traces on the back).
E2	Out	Floppy Precomp 105 ns*
	In	Floppy Precomp 125 ns
E3	In	Dual Speed Floppy
E5	In	Hard drive support (cut traces on the back).

ADP 60LF/L

IDE

E1	In	Floppy Drive Disable

E2, E3	Out*	Reserved
E4	Out	Primary Floppy Address (1F0-AF7)*
	In	Secondary Floppy Address (170-177)
E5		**ROM BIOS Address** (small)
	Out	C800*
	In	CA00
E6		**ROM BIOS Address** (large)
	Out	C8000*
	In	CA000
E7	In	BIOS Enable (cut trace on the back)
E8	1-2 In*	Reserved

Storage Plus

Sumo

SCSI

OPT	In	Zero Wait State				
CODE	In*					
FLPY	In	FloppyEnable*				
A,B,R		**BIOS Address**	**B**	**A**	**R**	
		C800:0000-1FFF	1	1	1	
		CC00:0000-1FFF	0	1	1	
		D800:0000-1FFF	1	0	1	
		DC00:0000-1FFF*	0	0	1	
		Disable	0	0	0	
C,D,E,I		**I/O Address**	**E**	**D**	**C**	**I**
		300H	1	1	1	1
		310H*	0	1	1	1
		320H	1	0	1	1
		330H	0	0	1	1
		340H	1	1	0	1
		350H	0	1	0	1
		360H	0	1	1	1
		370H	0	0	0	0
		Disable	0	0	0	0
IRQ		Default is 14; numbered in order.				

UltraStor

12C

ESDI

JP2		Out	Factory use only							
JP3		In	Factory use only							
JP4	1-2	Out	Reserved							
	3-4	In	Reserved							
JP10		**BIOS**		**Dis**	***C800**	**CC00**	**D000**	**D400**	**D800**	**DC00**
			1-2	0	0	0	0	1	1	1
			3-4	0	0	1	1	0	0	1
			5-6	0	1	0	1	0	1	0
JP11	1-2	Out*	3rd floppy; Double-twist cable, set as drive 2							
		In	3rd floppy; Single-twist cable, set as drive 4							
	3-4	In	2nd floppy; PS/2 type (3.5" only)							
		Out*	2nd floppy; AT type (3.5" or 5.25")							
	5-6	In	1st floppy; PS/2 type (3.5" only)							
		Out*	1st floppy; AT type (3.5" or 5.25")							
	7-8	In	Secondary floppy address (370-377)							
		Out*	Primary floppy address (3F0-3F7)							
	9-10	In	Dual speeds (300, 360 RPM)							
		Out*	Single speed (300 RPM)							
	11-12	In	Precomp fixed at 125ns							
		Out*	Precomp varies with data rate 250khz:250ns 300khz:208ns 500KHz:125ns							
JP12		In	HD Secondary address (170-177).							
		Out*	HD Primary address (1F0-1F7).							
JP16		In	Chassis ground connected to logic ground.							
JP17		In	Floppy Enabled*							
JP20			Factory use only.							
JP21	1-2	In	HD IRQ 15							
	2-3	In	HD IRQ 14							

12F

ESDI

JP1		In	Enable to co-reside with another controller
		Out	Primary controller
JP2		Out	Factory use only
JP3		In	Factory use only*
JP4	1-2	Out	Reserved*

	3-4	In	Cache Control disable							
JP5	1-2		32K data buffer*							
	2-3		8K data buffer							
JP6	1-2		Factory configured: 8/32K data buffer							
	2-3		Reserved							
JP7	1-2		Factory use only							
JP9		Out	Factory use only							
JP10		**BIOS**		**Dis**	***C800**	**CC00**	**D000**	**D400**	**D800**	**DC00**
			1-2	0	0	0	0	1	1	1
			3-4	0	0	1	1	0	0	1
			5-6	0	1	0	1	0	1	0
			Pri addresses must use C800, D000 or D800; sec CC00, D400 or DC00. JP12.							
JP11	1-2	Out*	3rd floppy; Double-twist cable, set as drive 2							
		In	3rd floppy; Single-twist cable, set as drive 4							
	3-4	In	2nd floppy; PS/2 type (3.5" only)							
		Out*	2nd floppy; AT type (3.5" or 5.25")							
	5-6	In	1st floppy; PS/2 type (3.5" only)							
		Out*	1st floppy; AT type (3.5" or 5.25")							
	7-8	In	Secondary floppy address (370-377)							
		Out*	Primary floppy address (3F0-3F7)							
	9-10	In	Dual speeds (300, 360 RPM)							
		Out*	Single speed (300 RPM)							
	11-12	In	Precomp fixed at 125ns							
		Out*	Precomp Varies with data rate: 250khz:250ns 300khz:208ns 500KHz:125ns							
JP12		In	HD Secondary address (170-177)							
		Out*	HD Primary address (1F0-1F7)							
JP17		In	Floppy Enabled*							
JP20	1-2	In	HD IRQ 15							
	2-3	In	HD IRQ 14							

22F

ESDI

JP1			Reserved
JP2		Out	Factory use only*
JP3		In	Factory use only*
JP4	1-2		Reserved*
	3-4	In	Cache Control disable
JP5	1-2		32K data buffer
	2-3		8K data buffer
JP6	1-2		8/32K data buffer
	2-3		Reserved

JP7			Factory use only							
JP9		Out	Factory use only							
JP10		**BIOS**		**Dis**	***C800**	**CC00**	**D000**	**D400**	**D800**	**DC00**
			1-2	0	0	0	0	1	1	1
			3-4	0	0	1	1	0	0	1
			5-6	0	1	0	1	0	1	0
			Primary addresses must use C800, D000 or D800; secondary CC00, D400 or DC00. See JP12.							
JP11	1-2	Out*	3rd floppy; Double-twist cable, set as drive 2							
		In	3rd floppy; Single-twist cable, set as drive 4							
	3-4	In	2nd floppy; PS/2 type (3.5" only)							
		Out*	2nd floppy; AT type (3.5" or 5.25")							
	5-6	In	1st floppy; PS/2 type (3.5" only)							
		Out*	1st floppy; AT type (3.5" or 5.25")							
	7-8	In	Secondary floppy address (370-377)							
		Out*	Primary floppy address (3F0-3F7)							
	9-10	In	Dual speeds (300, 360 RPM)							
		Out*	Single speed (300 RPM)							
	11-12	In	Precomp fixed at 125nsPrecomp							
		Out*	Varies with data rate: 250khz:250ns 300khz:208ns 500KHz:125ns							
JP12		In	HD Secondary address (170-177)							
		Out*	HD Primary address (1F0-1F7)							
JP16		In	Chassis ground connected to logic ground.							
JP17		In	Floppy Enabled*							
JP20	1-2	In	HD IRQ 15							
	2-3	In	HD IRQ 14							

Western Digital

Speedkit

See WD 1006V-MM1/MM2.

WD 1002-27X

RLL. Half size, 8-bit. Has a power connector for filecards. Discontinued March 1989.

W3		In	BIOS Enable.
W4	1-2	In	Secondary Address 324-327
	2-3	In	Primary Address 320-323*

W6	1-2	In*	16 head disk drive.
	2-3	In	8 head disk drive w/RWC*
W7	1-2	In	IRQ 5
	2-3	In	IRQ 2 (needs custom BIOS, close S1-7).
W8	1-2	In	Secondary controller (CA00)Primary Controller (C800*)
	2-3	In	
Sw 1-7		Out	IRQ 5
		In	IRQ 2; also modify W7; must have custom BIOS.
Sw 1-8		Out	XT Mode.
		In	AT Mode

BIOS Table	*Cap*	*Cyls*	*Hds*	*SpT*	*1-1**	*1-2**	*1-3**	*1-4**	*1-5*	*1-6*	*W9*
0	65	981	5		In	In	In	In	Out	Out	
1	92	987	7	17	Out	In	Out	In	In	Out	Out
2	33	612	4	26	In	Out	In	Out	Out	In	Out
3	33	612	4	17	Out	Out	Out	Out	In	In	In

*Standard settings are Sw 1-1/1-2=Drive 1 and Sw 1-3/1-4=Drive 0. Swap for Super BIOS. Sw 5-8 should be out for BIOS tables 0, 1 & 2; valid for Super BIOS only.

WD 1002A-27X

RLL; half-size. Unavailable from March, 1989.

Translation Mode for 17 secs/track—30 Mb/< 663 Cyls, 4 Hds:	W1, W2 On
> 663 Cyls, with Dynamic Formatting (e.g physical CHS):	W1, W2 Off

WD 1002A-FOX

Supports up to 4 drives; 360 and/or 720K should be external. Not with Perstor 180. There are four versions:

- F 001 supports two drives internally with no BIOS.
- F 002 supports four drives (two internal/two external) with no BIOS.
- F 003 supports two drives internally with the BIOS.
- F 004 supports four drives (two internal/two external) with BIOS.

W1	1-2	High density to J2 pins 2 and 3		
	2-3	Ground return J2 pins 2 and 3		
W2, W3	ROM BIOS Address	W2	2-3	EE000-EFFFF
		W3	2-3	
		W2	2-3	CE000-CFFFF
		W3	1-2	
		W2	1-2	EC000-EDFFF
		W3	2-3	

		W2	1-2	CC000-CDFFF
		W3	1-2	
W4	1-2	Secondary addresses 3F0-377		
	2-3	Primary addresses 3F0-3F7		
W5	1-2	Optional +5V to external drive; +5V to J2 pin 4		
	2-3	No connection. Storage position only		
W6	1-2	Optional +12V to external drive		
	2-3	No connection. Storage position only		
W7	1-2	Dual speed spindle support		
W8	1-2	Connects logic ground to chassis ground		
SW1		**1,3,5,7**	**2,4,6,8**	**Drive Type**
		OFF	OFF	360K
		OFF	ON	1.2 Mb
		ON	OFF	720K
		ON	ON	1.44 Mb
		1-1 and 1-2 indicates first drive 1-2 and 1-4 indicates second drive 1-5 and 1-6 indicates third drive 1-7 and 1-8 indicates fourth drive.		

WD 1002-HX4

Used in Compaq Deskpro.

Drive Type	*SW1/1*	*SW1/2*	*SW1/3*	*SW1/4*
10 Mb	On	On	On	On
20 Mb	On	Off	On	On
30 Mb	On	On	Off	Off

WD 1002-WAH

MFM

W1	1-2	Primary address*
	2-3	Secondary address, 170-177 and 376-377
W2	L	Latched mode—LED constantly on*
	NL	Non-Latched Mode—current drive is selected only when controller is communicating with it, and LED only lights when drive is accessed. Used for Compaqs.

WD 1002A-WA2

E1-E2	Floppy secondary addresses, 372 and 374-377
E2-E3	Floppy primary addresses*

E4-E5	HD secondary addresses, 170-177 and 376-377
E5-E6	HD primary addresses*
E7-E8	Must be installed.

WD 1002A-WX1

MFM. If U12, the BIOS ROM, is part number 62-000094-followed by any three numbers, you have the SUPERBIOS, so the WD1002A-WX1 works in ATs.

W1		Not used
W2		Not used
W3	In	BIOS Enabled
W4	1-2	Device Address 324H
	2-3	Device Address 320H
W5	1-2	32 or 64K BIOS ROM (solder connection)
	2-3	16K BIOS ROM (solder connection)
W6	1-2	Head Sel 3 (16 heads)
	2-3	RWC (8 Heads)
W7	1-2	IRQ 5
	2-3	IRQ 2
W8	1-2	Second disk controller—modify W4
	2-3	First controller*

S1 Jumper Settings

	10 Mb/306 x 4	*10 Mb/615 x 2*	*20 Mb/615 x 4*
1-1	Open	Closed	Open
1-2	Closed	Open	Open
1-3	Open	Closed	Open
1-4	Closed	Open	Open
1-5	Open	Open	Open
1-6	Open	Open	Open
1-7	Open	Open	Open
1-8 (XT Mode)	Open	Open	Open
1-8 (AT Mode)	Open	Open	Open

WD 1002(A)-WX2

Drive Tables

Full size, and the WD1002-WX2 a half-card; otherwise, they're both the same. *Drive 1 **Drive 2

BIOS Table	*Cap*	*Cyls*	*Hds*	*E5-6**	*E7-8**	*E9-10***	*E11-12***
0	10	306	4	In	In	In	In

1	10	612	2	In	Out	In	Out
2	20	612	4	Out	In	Out	In
3	31	640	6	Out	Out	Out	Out

Switch Settings

SW1	5	In	IRQ 2*
		Out	IRQ 5
	6		Reserved
	7		Reserved
	8		Reserved

WD 1002S-WX2A

MFM

W1		Not used
W2		Not used
W3	In	BIOS Enabled
W4	1-2	Device Address 324H
	2-3	Device Address 320H
W5	1-2	32 or 64K BIOS ROM
	2-3	16K BIOS ROM
W6	1-2	Head Select 3 (16 heads)
	2-3	RWC (8 Heads)
W7	1-2	IRQ 5
	2-3	IRQ 2
W8	2-3	Standard setting
W9	1-2	CO23 setting
W10	2-3	Standard configuration
	1-2	Special feature
Sw 1-5	Out	No translation
	In	Not allowed
Sw 1-6	Out	17 sectors per track
	In	Not allowed
Sw 1-7	Out	IRQ 5
	In	IRQ 2; requires modification of W7 and custom BIOS.
Sw 1-8	Out	XT Mode
	In	AT Mode

SW1 settings for Rev G/H

BIOS Table	*Cap*	*Cyls*	*Hds*	*WPC*	*1-1*	*1-2*	*1-3*	*1-4*
0	20	612	4	0	In	In	In	In
1	10	612	2	128	Out	In	Out	In

2	20	612	4	128	In	Out	In	Out
3	10	612	4	None	Out	Out	Out	Out

SW1 settings for Super BIOS

BIOS Table	*Cap*	*Cyls*	*Hds*	*WPC*	*1-1*	*1-2*	*1-3*	*1-4*
0	20	612	4	450	In	In	In	In
1	10	306	4	0	Out	In	Out	In
2	10	615	2	450	In	Out	In	Out
3	10	615	4	450	Out	Out	Out	Out

WD BIOS 62000042-15 (Rev H)

BIOS Table	*Drive 1*			*Drive 1*						
	1	2	7	3	4	8	Cap	Cyls	Hds	WPC
0	In	In	In	In	In	In	43	977	5	None
1	Out	In	In	Out	In	In	32	733	5	300
2	In	Out	In	In	Out	In	33	640	6	None
3	Out	Out	In	Out	Out	In	62	1024	8	1024
4	In	In	Out	In	In	Out	43	820	6	None
5	Out	In	Out	Out	In	Out	10	612	2	128
6	In	Out	Out	In	Out	Out	20	612	4	128
7	Out	Out	Out	Out	Out	Out	10	306	4	0

WD 1003-GRY

Used in IBM XT286; no jumpers.

WD 1003-WA2

MFM. Revision E044 can operate with bus speeds up to 12MHz.

E1-E2	Secondary floppy addresses
E2-E3	Primary floppy addresses,
E4-E5	Secondary HD addresses
E5-E6	Primary HD addresses
E7-E8	360 RPM floppies
E8-E9	300 RPM floppies

WD 1003-WAH

MFM

W1	Out	Status Read is non-latched. Dynamic drive select; i.e. SELECT = DRIVE BUSY. Used for Compaq hosts.

		In*	Status Read is latched. Static drive select (SELECT asserted except during RESET).
W2		Out*	Primary address
		In	Secondary address
W3		Out	Used with WD11C00C-22, or if W5 1-2 is jumpered.
		In	Required only on early units with WD11C00-22 and W5 1-2 jumpered. Do not jumper with the WD11C00C-22 installed.
W4	1-2		Supports 615 x 2 second drive with system set for 4 head, 306 cylinder drive
	2-3		Ties firmware sense bit input high*
W5	1-2		Internal signal Power-up circuit controls WG enable
	2-3		Standard factory setting
W6	1-2		Ties input low; 16 msec step rate; not 35 msec.
	2-3		Ties input high*

WD 1003-RA2

RLL

W1	1-2		Used with a WD11C00C-22 at U16
	2-3		Required only on early units with WD11C00-22 and W5 1-2 jumpered. Do not jumper with the WD11C00C-22 installed.
W2	1-2	Out	No translation for drive 0.
		In	Translation enabled. Select a 615 cylinder and six head drive type through Setup.
	3-3	Out	No translation for drive 1.
		In	Translation enabled. Select a 615 cylinder and six head drive type through Setup.
W3	1-2	In	Standard setting; do not use.
	3-4	In	Standard setting; do not use.
W4	3-5		HD primary address, 1F0-1F7
	1-3		HD secondary address, 170-177
	4-6		Floppy primary address, 3F0-3F7
	2-4		Floppy secondary address, 370-377
W5	1-2*		Closed by etch on solder side. Controls drives with a maximum of eight heads or RWC.
	2-3		Closed by etch on solder side. Controls drives with a maximum of 16 heads.
W6			Removed from final release
W7	1-2		Dual speed floppies
	2-3		300/360 RPM floppies (single speed)

E1-E2	Secondary HD address; 170-177
E2-E3	Primary HD address; 1F0-1F7
E4-E5	Secondary floppy address, 370-377
E5-E6	Primary floppy address, 3F0-3F7
E7-E8	300/360 RPM floppies (single speed)
E8-E9	Dual speed floppies

WD 1003A-WA2

MFM. See WD 1003A-RA2.

WD 1003-RAH

RLL

W1	1-2	Out	Non-latched Mode; HD LED only on during drive access; used for Compaqs.
		In	Latched mode; HD LED permanently on; used for ATs
W2	3-4	Out	Primary Addresses*, 1F0-1F7, 3F0-3F7
		In	Secondary Addresses, 170-177, 370-377
W4	1-2	In	No translation for drive 0*
	2-3	In	Enables drive 0 translation to 17 s/track; only available for drives with 615 cyls/4 hds. Select a drive with 6 heads in CMOS setup.
W5	1-2	In	WG and drive select lines are disabled during power up reset and when +5v power supply drops below approx +4.15v.
	2-3	In*	WG and drive select lines only enabled when drive.
W6	1-2	In	No translation for drive 1*.
	2-3	In	Enables drive 1 translation to 17 secs per track; only available for drives with 615 cyls/4 hds. Select a drive with 6 heads in CMOS setup.
W7	1-2 3-4*		Operates with daisy-chained drive(s) Both can be daisy-chained from J1, or drive 0 can be connected to J1 and drive1 to J5. Set first drive as 0 and second as 1.
	1-3 2-4		Operates with parallel connected drives. Attach drive 1 to J1, drive 0 to J5. Set both drives as 0.
W8	1-2		Ties input high*
1	2-3		Enables seek to landing zone (cylinder663) on any seek to cylinder drives. Also changes step rate 0 (24msec) to step rate 15 (11 msec).

WD 1003(V)-MM1/2

MFM

W1	1-2	Out	Latched mode*; HD LED permanently on; used for ATs
		In	Non-latched mode; HD LED only on during drive access; used for Compaqs.
	3-4	Out	ECC 4-byte Enabled*
		In	Reserved
	5-6	Out	Cacheing enabled*
	7-8	Out	Incompatible with WD 1003-WA2/H
		In	Compatible with WD 1003-WA2/H (> 8 Hds). The WD1003-WAH numbers heads 8-15 as 0-7.
W3		In	HD Secondary Address
		Out	HD Primary Address*
W4		In	Floppy Secondary Address
		Out	Floppy Primary Address*
W5		In	Dual Speed Floppies

	Out	Single Speed Floppies
W6	In	Bracket grounded

WD 1003V-SR1/2—RLL

W1	1-2	Out	Latched mode*; HD LED permanently on; used for ATs
		In	Non-latched mode; HD LED only on during drive access; used for Compaqs.
	3-4	Out	ECC 4-byte*
		In	ECC 7-byte
	5-6	Out	Cacheing enabled*
W2	1-2	In	BIOS disabled
		Out	BIOS enabled*
W3		In	HD Secondary Address
		Out	HD Primary Address*
W4		In	Floppy Secondary Address
		Out	Floppy Primary Address*
W5		In	Dual Speed Floppies
		Out	Single Speed Floppies
W6		In	Bracket grounded

WD 1004A-27X

RLL. Half size. The A version cannot be used as a secondary controller.

R23	Out*	Internal BIOS
	In	External BIOS
W27	Out	IRQ5*
	In	IRQ2
W28	Out	XT Mode
	In	AT Mode

Drive Tables

*1st drive **Second drive

BIOS Table	*Cap*	*Cyls*	*Hds*	*W17**	*W18**	*W19***	*W20***
0	65	820	6	In	In	In	In
1	42	782	4	Out	In	Out	In
2	21	782	2	In	Out	In	Out
3	32	615	4	Out	Out	Out	Out

Address and BIOS ranges

BIOS Address	*I/O Address*	*W21*	*W22*
C8000-C9FFF	320-323	Out*	Out*
CA000-CBFFF	324-327	In	Out

CC000-CDFFF	328-32B	Out	In
CE000-CFFFF	32C-32F	In	In

Sector Settings/Translation

Table	*Cap*	*Sectors*	*Translate*	*Dynamic*	*W25*	*W26*
RLL	65	17	Yes	No	In*	Out*
RLL	42	26	No	Yes	Out	In

WD 1004A-WX1

MFM

Drive Tables

BIOS Table	*Cap*	*Cyls*	*Hds*	*W17**	*W18**	*W19***	*W20***
0	21	612	4	In	In	In	In
1	10	306	4	Out	In	Out	In
2	10	615	2	In	Out	In	Out
3	21	615	4	Out	Out	Out	Out

Address and BIOS ranges

BIOS Address	*I/O Address*	*W21*	*W22*
C8000-C9FFF	320-323	Out*	Out*
CA000-CBFFF	324-327	In	Out
CC000-CDFFF	328-32B	Out	In
CE000-CFFFF	32C-32F	In	In

Sector Settings/Translation

Table	*Cap*	*Sectors*	*Translate*	*Dynamic*	*R25*	*R26*
RLL	65	17	Yes	No	In*	Out*
RLL	42	26	No	Yes	Out	In

WD 1005-WAH

ESDI

W1	Out*	Not used
	In	Test setting for OEM
W2	Out	Translation mode enabled (MS-DOS compatible).
	In	Translation mode disabled.
W3	2-3*	Primary address
	1-2	Secondary address

WD 1006-RAH

RLL

W1	1-2	In	Supports 16 heads. No RWC		
	2-3	In	Supports 8 heads and RWC		
W2		Out	No wait states requested		
W3	1-2	In	Primary Ports*		
	2-3	In	Secondary ports		
W4	1-2	In	LED not latched; LED lights for drive select. Remove W10 if this installed.		
W5,W6			**BIOS Address**	**W5**	**W6**
			C800*	In	In
			CA00	In	Out
			CC00	Out	In
			Disabled Out	Out	
W7	1-2	In*	Enables BIOS		
W8	1-2	Out*	4-byte ECC		
		In	7-byte ECC		
W9		Out*	Enables cacheing		
W10	1-2	Out*	Non-latched mode		
		In	Latched mode		

WD 1006-WAH

W1	1-2	In*	Supports 16 heads. No RWC
	2-3	In	Supports 8 heads and RWC
W2	1-2		Not used with F001 (no wait state hardware)
W3	1-2	In	Primary Ports*
	2-3	In	Secondary ports
W4	1-2	In	Drive LED is not latched. Remove W10 if this is installed.
W5-W8		Out	Reserved for WD 1006-RAH
W9	1-2	In	On F001 disables cacheing
W10		Out	Non-latched mode (factory setting).
W11		Out	Isolates mounting bracket from board logic ground

WD 1006(S)-WAH

Half-size, with surface mount technology (SMT).

W1	1-2	In	Drive LED is non-latched*. Remove W6 if this is installed.
		Out	Drive LED is latched.
W2	1-2		Supports 16 heads. No RWC*
	2-3		Supports 8 heads and RWC
W3	1-2	Out	Cacheing enabled*
W4	1-2	In	Connects mounting bracket to board logic ground

W5	1-2	In	Selects primary ports. Etch connects pins 1 and 2.*
	2-3	In	Selects secondary ports. Requires cutting etch between pins 1 and 2 and installing a jumper.
W6	1-2	Out	Non-Latched mode*

WD 1006V-MC1

MFM. For PS/2 Model 50, 60, 80 systems. V boards can run in high speed AT systems (10-16 Mhz). If you have one ESDI and one ST506 drive, the Micro Channel architecture selects the ESDI drive as C, regardless of the order in which you installed or identified them.

WD 1006V-MCR

RLL. See WD 1006C-MC1.

WD 1006V-MM1/2

MFM. You can't disable the floppy controller. Supplied with Speedkit.

W1	1-2	In	Non-latched Mode (LED on when drive accessed)
		Out	Latched mode* (LED always on)
	3-4	Out	ECC 4-byte Enabled*
		In	Reserved
	5-6	Out	Cacheing enabled*
	7-8	Out	Incompatible with WD 1003-WA2/H
		In	Compatible with WD 1003-WA2/H (> 8 Hds). The WD1003-WAH numbers heads 8-15 as 0-7.
W3	1-2	In	HD Secondary Address
		Out	HD Primary Address*
W4	1-2	In	Floppy Secondary Address
		Out	Floppy Primary Address*
W5	1-2	In	Dual Speed Floppies
		Out	Single Speed Floppies
W6	1-2	In	Bracket grounded

WD 1006V-SM1/SM2

See WD 1006V-MM1/MM2.

WD 1006V-SR1/2

RLL

W1	1-2	In	Non-latched Mode
		Out	Latched mode*
	3-4	Out	ECC 4-byte*

		In	ECC 7-byte
	5-6	Out	Cacheing enabled*
W2	1-2	In	BIOS Disabled
		Out	BIOS Enabled
W3	1-2	In	HD Secondary Address
		Out	HD Primary Address*
W4	1-2	In	Floppy Secondary Address
		Out	Floppy Primary Address*
W5	1-2	In	Dual Speed Floppies
		Out	Single Speed Floppies
W6	1-2	In	Bracket connected to board ground

WD 1007-WA2

ESDI

W1, W2	In	**BIOS Address**	**W1**	**W2**
		C8000-C9FFF	2-3	2-3
		CA000-CBFFF	2-3	1-2
		CC000-CDFFF	1-2	2-3
		CE000-CFFFF	1-2	1-2
W3	Out	BIOS disabled		
W4	Out	Floppy disabled		
W5	Out	Single speed floppy		
W6	2-3	Floppy address select (3FX)		
W7	1-2	Floppy drive type		
W8	Out*	WD1007 Mode. Firmware forces a 10 MHz drive to 35 secs/track when using the Set Unformatted Bytes per Sector command. This mode supports a 1:1 interleave.		
	In	Allows the WD1007A-WA2 to be used as a replacement board for the WD1005-WAH without reformatting the drive. The controller reads the Unformatted Bytes Per Sector from the drive.		
W9	Out	Chassis ground disconnected		
W10	Out*	Digital Input Register unlatched		
W11	Out	Diskette change enable (with FDC Option)		
W12	Out	Secondary sddress select (1FX)		
W14	Out	Sector Translation Enabled		
W15	Out*	7-byte ECC		
	In	4-byte ECC		

WD 1007A-WA2

ESDI. Feature 0 (F000) does not have the BIOS.

W1,W2	In	**BIOS Address**	**W1**	**W2**
		C8000-C9FFF	2-3	2-3

			CA000-CBFFF	2-3	1-2
			CC000-CDFFF	1-2	2-3
			CE000-CFFFF	1-2	1-2
	3-4	Out	ECC 4-byte*		
		In	ECC 7-byte		
	5-6	Out	Cacheing enabled*		
W3	1-2	In	BIOS Disabled		
		Out	BIOS Enabled		
W4	1-2	Out	Floppy enabled		
W5		Out	Single Speed Floppy (125 ns precomp)*		
		In	Dual Spindle Speed Floppy		
W6	1-2		Floppy Address Select (37X)		
	2-3		Floppy Address Select (3FX)*		
W7	1-2		Floppy Drive Select		
W8		Out*	WD1007 Mode. Forces 10 MHz ESDI drive to 35 secs per track when using the Set Unformatted Bytes Per Sector command. Supports 1:1 interleave.		
		In	Can be used as replacement board for the WD1005-WAH without reformatting drive. Controller reads Unformatted Bytes/Sector from drive.		
W9	1-2	Out	Chassis ground disconnected		
W10		Out*	Digital Input Register Unlatched		
W11		In*	Diskette Change Enable (with FDC Option)		
W12		Out*	Secondary Address Select (1FX)		
W13		In	Floppy Controller Enabled (Etch)		
W14		Out*	Sector Translation Enabled		
W15		Out*	4 bytes ECC		
		In	7 bytes ECC		

WD 1007A-WA4

ESDI. Supports only hard sectored drives.

W1	1-2		Primary floppy address (3FX)*			
	2-3		Disable Floppy controller			
	3-4		Secondary floppy address (37X)			
W2	1-2		Primary hard disk address (1FX)*			
	2-3		Secondary hard disk address (17X)			
W3	1-2		Primary parallel port address (37X)			
	2-3		Disable parallel port			
	3-4		Secondary parallel port address (27X)			
W4	1-2		Primary serial port address (3FX)*			
	2-3		Disable serial port			
	3-4		Secondary serial port address (2FX)			
W9		Out*	Digital input register, non-latched			
		In	Digital input register, latched			
W13			**W13**	**W14**	**W15**	**Function**

W14			off	xx		BIOS disabled
W15			on	1-2	1-2	CE00-CFFF
			1-2	2-3		CC000-CDFFF
			2-3	1-2		CA000-CBFFF
			2-3*	2-3		C8000-C9FFF
W16	1-2	Out*	WD 1007 mode (always 35 sectors per track)WD 1005 mode			
		In				
	3-4	Out*	Translation enabled			
		In				
	5-6	Out*	4 bytes ECC7 bytes ECC			
		In				

WD 1007A-WAH

ESDI. Hard sector mode only. Feature 0 (F000) does not have the BIOS.

W1,W2		In	**BIOS Address**	**W1**	**W2**
			C8000-C9FFF	2-3	2-3
			CA000-CBFFF	2-3	1-2
			CC000-CDFFF	1-2	2-3
			CE000-CFFFF	1-2	1-2
W3	1-2	In	BIOS Disabled		
		Out	BIOS Enabled		
W8	1-2	Out*In	WD 1007 mode (always 35 sectors per track)WD 1005 mode.		
W9		Out*	Chassis Ground Disconnected		
W10	5-6	Out*	Digital input register, non-latched		
W11		Out	Diskette Change Enable w/FDC Option		
W12		Out	Secondary hard disk address (1FX)		
W14		Out	Sector Translation Enabled		
W15		Out*	4 Bytes ECC*		
		In	7 Bytes ECC		

WD 1007V-SE1/SE2

ESDI. If replacing a WD1007A with a WD1007V, install jumpers on W1 9-10/11-12 to save reformatting.

W1	1-2	In	Look ahead cacheing disabled.
	3-4	In	7-byte ECC
		Out	4-byte ECC (most common)
	5-6	In	Controller uses true physical values of the drive.
		Out*	Translation enabled

	7-8	Out*	Reserved
	9-10	In	Forces drive to 35 SpT,but not on drives with transfer rates of 15 Mbits/sec.
		Out	Controller uses physical SpT as determined by the drive's jumper settings.
	11-12	In	Alternate sectors per track are provided, for operating systems which can accommodate only a certain number of errors. You will lose drive capacity.
W3	1-2	In	Disable BIOS
W5	1-2	In	Dual speed floppies
		Out	Single speed floppies
W6	1-2	Out*	Primary floppy address, 3F2-3F7
		In	Secondary floppy address, 372-377
W7	1-2	In	IRQ 14
	2-3	In	IRQ 15
W8	1-2	In	BIOS address C8000-CFFFF
	2-3	In	BIOS address CC000-CFFFF
W12	1-2	In	Primary HD address, 1F0-1F7
		Out	Secondary HD address, 170-177

WD 1009V-SE1/SE2

ESDI (EISA). There are two models; The -SE2 controls floppies as well. The enhanced EISA version has a chip at U51 capable of EISA Auto configuration.

W2	1-2		Centre twisted floppy cable				
	2-3		End twisted floppy cable				
W3	1-2		AT type 1.4 Mb				
	2-3		PS/2 type 1.4 Mb				
W4		Out	Card always enabled				
		In	Card enabled by EISA host				
W5	1-2	In	Alternate sectors enabled; reserves 1 sect/track for bad sector swapping.				
	3-4	In	Translation disabled.				
	5-6	In	Physical sectors per track				
		Out*	Force 35/53 sectors per track on 10/15 Mb/s drives.				
	7-8	Out*	4-byte ECC				
		In	7-byte ECC; only used for certain diagnostics.				
	9-10	In	Look ahead cacheing disabled.				
		Out*	Look ahead cacheing enabled.				
	11-12	In	Secondary BIOS address CC00				
		Out*	Primary BIOS address C600				
	13-14	In	Disable BIOS				
	15-18	In	**IRQ**	**15**	**16**	**17**	**18**
			14	0	0	0	0
			11	1	1	1	1
			12	1	1	0	0

			15 0 0 1 1
	19-20	Out*	DMA channel 6
		In	DMA channel 7
	21-22	Out*	Primary HD address, 1F0-1F7
		In	Secondary HD address, 170-177
	23-24	Out*	HD controller enabled
W6	1-2	Out*	Floppy enabled
	3-4	Out*	Floppy DMA channel 2
		In	Floppy DMA channel 3
	5-6	Out*	Primary floppy address, 3F0-3F7
		In	Secondary floppy address, 370-377
	7-8	Out*	Single speed floppy
		In	Dual speed floppy
W7		Out*	EISA auto-configuration disabled

WDAT-140

W1	1-2	3-4	
	Out*	In*	DIRQ 14 passed directly to host
	In	Out	For CP 342 or 3022 in IBM AT; DIRQ 14 gated to host.

WDAT-240

W1	1-2	Out	DIRQ 14 passed directly to host
	3-4	In	
W2	1-2	In	Floppy primary address 3F0-3F7
	3-4	Out	
	1-2	In	Floppy secondary address 370-377
	3-4	In	
	1-2	Out	Floppy address 370-377
	3-4	In	
W3	1-2	In	Dual speed floppy
		Out*	Single speed floppy
W4	1-2	In	Logic ground connected to chassis
		Out	Logic ground independent of chassis

WD 7000-FASST2

SCSI. Sold to Future Domain in 1991. Software from Columbia Data Products, called SST. The OEM version of the board is the 7000-ASC; the consumer version, with software, is called 7000-FASST, or 7000-FASST2.

W1	1-2	IRQ 3
	3-4	IRQ 4

	5-6	IRQ 5					
	7-8	IRQ 7					
	9-10	IRQ 9					
W2	1-2	DRQ 7					
	3-4	DRQ 6*					
	5-6	DRQ 5					
	7-8	DACK 7					
	9-10	DACK 6*					
	11-12	DACK 5					
	13-14	IRQ 15*					
	15-16	IRQ 14					
	17-18	IRQ 12					
	19-20	IRQ 11					
	21-22	IRQ 10					
W3		**I/O address**	**1-2**	**3-4**	**5-6**	**7-8**	**9-10**
		300	1	1	1	1	1
		308	0	1	1	1	1
		310	1	0	1	1	1
		318	0	0	1	1	1
		320*	1	1	0	1	1
		328	0	1	0	1	1
		330	1	0	0	1	1
		338	0	0	0	1	1
		340	1	1	1	0	1
		348	0	1	1	0	1
		350	1	0	1	0	1
		358	0	0	1	0	1
		360	1	1	0	0	1
		368	0	1	0	0	1
		370	1	0	0	0	1
		378	0	0	0	0	1
		380	1	1	1	1	0
		388	0	1	1	1	0
		390	1	0	1	1	0
		398	0	0	1	1	0
		3A0	1	1	0	1	0
		3A8	0	1	0	1	0
		3B0	1	0	0	1	0
		3BH	0	0	0	1	0
		3C0	1	1	1	0	0
		3C8	0	1	1	0	0
		3D0	1	0	1	0	0
		3D8	0	0	1	0	0
		3E0	1	1	0	0	0
		3E8	0	1	0	0	0

			3F0	1	0	0	0	0
			3F8	0	0	0	0	0
W4			**BIOS address**	**1-2**	**3-4**	**5-6**	**7-8**	
			C000	1	1	1	1	
			C200	0	1	1	1	
			C400	1	0	1	1	
			C600	0	0	1	1	
			C800	1	1	0	1	
			CA00	0	1	0	1	
			CC00	1	0	0	1	
			CE00	0	0	0	1	
			D000	1	1	1	0	
			D200	0	1	1	0	
			D400	1	0	1	0	
			D600	0	0	1	0	
			D800*	1	1	0	0	
			DA00	0	1	0	0	
			DC00	1	0	0	0	
			DE00	0	0	0	0	
W5	1-2	In	Terminator power					
W7	1-2	In	Dual Speed (300/360) floppy support					
		Out*	Single Speed floppies only (300 rpm)					
W8	1-2	In	Floppy write precomp 187 ns					
		Out*	Floppy write precomp 125 ns					
W6,W9			**Floppy support**	**W6**	**W9**			
			Disabled	1	1			
			w/hard card	0	1			
+W98		In*	BIOS enabled					
		Out	BIOS disabled (if 2nd card)					
+W99	1-2		Reserved					
	2-3		8Kx8 ROMs					
+W100			Reserved—must be jumpered					
+W200	1-2		1st floppy PS/2 type					
	2-3*		1st floppy AT/ANSI type					
+W201	1-2		2nd floppy PS/2 type					
	2-3*		2nd floppy AT/ANSI type					

WDXT-GEN

No jumpers to select. Discontinued March 1989.

WDXT-GEN2

Disable BIOS in AT&T 6300(T).

WDXT-GEN2

MFM

R23	In	External BIOS
	Out*	Internal BIOS
R27	Out*	IRQ5*
	In	IRQ2

Drive Tables

*First hard disk **2nd hard disk

BIOS Table	*Cap*	*Cyls*	*Hds*	*W17**	*W18**	*W19***	*W20***
0	21	612	4	In	In	In	In
1	10	306	4	Out	In	Out	In
2	10	615	2	In	Out	In	Out
3	21	615	4	Out	Out	Out	Out

Address and BIOS ranges

BIOS Address	*I/O Address*	*R21*	*R22*
C8000-C9FFF	320-323	Out*	Out*
CA000-CBFFF	324-327	In	Out
CC000-CDFFF	328-32B	Out	In
CE000-CFFFF	32C-32F	In	In

WD XT-GEN2 Plus

MFM

W25,W26	Out*	
	Out*	
W27	Out	IRQ5*
	In	IRQ2
W28	Out	XT Mode
	In	AT Mode

Drive Tables

*First hard disk **2nd hard disk

BIOS Table	*Cap*	*Cyls*	*Hds*	*W17**	*W18**	*W19***	*W20***
0	21	612	4	In	In	In	In
1	10	306	4	Out	In	Out	In
2	10	615	2	In	Out	In	Out
3	21	615	4	Out	Out	Out	Out

Address and BIOS ranges

BIOS Address	*I/O Address*	*W21*	*W22*
C8000-C9FFF	320-323	Out*	Out*
CA000-CBFFF	324-327	In	Out
CC000-CDFFF	328-32B	Out	In
CE000-CFFFF	32C-32F	In	In

WD XT-GEN2R

RLL

R23	In	External BIOS
	Out	Internal BIOS
R27	Out	IRQ5*
	In	IRQ2
R28	Out	XT Mode
	In	AT Mode

Drive Tables

*First hard disk **2nd hard disk

BIOS Table	*Cap*	*Cyls*	*Hds*	*R17**	*R18**	*R19***	*R20***
0	65	820	6	In	In	In	In
1	42	782	4	Out	In	Out	In
2	21	782	2	In	Out	In	Out
3	32	615	6	Out	Out	Out	Out

Address and BIOS ranges

BIOS Address	*I/O Address*	*R21*	*R22*
C8000-C9FFF	320-323	Out*	Out*
CA000-CBFFF	324-327	In	Out
CC000-CDFFF	328-32B	Out	In
CE000-CFFFF	32C-32F	In	In

Sector Settings/Translation

Table	*Sectors*	*Translate*	*Dynamic*	*R25*	*R26*
RLL	17	Yes	No	In*	Out*
RLL	26	No	Yes	Out	In

WD XT 150

IDE

W1	2-3	Primary BIOS address C800
	1-2	Secondary BIOS address C800
W2	1-2	Primary port address 320
	2-3	Secondary port address 324
W3	1-2	IRQ 5*
	2-3	IRQ 2

WDATXT-FASST

8-bit SCSI. Software from Columbia Data Products.

W1	All	Out	Single byte programmed I/O; slow but most reliable.				
	1-2	In	DMA 1				
	3-4	In	Demand driven I/O (aka Blind I/O). Fastest.				
	1-2	In	DMA 3				
	5-6	In					
W2			**I/O address**	**1-2**	**3-4**	**5-6**	**7-8**
			200	1	1	1	1
			220	0	1	1	1
			240	1	0	1	1
			250	0	0	1	1
			280	1	1	0	1
			200	0	1	0	1
			2C0	1	0	0	1
			2E0	0	0	0	1
			300	1	1	1	0
			320	0	1	1	0
			340	1	0	1	0
			360	0	0	1	0
			380	1	1	0	0
			3A0	0	1	0	0
			3C0	1	0	0	0
			3E0	0	0	0	0
			Try reversing the above!				
W3			**BIOS address**	**1-2**	**3-4**	**5-6**	**7-8**
			C800*	1	0	1	1
			CC00	0	0	1	1
			D000	1	1	0	1
			D400	0	1	0	1
			D800*	1	0	0	1
			DC00	0	0	0	1
W4	1-2		IRQ 2	Also W1 9-10			
	3-4		IRQ 3	Also W1 7-8, 9-10			
	5-6		IRQ 4	Also W1 11-12			
	7-8		IRQ 5	Also W1 7-8, 11-12			

	9-10		IRQ 6	Also W1 9-10, 11-12
	11-12		IRQ 7	Also W1 7-8, 9-10, 11-12
W5	1-2	Out	No signal lines tied between W1 and W2.	
	3-4	Out		
	1-2	In	W1/9-10 tied to W2/3-4	
	3-4	Out		
	1-2	Out	W1/11-12 tied to W2/3-4	
	3-4	In		

Xebec

Xebec 1210

ROM #106020

*First hard disk **2nd hard disk

BIOS Table	*Cyls*	*Hds*	*1*	*2*	*3*	*4*
0	306	2	In	In	In	In
1	375	8	In	Out	In	Out
2	375	6	Out	In	Out	In
3	306	4	Out	Out	Out	Out

ROM106022 #

*First hard disk **2nd hard disk

BIOS Table	*Cyls*	*Hds*	*1*	*2*	*3*	*4*
0	306	4	In	In	In	In
1	375	8	In	Out	In	Out
2	375	4	Out	In	Out	In
3	306	2	Out	Out	Out	Out

Xebec 1220

As for 1210, but has a floppy interface.

Notes

Tape Streamers

Wangtek

PC-02

Note: IRQ/DRQ/DACK as labelled on board.

I/O Address	1	2	3	4	5	6	7	8	9	10
200	1	1	1	1	1	1	1	1	0	N/A
238	1	1	0	0	0	1	1	1	0	N/A
280	1	1	1	1	1	1	0	1	0	N/A
288	1	1	0	1	1	1	0	1	0	N/A
2AC	1	0	0	1	0	1	0	1	0	N/A
300*	1	1	1	1	1	1	1	0	0	N/A
338	1	1	0	0	0	1	1	0	0	N/A
360	1	1	1	1	0	0	1	0	0	N/A
368	1	1	0	1	0	0	1	0	0	N/A

Notes

Memory/Multi I/O Cards

AST

Rampage! Mk 1

Prototype or initial release boards have only 1 switch block. Use **remm.sys**.

1-1 to 1-4	**1**	**2**	**3**	**4**	**IO Address**
	On	On	On	On	208
	On	On	On	Off	218*
	On	Off	On	Off	258
	On	Off	Off	On	268
	Off	On	Off	On	2AB
	Off	On	Off	Off	2B8
	Off	Off	Off	On	2E8
	Off	Off	Off	Off	Disabled
1-5 to 1-6	**5**	**6**	**Backfill Start Address**		
	Off	Off	0K		
	On	Off	64K		
	Off	On	256K		
	On	On	640K*		
1-7 to 1-8	**7**	**8**	**Banks used as Backfill**		
	On	On	0		
	Off	On	1*		
	On	Off	2		

	Off	Off	All
E1-E2	Dual Page Mode disabled		
E2-E3	Dual Page Mode enabled		
E8-E9	Parity Check enabled		

Rampage XT

Switch 1	**I/O Address**	**1**	**2**	**3**	**4**	
1 to 4		On	On	On	On	208
		On	On	On	Off	218*
		On	Off	On	Off	258
		On	Off	Off	On	268
		Off	On	Off	On	2AB
		Off	On	Off	Off	2B8
		Off	Off	Off	On	2E8
		Off	Off	Off	Off	Disabled
5 to 6	**Banks Installed**	**5**	**6**			
		On	On	0K		
		Off	On	1 (256K)		
		On	Off	2 (512K)		
		Off	Off	3 (768K)		
	7	On = Dual Page Mode enabled				
	8	On = Parity Check enabled				
Switch 2	**Start Address**	**1**	**2**	**3**	**4**	
1 to 4		Off	Off	Off	Off	0
		On	Off	Off	Off	64K
		Off	On	Off	Off	128K
		On	On	Off	Off	192K
		Off	Off	On	Off	256K
		On	Off	On	Off	320K
		Off	On	On	Off	384K
		On	On	On	Off	448K
		Off	Off	Off	On	512K
		On	Off	Off	On	576K
		Off	On	Off	On	640K

Rampage XT

Switch 1	1 to 4	**1**	**2**	**3**	**4**	
	Start Address	Off	Off	Off	Off	0
		On	Off	Off	Off	64K
		Off	On	Off	Off	128K
		On	On	Off	Off	192K
		Off	Off	On	Off	256K
		On	Off	On	Off	320K

		Off	On	On	Off	384K	
		On	On	On	Off	448K	
		Off	Off	Off	On	512K	
		On	Off	Off	On	576K	
		Off	On	Off	On	640K*	
	5 to 7	**5**	**6**	**7**	**Bk1**	**Bk2**	**Bk3**
	Banks Installed	Off	Off	Off	256K	256K	256K
		On	Off	Off	64K	256K	256K
		On	On	Off	64K	64K	256K
	8	On=parity check enable					
Switch 2	1 to 4	**1**	**2**	**3**	**4**		
	I/O Address	On	On	On	On	208	
		Off	On	On	Off	218*	
		Off	On	Off	On	258	
		On	Off	Off	On	268	
		On	Off	On	Off	2AB	
		Off	Off	On	Off	2B8	
		Off	Off	On	Off	2E8	
		Off	Off	Off	Off	Disabled	
	5-8	**5**	**6**	**7**	**8**		
	MemoryInstalled	On	On	On	Off	576K	
		Off	Off	Off	On	512K	
		On	Off	Off	On	448K	
		Off	On	Off	On	384K	
		On	On	Off	On	320K	
		Off	Off	On	On	256K	
		On	Off	On	On	192K	
		Off	On	On	On	128K	
		On	On	On	On	64K	
		Off	Off	Off	Off	0K	
	7	On = Dual Page Mode enabled					

Rampage/EGA AT

Switch 1	1 to 4	**1**	**2**	**3**	**4**	
	Back fill	On	On	On	On	128K*
		On	On	On	Off	256K
		On	On	Off	On	384K
		On	On	Off	Off	512K
		On	Off	On	On	640K
		On	Off	On	Off	768K
		On	Off	Off	On	896K
		On	Off	Off	Off	1024K
		Off	On	On	On	1152K
		Off	On	On	Off	1280K

		Off	On	Off	On	1408K
		Off	On	Off	Off	1536K
		Off	Off	On	On	1664K
		Off	Off	On	Off	1792K
		Off	Off	Off	On	1920K
		Off	Off	Off	Off	2048K
	5 to 8	**5**	**6**	**7**	**8**	**IO Add**
	I/O address	On	On	On	On	208
		On	On	On	Off	218*
		On	Off	On	Off	258
		On	Off	Off	On	268
		Off	On	Off	On	2AB
		Off	On	Off	Off	2B8
		Off	Off	Off	On	2E8
		Off	Off	Off	Off	Disabled
Switch 2	8	On=parity enabled				
	9	On=Dual Page Mode enabled				

Monographplus Graphics Board

1	Clock enable
2	COM 2 IRQ 3
3	COM 1 IRQ4

Rampage AT

Note: Each bank has two rows of chips. 2 Meg max.

Switch 1	1 to 4	**1**	**2**	**3**	**4**	
	Back fill	On	On	On	On	128K*
		On	On	On	Off	256K
		On	On	Off	On	384K
		On	On	Off	Off	512K
		On	Off	On	On	640K
		On	Off	On	Off	768K
		On	Off	Off	On	896K
		On	Off	Off	Off	1024K
		Off	On	On	On	1152K
		Off	On	On	Off	1280K
		Off	On	Off	On	1408K
		Off	On	Off	Off	1536K
		Off	Off	On	On	1664K
		Off	Off	On	Off	1792K
		Off	Off	Off	On	1920K
		Off	Off	Off	Off	2048K

	5 to 8	5	6	7	8	IO Add
	I/O address	On	On	On	On	208
		On	On	On	Off	218*
		On	Off	On	Off	258
		On	Off	Off	On	268
		Off	On	Off	On	2AB
		Off	On	Off	Off	2B8
		Off	Off	Off	On	2E8
		Off	Off	Off	Off	Disabled
Switch 2	1-7	Non-page memory				
	8	On=parity enabled				
	9	On=Dual Page Mode enabled				

I/O Plus II

Port Enable

C1	1st serial as COM 1
C2	1st serial as COM 2
S2	2nd serial as COM2
P2	LPT1 (LPT2 with IBM mono)
P1	LPT2 (LPT3 with IBM mono)
G	Game port enable

IRQ Block

7	Parallel (later boards only)
5C	Clock to IRQ 5
5S	2nd serial to IRQ 5
4	1st serial to IRQ 4 (COM 1)
3	1st serial to IRQ 3 (COM 2)
3S	2nd serial to IRQ 3 (COM 2)
2C	Clock to IRQ 2
2S	2nd serial to IRQ 2

I/O Mini

E1	Clock enable
E2	Parallel is LPT 1/2
E3	Parallel is LPT 2/3
E4	1st serial to IRQ 3 (COM 2)
E5	1st serial to IRQ 4 (COM 1)
E6	1st serial is COM 1
E7	1st serial is COM 2

E8	2nd serial port enabled (COM 2)
E9	2nd serial to IRQ 3 (COM 2)
E10	Parallel port IRQ 7 enable

I/O Mini II

E1	1-2 CTS
E2	1-2 DSR
E3	1-2 DCD
E4	1-2 CTS
E5	1-2 DCD
E6	1-2 DSR
E7	1-2 PCAT; 2-1 PCXT
E8	1st serial port enabled (COM 1)
E9	2nd serial (COM 2) disabled
E10	LPT 1 enabled
E11	LPT 2 disabled
E12	Game port enabled
E13	Clock/calendar enabled
E14	IRQ 3 for COM 2 (2nd serial port) disabled
E15	IRQ 3 for COM 2 (1st serial port) disabled
E16	IRQ 4 for COM 1 enabled
E17	IRQ 7 for parallel port (LPT 1) enabled
E18	Reserved, but in an AT, move E17 here to configure parallel for IRQ 5

MP Mini

DL1 On=Parity Enable

Shortpak

1 to 3	**1**	**2**	**3**		
Start Address	Off	Off	Off	64K	
	Off	Off	On	128K	
	Off	On	Off	192K	
	Off	On	On	256K	
	On	Off	Off	320K	
	On	Off	On	384K	
	On	On	Off	448K	
	On	On	On	512K	
4 to 6	**4**	**5**	**6**		
Memory size	On	On	On	576K	Bank 0 64K, 1,2 256K
	On	On	Off	512K	Bank 0,1 256K
	On	Off	On	384K	Bank 0,1 64K, 2 256K

	On	Off	Off	320K	Bank 0 64K, 1 256K
	Off	On	On	256K	Bank 0 256K
	Off	On	Off	128K	Bank 0, 1 64K
	Off	Off	On	64K	Bank 0 64K
	Off	Off	Off	0K	
8	On=Enable Parity				

FastRAM

1 to 5	**1**	**2**	**3**	**4**	**5**	
Memory size	On	On	On	On	On	128K*
	Off	On	On	On	On	256K
	On	Off	On	On	On	384K
	Off	Off	On	On	On	512K
	On	On	Off	On	On	640K
	Off	On	Off	On	On	768K
	On	Off	Off	On	On	896K
	Off	Off	Off	On	On	1024K
	On	On	On	Off	On	1152K
	Off	On	On	Off	On	1280K
	On	Off	On	Off	On	1408K
	Off	Off	On	Off	On	1536K
	On	On	Off	Off	On	1664K
	Off	On	Off	Off	On	1792K
	On	Off	Off	Off	On	1920K
	Off	Off	Off	Off	On	2048K
6	On=1					
Board No	Off=2					
7 to 10	**7**	**8**	**9**	**10**	**IO Add**	
I/O address	On	On	On	On	208	
	Off	On	On	On	218*	
	Off	On	Off	On	258	
	On	Off	Off	On	268	
	On	Off	On	Off	2AB	
	Off	Off	On	Off	2B8	
	On	Off	Off	Off	2E8	

SixPakPlus (Original)

1 to 3	**1**	**2**	**3**	
Start Address	Off	Off	Off	64K
	Off	Off	On	128K
	Off	On	Off	192K
	Off	On	On	256K
	On	Off	Off	320K

	On	Off	On	384K		
	On	On	Off	448K		
	On	On	On	512K		
4 to 6	**Bks Installed**		**4**	**5**	**6**	
Memory size	6		On	Off	On	384K
	5		On	Off	Off	320K
	4		Off	On	On	256K
	3		Off	On	Off	128K
	2		Off	Off	On	64K
	1		Off	Off	Off	0K
7	Not used					
8	On=Enable Parity					

Port Enable Jumpers

1	COM 1
2	COM 2
3	LPT 1
4	LPT 2
5	Game Port
6	Clock

Interrupts (earlier boards)

3S	COM 2 interrupt
4S	COM 1 interrupt
4, 5, 7, 2	CLK interrupt

Interrupts (later boards)

3	COM 2 interrupt
4	COM 1 interrupt
7	Printer interrupt

RS232 block (earlier boards)

1	CTS
2	DSR
3	DCD

RS232 block (later boards)

1	CTS True
2	CTS Normal
3	DSR True

4	DSR Normal
5	DCD True
6	DCD Normal

SixPakPlus (Mica)

1 to 3	**1**	**2**	**3**		
Start Address	Off	Off	Off	64K	
	Off	Off	On	128K	
	Off	On	Off	192K	
	Off	On	On	256K	
	On	Off	Off	320K	
	On	Off	On	384K	
	On	On	Off	448K	
	On	On	On	512K	
4 to 6	**4**	**5**	**6**		
Memory size	On	On	On	576K	Bank 0 64K, 1,2 256K
	On	On	Off	512K	Bank 0,1 256K
	On	Off	On	384K	Bank 0,1 64K, 2 256K
	On	Off	Off	320K	Bank 0 64K, 1 256K
	Off	On	On	256K	Bank 0 256K
	Off	On	Off	128K	Bank 0, 1 64K
	Off	Off	On	64K	Bank 0 64K
	Off	Off	Off	0K	
8	On=Enable Parity				

IRQ block

3	IRQ 3 – COM 2
4	IRQ 4 – COM 1
7	IRQ 7 – LPT 1

Port enable block

CM1	COM 1
CM2	COM 2
LP 1	LPT 1
LP 2	LPT 2
GME	Game Port
CLK	Clock/Calendar

RS 232C block

1	DSR True
2	DSR Normal

3	DCD True
4	DCD Normal
5	CTS True
6	CTS Normal

Megaplus II

S1 to S4	**1**	**2**	**3**	**4**	
Start	On	On	On	Off	64K
Address	On	On	Off	On	128K
	On	On	Off	Off	192K
	On	Off	On	On	256K
	On	Off	On	Off	320K
	On	Off	Off	On	384K
	On	Off	Off	Off	448K
	Off	On	On	On	512K
	Off	On	On	Off	576K
S5/S6	Used for split memory - normally off				
S7	On=parity enabled				
S8	Game port enable - not used				

Interrupts (Ancient)

2S	Serial 2 to IRQ 2
2C	Clock to IRQ 2
3S (3)	Serial 2 to IRQ 3 (COM 2)
3 (3S)	Serial 1 to IRQ 3 (COM 2)
4 (4S)	Serial 1 to IRQ 4 (COM 1)
4C	Clock to IRQ 4
5C	Clock to IRQ 5
5S	Serial 2 to IRQ 5
7C	Clock to IRQ 7

Serial/Clock

CS	Clock enable
C2	1st serial as COM 2
C1	1st serial as COM 1
S2	2nd serial as COM 2

Parallel

P1	Printer=LPT1 (or LPT 2 with IBM mono)
P2	Printer=LPT2 (or LPT 3 with IBM mono)

CC-432

1 to 2	**1**	**2**	**IO Add**
	On	On	300-30F
	Off	On	320-32F
	On	Off	340-34F
	Off	Off	360-36F
3	IRQ 7		
4	IRQ 8		
5	IRQ 5		
6	IRQ 4		
7	IRQ 3		
8	IRQ 2		

HotShot/286

1 to 3	**1**	**2**	**3**		
Cached area (base)	Off	Off	Off	disabled	
	On	Off	Off	0-256K	
	Off	On	Off	disabled	
	On	On	Off	disabled	
	Off	Off	On	disabled	
	On	Off	On	0-512K	
	Off	On	On	0-576K	
	On	On	On	0-640K	
4 to 7	**4**	**5**	**6**	**7**	
Cached area (extended)	Off	Off	Off	Off	disabled
	On	Off	Off	Off	C0000-CFFFF
	On	On	Off	Off	C4000-D3FFF
	Off	On	On	Off	CC000-DBFFF
	Off	Off	On	Off	D0000-DFFFF
	On	Off	On	Off	D4000-E3FFF
	On	On	On	Off	D8000-E7FFF
	On	On	On	On	DC000-EBFFF
	Off	On	On	On	E0000-EFFFF
	Off	Off	On	On	CC000-EFFFF
	On	Off	On	On	CC000-EFFFF A0000-AFFFF
	On	Off	Off	On	CC000-EFFFF A0000-B7FFFF
	On	On	Off	On	CC000-DBFFFF A0000-AFFFF
	Off	On	Off	On	CC000-DBFFF A0000-B7FFF
	Off	Off	Off	On	D0000-DFFFF A0000-B7FFF

220

E5	IRQ 3*
E6	IRQ 4
E7	IRQ 5
E8	IRQ 6
E9	IRQ 7
E10	DRQ 1
E11	DACK 1
E12	DRQ 3
E13	DACk 3

Scanner Cards

Canon

IX31F

For IX-12 scanner; half-size. The Mk I is full-size, with only two jumpers. Switches are On when down. Software is **ixhnd2.com**, from Canon, plus a device driver from scanner software.

SW5,SW6	**I/O address**	**SW5**	**SW6**			
	308-30F* 0	0				
	318-31F 0	1				
	1A8-1AF 1	0				
	Not selectable	1	1			
	1A8-1AF cannot be used on IBMs and compatibles.					
SW1,SW2	**Mem addr**	**SW1**	**SW2**	**SW3**	**SW4** (:0000-:0FFF)	
SW3,SW3	C000	1	1	1	1	
	C400	0	1	1	1	
	C800*	1	0	1	1	
	CC00	0	0	1	1	
	D000	1	1	0	1	(VGA)
	D400	0	1	0	1	(EGA)
	D800*	1	0	0	1	
	DC00	0	0	0	1	
	E000	1	1	1	0	

E400	0	1	1	0
E800	1	0	1	0
EC00	0	0	1	0
F000	1	1	0	0
F400	0	1	0	0
F800	1	0	0	0
FC00	0	0	0	0

Notes

Video Cards

Many VGA cards have a jumper setting to give 0 or 1 wait states for the memory on board; worth trying to get better performance, but not if your bus is running too fast. There may also be a jumper (particularly on Tridents—J7) that will run monitors at higher speeds, and one for switching between 8/16 bit. The BIOS in early IBM PCs (1981-82) cannot recognise advanced graphics adapters; as a rule of thumb, if there is more than 64K of memory on the board, you may have a problem.

Tandon/Taxan (plus others)

EGA

Switch 5 is for Int mode. Jumper is always 1-2.

	1	*2*	*3*	*4*
Mono	Off	Off	On	Off
CGA	Off	Off	Off	On
EGA	Off	On	On	Off

EGA Supreme

5, 6 and 7 must be set for the monitor type.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Mono	Off	On	On	Off	Off	On	Off	On

CGA	On	On	On	Off	On	On	Off	On
EGA	Off	On	On	Off	On	Off	Off	On
Comp	On	On	On	Off	On	On	Off	On

Trident

TVGA 9000

J7	On = Interlaced (default)
J9	8/16-bit operation

Unknown

ET 4000/W32P

JP1	1-2	IRQ2 enabled
	2-3	Disabled
JP2	1-2	DAC Snoop disabled
	2-3	Enabled
JP3	1-2	Delay command disabled
	2-3	Enabled

CD-ROM Cards

Hitachi

CD-IF14/18/35

/P:*address* (as specified above) required for device driver.

S7, 360	36F
S6, 340	34F
S5, 320	32F
S4, 300	30F
S3, 260	26F
S2, 240	24F
S1, 220	22F
S0, 200	20F

Notes

Sound Cards

Gravis

UltraSound Classic rev 2.1 - 3.74

Rev 2.1-2.4 has a joystick enable/disable jumper at JP 2.

Rev 3.4 - 3.74 uses software:

ultrinit -ej to enable and **ultrinit -dj** to disable.

Base I/O address:

Address	*4*	*5*	*6*	*7*
210	OFF	ON	ON	ON
220	ON	OFF	ON	ON
230	OFF	OFF	ON	ON
240	ON	ON	OFF	ON
250	OFF	ON	OFF	ON
260	OFF	ON	ON	OFF

The four other banks of jumpers were removed when a 16-bit recording daughterboard was added, and should all be set to **On Off On Off** if the daughterboard is not used.

Notes

Network Cards

AST

8-bit long card

IRQ	SW	1-1	1-2		
	IRQ 2*	On	On		
	IRQ 3	Off	On		
	IRQ 4	On	Off		
	IRQ 5	Off	Off		
Memory-Mapped	**SW**	**1-5**	**1-6**	**1-7**	**1-8**
Address Space	C0000-C3FFF	On	On	On	On
	C4000-C7FFF	Off	On	On	On
	C8000-CBFFF	On	Off	On	Off
	CC000-CFFFF*	Off	Off	On	On
	D0000-D3FFF	On	On	Off	On
	D4000-D7FFF	Off	On	Off	On
	D8000-DBFFF	On	Off	Off	On
	DC000-DFFFF	Off	Off	Off	On
	E0000-E3FFF	On	On	On	Off
	E4000-E7FFF	Off	On	On	Off
	E8000-EBFFF	Off	Off	On	Off

Coax II

Beta version has jumpers for IRQ.

Base I/O Address	**SW**	**1**	**2**
	02Dx	Off	Off
	06Dx	Off	On
	0ADx	On	Off
	0EDx	On	On
Segment & Control	**SW**	**3**	**4**
I/O Address	0250/0251	Off	Off
	0350/0351	Off	On
	0450/0451	On	Off
	0550/0551	On	On
IRQ	IRQ 2* 5		
	IRQ 3 6		
	IRQ 4 7		
	IRQ 5 8		

Star Port

E1 should always be installed

I/O Address	0380-038F	E2 Installed	
	0390-039F	E2 removed	
IRQ	**SW**	**1-1**	**1-2**
	IRQ 2*	On	On
	IRQ 3	On	Off
	IRQ 4	Off	On
	IRQ 5	Off	Off
DMA	**SW**	**1-3**	**1-4**
	1	On	On
	2	On	Off
	3	Off	On
	Not used Off	Off	

Novell/Eagle

NE 1000/NE2000

I/O	**I/O**	**W9**	**W10**	**W11**
	300	On	On	Off
	320	Off	On	Off
	340	On	Off	Off

	360	Off	Off	Off	
IRQ	**IRQ**	**W12**	**W13**	**W14**	**W15**
	2	On	Off	Off	Off
	3	Off	On	Off	Off
	4	Off	Off	On	Off
	5	Off	Off	Off	On

Western Digital

Each board has a RAM buffer of 8, 16, or 32 K that occupies memory space, the base address of which is set by your software.

EtherCard PLUS (WD8003E) with Boot ROM Socket (WD8003EBT)

Jumper	*Pins*	*Name*	*Function when selected*	
W1	1-2	Zero	Select 0 wait states for optimized Wait operation in a 6MHz AT (default is jumper removed, which ensures correct operation in faster AT bus systems). Ignored in XT bus systems.	
	3-4	I/O Base	3-4*5-6*9-10*	280
	5-6		5-6, 9-10 2A0	
	7-8		3-4, 9-10 2C0	
	9-10		9-10	2E0
			3-4, 5-6, 7-8	300
			5-6, 7-8	320
			3-4, 7-8 340	
W2	1-2		IRQ 7	
	3-4		IRQ 6	
	5-6		IRQ 5	
	7-8		IRQ 4	
	9-10		IRQ 3	
	11-12		IRQ 2	
W3	1-2	AUI/BNC	All jumpered for BNC (Thin Ethernet)	
	3-4		All off for AUI (Thick Ethernet)	
	5-6		W4 1-2 Ethernet Version	
	7-8		Out for Thin Ethernet and 802.3/V 2 Thick Ethernet*. In for Thick Ethernet v1.	
	9-10			
	11-12			
W5	1-2	Segment Length	In for 802.3 standard (185m)	
			Out for 300m extended	
W6	1-2	ROM	Open	C0000 (16K, 32K, 64K ROMs)
	3-4	Address	1-2	C4000 (16K ROMs)
	5-6		3-4	C8000 (16K, 32K ROMs)
	7-8		1-2, 3-4	CC000 (16K ROMs)
	9-10		5-6	D0000 (16K, 32K, 64K ROMs)

			1-2, 5-6 D4000 (16K ROMs) 3-4*, 5-6* D8000 (16K, 32K ROMs) 1-2, 3-4, 5-6 DC000 (16K ROMs) 7-8*,9-10* Disabled (disabled) Do not useC0000 or C4000 for Boot ROMs
W6 W9 W10	7-8, 9-10 2-3 2-3	ROM Size	Disabled
W6 W9 W10	Open 2-3 2-3	ROM Size	16K
W6 W9 W10	7-8 2-3 1-2	ROM Size	32K
W6 W9 W10	9-10 1-2 1-2	ROM Size	64K
W7 W8 W11	2-3* 2-3* 2-3*	RAM Buffer Size	8K RAM. Valid 8 K RAM base addresses are C0000, C2000, C8000, CA000, D0000, D2000, D8000, and DA000
W7 W8 W11	1-2 1-2 1-2	RAM Buffer Size	32K RAM. Valid 32 K RAM base addresses are C0000, C8000, D0000 and D8000

EtherCard PLUS with Boot ROM Socket (WD8003EB)

Jumper	*Name*	*Function when selected*		
W1	Init 280	If jumper is installed when power is turned on, I/O Base Address is temporarily set to 280. Setup Program must then be run to store new I/O Base Address, and jumper must be removed (*).		
W3	AUI/BNC	All jumpered for BNC (Thin Ethernet) All off for AUI (Thick Ethernet)		
W9	ROM		**Left**	**Right**
	Size	16 K(*)	Top	Top
		32 K	Bottom	Top
		64 K	Bottom	Bottom
		Jumpers are ignored if no ROM is installed		

EtherCard PLUS16 (WD8013EBT)

Jumper	*Name*	*Function when selected*
W0	Wait State 8-bit Access	Reduces wait states for 8-bit memory access from four to two.
	Wait State 16-bit Access	Reduces wait states for 16-bit memory access from 1 to 0. Both jumpers for bus speeds <8MHz. Default is both off. Ignored in XTs.

W1	I/O Add	200, 220, 240, 260, 280(*), 2A0				
W2	IRQ	10, 11 and 15 are not available in 8-bit bus systems. IRQ2/9 selects IRQ2 for 8-bit systems and IRQ9 for 16-bit.				
W3	AUI/BNC	All jumpered for BNC (Thin Ethernet). Off for AUI (Thick Ethernet)				
W6	ROM Memory Space	NONE(*), 16K, 32K, Space and 64K				
W9	ROM Size	16 K(*)	Left	Left		
		32 K	Left	Right		
		64 K	Right	Right		
		Jumpers are ignored if no ROM is installed.				
W15	ROM Base Address	Ignored when W6 is set to NONE.				
		Address	C4000	C8000	D0000	
		C0000				
		C4000		X		
		C8000			X	
		D0000				X
		CC000		X	X	
		D4000		X		X
		D8000(*)	X		X	
		DC000		X	X	X

EtherCard PLUS TP, LattisNet Compatible (WD8003WT)

Jumper	*Pins*	*Name*	*Function when selected*		
W1	1-2	Zero	Select zero wait states for optimized Wait operation in a 6MHz AT (default is jumper removed, which ensures correct operation in faster AT bus systems). Ignored in XT bus systems.		
	3-4	I/O Base	3-4*,5-6*,9-10*		280
	5-6		5-6, 9-10	2A0	
	7-8		3-4, 9-10	2C0	
	9-10		9-10		2E0
			3-4, 5-6, 7-8		300
			5-6, 7-8		320
			3-4, 7-8	340	
W2	1-2		IRQ 7		
	3-4		IRQ 6		
	5-6		IRQ 5		
	7-8		IRQ 4		
	9-10		IRQ 3		
	11-12		IRQ 2		
W3	1-2	AUI/RJ45	All jumpered for RJ 45 (UTP)All off for AUI (Thick Ethernet)		
	3-4				
	5-6				
	7-8				
	9-10				
	11-12				

W4	1-2	Ethernet Version	Out for Thin Ethernet and 802.3/V 2 Thick Ethernet*.In for Thick Ethernet v1.	
W5	1-2	Segment Length	In for 802.3 standard (185m)Out for 300m extended	
W6	1-2	ROM Address	Open	C0000 (16K, 32K, 64K ROMs)
	3-4		1-2	C4000 (16K ROMs)
	5-6		3-4	C8000 (16K, 32K ROMs)
	7-8		1-2, 3-4	CC000 (16K ROMs)
	9-10		5-6	D0000 (16K, 32K, 64K ROMs)
			1-2, 5-6	D4000 (16K ROMs)
			3-4*, 5-6* D8000 (16K, 32K ROMs)	
			1-2, 3-4, 5-6	DC000 (16K ROMs)
			7-8*,9-10* ROMs	Disabled Do not useC0000 or C4000 for Boot
W6	7-8, 9-10	ROM Size	Disabled	
W9	2-3			
W10	2-3			
W6	Open	ROM Size	16K	
W9	2-3			
W10	2-3			
W6	7-8	ROM Size	32K	
W9	2-3			
W10	1-2			
W6	9-10	ROM Size	64K	
W9	1-2			
W10	1-2			
W7	2-3*	RAM	8K RAM: C0000, C2000, C8000, CA000, D0000, D2000, D8000, and DA000	
W8	2-3*	Buffer Size		
W11	2-3*			
W7	1-2	RAM	32K RAM: C0000, C8000, D0000 and D8000	
W8	1-2	Buffer Size		
W11	1-2			

EtherCard PLUS10T for UTP - 10BaseT (WD8003W)

Jumper	*Name*	*Function when selected*		
W1	Init 280	If jumper is installed when power is turned on, I/O Base Address is temporarily set to 280. Setup Program must then be run to store new I/O Base Address, and jumper must be removed (*).		
W9	ROM Size		**Left**	**Right**
		16 K(*)	Top	Top
		32 K	Bottom	Top
		64 K	Bottom	Bottom
		Ignored if no ROM is installed.		
W20	Auto Polarity Correction	On(*), adapter automatically corrects for incorrect polarity on receive twisted pair. Off, receive twisted pair polarity must be correct to 10BaseT standard.		

W21	Link Integrity	10BaseT link integrity test between the adapter and a 10BaseT concentrator is performed with jumper removed (*). Not if jumper installed.

EtherCard PLUS/A For Micro Channel (WD8003ET/A)

Jumper	*Pins*	*Name*	*Function when selected*
W3	1-2 3-4 5-6 7-8 9-10 11-12	AUI/BNC	All jumpered for BNC. All off for AUI
W9 W10	2-3 Open	ROM Size	16K
W9 W10	2-3 1-2	ROM Size	32K
W9 W10	1-2 1-2	ROM Size	64K
W7 W8 W11	2-3* 2-3* 2-3*	RAM Buffer Size	8K RAM: C0000, C2000, C8000, CA000, D0000, D2000, D8000, and DA000
W7 W8 W11	1-2 1-2 1-2	RAM Buffer Size	32K RAM:C0000, C8000, D0000 and D8000

EtherCard PLUS/A for Micro Channel (WD8003E/A)

Jumper	*Name*	*Function when selected*		
W9	ROM Size		**W10**	**W9**
W10		16 K(*)	Top	Top
		32 K	Bottom	Top
		64 K	Bottom	Bottom
		Ignored if no ROM is installed.		

EtherCard PLUS10T/A for Micro Channel (WD8003W/A)

Jumper	*Name*	*Function when selected*		
W9	ROM		**W10**	**W9**
W10	Size	16 K(*)	Top	Top
		32 K	Bottom	Top
		64 K	Bottom	Bottom
		Ignored if no ROM is installed.		
W20	Auto Polarity Correction	When ON(*), the adapter automatically corrects for incorrect polarity on the receive twisted pair. When Off, the receive twisted pair polarity must be correct on the RJ-45		

		port according to the 10BaseT standard.
W21	Link Integrity	The 10BaseT link integrity test between the adapter and a 10BaseT concentrator is performed with the jumper removed (*). Not if the jumper is installed.

StarCard PLUS/A For Micro Channel (WD8003ST/A)

Jumper	*Pins*	*Name*	*Function when selected*
W9	2-3	ROM	16K
W10	Open	Size	
W9	2-3	ROM	32K
W10	1-2	Size	
W9	1-2	ROM	64K
W10	1-2	Size	

StarCard PLUS (WD8003S) and StarLink PLUS (WD8003SH)

Jumper	*Pins*	*Name*	*Function when selected*	
W1	1-2	Zero	Select zero wait states for optimized Wait operation in a 6MHz AT (default is jumper removed, which ensures correct operation in faster AT bus systems). Ignored in XT bus systems.	
	3-4	I/O Base	3-4*, 5-6*, 9-10*	280
	5-6		5-6, 9-10	2A0
	7-8		3-4, 9-10	2C0
	9-10		9-10	2E0
			3-4, 5-6, 7-8	300
			5-6, 7-8	320
			3-4, 7-8	340
W2	1-2		IRQ 7	
	3-4		IRQ 6	
	5-6		IRQ 5	
	7-8		IRQ 4	
	9-10		IRQ 3	
	11-12		IRQ 2	
W3	1-2	In	WD 8003S	
		Out	WD 8003SH (for compatibility with 802.3 1BASE5 StarLAN standard).	

Additional Jumpers On

StarLink PLUS Only (WD8003SH)

Jumper	*Pins*	*Name*	*Function when selected*	
W4	11-12	ROM Enable	On=enable	
W4		ROM Base Address	3-4*, 7-8*, 9-10*	C8000 (16K, 32K ROMs)-default
			7-8, 9-10	CC000 (16K ROMs)
			3-4, 5-6, 9-10	D0000 (16K, 32K, 64K ROMs)

			5-6, 9-10	D4000 (16K ROMs)
			3-4, 9-10	D8000 (16K, 32K ROMs)
W5	1-3, 2-4	ROM Size	16 K	
W6	1-3, 2-4*			
W5	1-3, 4-6	ROM Size	32 K	
W6	1-3, 4-6			
W5	3-5, 4-6	ROM Size	64K	
W6	3-5, 4-6			

Notes

Modems

Amstrad

MC 2400

IRQ 3	1 on	2 off
IRQ 4	1 off	2 on
Com 1	3 on	4 off
Com 2	3 off	4 on

Notes

Printer Switches

Epson

EPL 6000

*If on, pin 25 will be set to +5. Otherwise it is not used.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
RS 232C	Off	Off	Off	Off	*	Off	Off	On
RS 423A	Off	Off	Off	Off	Off	On	On	Off

LQ 2550

Has none.

LQ 800/1000

Switch	Function	Setting
2-1	Paper length	On=12"Off=11"
2-2	Not used	
2-3 2-4	Serial interface/parity settings	See table below
2-5 2-6	Baud rate	See table below

Switch	Function	Setting
2-7	Printer select	On=printer cannot be deactivated by software
2-8	Automatic Line Feed	On=Line Feed added to each Carriage Return
1-1 1-2 1-3	International Character Set	See table below
1-4	Large or small buffer	On=7K Off=1K
1-5	Letter Quality/Draft print	On=draft Off=LQ
1-6	Condensed characters	On=condensed
1-7	One-inch skipover	On=LQ leaves to and bottom margin of .5" and skips over perforations on each page.
1-8	Cut sheet feeder	On=feeder fitted

Country

	1-1	1-2	1-3
USA	On	On	On
France	On	On	Off
Germany	On	Off	On
UK	On	Off	Off
Denmark	Off	On	On
Sweden	Off	On	Off
Italy	Off	Off	On
Spain	Off	Off	Off

Interface Selection

	2-3	2-4
8-bit parallel	Off	Off
Serial, even parity	On	Off
Serial, odd parity	Off	On
Serial, non-parity	On	On

Baud rate

	2-5	2-6
300	Off	Off
1200	On	Off
4800	Off	On
9600	On	On

Panasonic

Switch	Function	Setting
SW 2	Printer Mode	See table below
SW3	Autofeed	On=LF added to each CR Off=It isn't
SW4	Skip perforation	On=3 line margin is skipped before and after perforations.
SW 5, 6, 7	International Character Set	See table below
SW 8	7/8 bit code selection	On=7 bit Off=8 bit

SW 1	SW 2	Printer Mode
On	On	Standard
Off	On	IBM Matrix
On	Off	IBM Graphics set G1
Off	Off	IBM Graphics set G2

SW 5	SW 6	SW 7	Intl Character Set	Form length
On	On	On	USA	11"
Off	On	On	France	12"
On	Off	On	Germany	11"
Off	Off	On	England	11"
On	On	Off	Denmark I	12"
Off	On	Off	Sweden	12"
On	Off	Off	Italy	12"
Off	Off	Off	Spain	12"

Samsung

SP 2412

Has none.

Notes

Pinouts

25-pin Parallel Port

Pin	*Description*	*Pin*	*Description*
1	-Strobe	10	-Acknowledge
2	Data Bit 0	11	Busy
3	Data Bit 1	12	Paper End
4	Data Bit 2	13	Select
5	Data Bit 3	14	-Auto Feed
6	Data Bit 4	15	-Error
7	Data Bit 5	16	-Init Printer
8	Data Bit 6	17	-Select Input
9	Data Bit 7	18-25	Signal Ground

Parallel PC-PC connections

Strobe	1 ---- 1	Strobe
Data 0	2 ---- 15	Error
Data 1	3 ---- 13	Slct
Data 2	4 ---- 12	PaperE
Data 3	5 ---- 10	Ack
Data 4	6 ---- 11	Busy
Ack	10 ---- 5	Data3
Busy	11 ---- 6	Data4
PaperE	12 ---- 4	Data2

Slct	13 ---- 3	Data1
AutoFd	14 ---- 14	AutoFd
Error	15 ---- 2	Data0
Init	16 ---- 16	Init
Slct In	17 ---- 17	SlctIn
Ground	25 ---- 25	Ground

25-pin Serial Port

Pin	*Description*	*Pin*	*Description*
1	Frame Ground	14	Secondary TD
2	Transmit Data	15	Transmit Clock
3	Receive Data	16	Secondary RD
4	Request To Send	17	Receive Clock
5	Clear To Send	18	Unassigned
6	Data Set Ready	19	Secondary RTS
7	Signal Ground	20	Data Terminal Ready
8	Data Carrier Detect	21	Signal Quality Detect
9	Data Set Test	22	Ring Indicator
10	Data Set Test	23	Data Signal Rate Select
11	Unassigned	24	Transmit Clock
12	Sec DCD	25	Unassigned
13	Sec CTS		

9-pin Serial Port

Pin	*Description*
1	DCD; Data Carrier Detect
2	RX; Receive Data
3	TX; Transmit Data
4	DTR; Data Terminal Ready
5	Signal Ground
6	DSR; Data Set Ready
7	RTS; Request To Send
8	CTS; Clear To Send
9	RI; Ring Indicator

Keyboard

	DIN		*Mini-DIN*
Pin	Description	Colour (maybe!)	Description
1	Clock	Orange	Data
2	Ground	Clear	Reset (n/c)

	DIN		*Mini-DIN*
3	Data	Red	Ground
4	5v	Yellow	5v
5	Reserved		Clock

Game Port

Pin	*Description*
1	+5v C
2	Button 0
3	Timer 0
4	Ground
5	Ground
6	Timer 1
7	Button 1
8	+5v DC
9	+5v DC
10	Button 2
11	Timer 2
12	Ground
13	Timer 3
14	Button 3
14	+5v DC

Power

Chips can accept 5% variations, but output from cheaper power supplies may be 10%.

Conn	*Pin*	*Colour*	*Description*
PS 8	1	White	Pwr Good
	2	Red	5v (AT) Key (XT)
	3	Yellow	12v
	4	Blue	-12v
	5	Black	GND
	6	Black	GND
PS 9	7	Black	GND
	8	Black	GND
	9	Green	-5v
	10	Red	5v
	11	Red	5v
	12	Red	5v
Towers	1	Red	5v
	2	Red	5v (Key)
	3	Red	5v

Conn	*Pin*	*Colour*	*Description*
	4	Black	GND
	5	Black	GND

Battery

Pin	*Description*
1	Ground
2	Not used
3	Key
4	6v DC

Video

EGA

Pin	*Description*
1	GND
2	Sec Red/Gnd
3	Primary Red
4	Primary Green
5	Primary Blue
6	Sec Green/Intensity
7	Secondary Blue/Mono video
8	Horizontal Sync
9	Vertical Sync

VGA

Pin	*Mono*	*Colour*	*SVGA*
1	None	Red	Red
2	Video	Green	Green
3	None	Blue	Blue
4	None	None	ID Bit 2 Gd
5	Self Test	Self Test	Self Test
6	None	Red rtn	Red rtn
7	Video grd	Green rtn	Green rtn
8	None	Blue rtn	Blue rtn
9	None	None	None
10	Digital grd	Digital grd	Digital grd
11	None	Digital grd	Digital grd
12	Connect 10	None	None

Pin	*Mono*	*Colour*	*SVGA*
13	Hsync	Hsync	Hsync
14	Vsync	Vsync	Vsync
15	None	None	None

Mono

Pin	*Description*
1	GND
2	GND
3	Not used
4	Not used
5	Not used
6	Intensity (out)
7	Video (out)
8	Horizontal Sync (out)
9	- Vertical Sync (out)

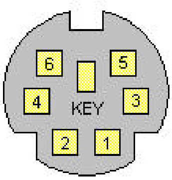
CGA

Pin	*Description*
1	GND
2	GND
3	Red (out)
4	Green (out)
5	Blue (out)
6	Intensity (out)
7	Reserved (out)
8	Horizontal Drive (out)
9	- Vertical Drive (out)

Mouse

6-pin connector (PS/2)

Pin	*Description*
1	Data
2	Reserved
3	Signal Ground
4	Power (+5v)
5	Clock
6	Reserved



9-pin connector

1	CD	Clocking
5	Ground	Signal Ground
3	CTS	Power (+5v)
4	RI	Data

Newton-PC

Newt		*PC*
4 (black/orange)	GROUND	1
8 (violet/violet)	GROUND	7
3 (orange/red)	data	2
5 (blue/yellow)	data	3
1 (yellow/black)	flow	4 (and 20)
		20 (to 4)
(green/brown)		5 (6, 8)

AUI (Dix)

Pin	*Description*
1	Ground
2	Collision Detect (+)
3	Transmit (+)
4	Ground
5	Receive Data (+)
6	Ground
7	Unused
8	Ground
9	Collision Detect (-)
10	Transmit (-)
11	Ground
12	Receive Data (-)
13	+12v DC
14	Ground
15	Unused

UTP (RJ 45)

Pin	*Description*
1	Transmit Data (+)
2	Transmit Data (-)
3	Receive Data (+)

4	Unused
5	Unused
6	Receive Data (-)
7	Unused
8	Unused

Modem (RJ 11)

Pin	*Description*
1	Not used
2	Not used
3	Input 1
4	Input 2
5	Not used
6	Not used

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The BIOS

Table of Contents

The BIOS

The instructions that turn a PC into a useful machine come in three stages, starting with application programs, which are loaded by an operating system, which in turn is loaded by a bootstrap loader by the BIOS, which stands for *Basic Input/Output System*. There are several in a PC, a good example being the one on the video card that controls the interface between it and the computer. However, we are concerned with the *System BIOS*, which is a collection of assembly language routines that allow programs and the components of a PC to communicate with each other at the hardware level. It therefore works in two directions at once and is active all the time your computer is switched on. In this way, software doesn't have to talk to a device directly, but can call a BIOS routine to do the job instead. However, these days the BIOS is often bypassed by 32-bit software - in fact, there are moves afoot to place its functions into the operating system, starting with Power Management (see *ACPI*).

For the moment, though, the BIOS will work in conjunction with the *chipset*, which is really what manages access to system resources such as memory, cache and the data buses, and actually is the subject of this book, as all those advanced settings relate to the chipset and not the BIOS as such.

On an IBM-compatible, you will find the BIOS embedded into a ROM on the motherboard, together with hard disk utilities and a CMOS setup program, although this will depend on the manufacturer. The ROM will usually occupy a 64K segment of upper memory at F000 if you have an ISA system, and a 128K segment starting at E000 with EISA or similar. It's on a chip so it doesn't get damaged if a disk fails, as sometimes used to happen on the Victor 9000/Sirius, which had both the BIOS and the system on the boot floppy.

Older machines, such as 286s, will have two ROMs, labelled *Odd* and *Even*, or *High* and *Low* (they must be in the right slots), because of the 16-bit bus, but these days there tends to be only one—look for one with a printed label (older 386s sometimes had 4). You can get away with one because BIOS code is often copied into *Shadow RAM* (explained later), and not actually executed from ROM, but extended memory. In addition, much of the code is redundant once the machine has started, and it gets replaced by the operating system anyway. Newer machines may actually have two BIOSes – the GigaByte GA-BX2000 motherboard, for example, use dual-BIOS technology, so if one fails, the back-up kicks in. Well, in theory, anyway – there are reports of the BIOSes flashing each other out!

With a *Flash ROM* you can change the BIOS code without replacing the chip(s). It’s similar in concept to the EEPROM, being a storage medium that doesn’t need a continuous power source, but deals with several blocks of memory at once, rather than single bytes, making it slightly faster. Older BIOSes used EPROMS, which require ultra violet light to erase them, so were a more permanent solution. Even older BIOSes used PROMs, which can’t be changed at all once programmed. All are considered to be *nonvolatile*, meaning that they don’t need a continuous source of power to keep information in them. Actually, this does include CMOS chips, as the power referred to is mains and not battery power, but the A+ exam might not agree.

As well as ROM space, the BIOS takes 256 bytes of low memory as a *BIOS Data Area*, which contains details about the Num Lock state, keyboard buffer, etc. DOS loads higher than this, so it's quite safe.

There are several types of BIOS because so many computers need to be IBM-compatible; they're not allowed to copy each other, for obvious reasons. The BIOS worries about all the differences and presents a standard frontage to the operating system, which in turn provides a standard interface for application programs. PC and motherboard manufacturers used to make their own BIOSes, and many still do, but most tend to be based on code supplied by third party companies, the most well-known of which are Phoenix, Award, Microid Research and American Megatrends (AMI). However, all is not what it seems! Award Software owns Unicore (the upgraders), which in turn owns MR, which does the customised stuff. Phoenix also owns Quadtel and has recently merged with Award.

How old is my BIOS?

Microsoft says that any earlier than 1987 are "suspect" for running Windows, and there is a list of *Known BIOS Problems* later on. For IDE systems, the AMI BIOS must be later than 04-09-90, and for SCSI 09-25-88, as long as the SCSI card is OS220 compatible. For RLL and MFM drives, try 9-25-88 or later. The keyboard BIOS for AMI systems must be revision 'F'. If you want to check how old your BIOS is, the date is on the start-up screen, usually buried in the *BIOS ID String*, which looks a bit like this (**121291** is the date in this AMI sample):

```
40-0201-BY6379-01101111-121291-UMCAUTO-04
```

If you don’t get one, you can also use **debug**. The BIOS lives between F000:0000 and F000:FFFF, with copyright messages typically at F000:E000, F000:C000 and F000:0000. Type:

```
debug
```

at the DOS prompt. A minus sign will appear. Press D followed by an address in memory to see the 128 bytes' worth of the values stored there, for example:

```
-d f000:e000
```

ASCII text information will be displayed on the right hand side of the screen.

You can also use the S command to search for the word "version", although some computers, IBM and Compaq, for example, don't use version numbers. In this case, the date will be near F000:FFE0.

Quit **debug** by pressing **q** at the dash prompt.

The AMI WinBIOS has a normal date on the startup screen. Otherwise, as you can see, you don't just get the date; many manufacturers include extras that identify the state of the chipset inside. For example, with the AMI Hi-Flex BIOS, there are two more strings, displayed by pressing **Ins** during bootup, or any other key to create an error condition.

Acer ID Strings

In the bottom left hand corner of the screen:

```
ACR89xxx-xxx-950930-R03-B6
```

The first 2 characters after ACR identify the motherboard. The last few are the BIOS revision. The ones before that are the date (e.g. 950930).

ID	Motherboard	Product
05	X1B	Altos 19000
07	M7	Altos 900/M and 9000/M
19	V55-2	Acros, Power
1A	M3A	Altos 300
1B	V35	Power
22	V50LA-N	Acros, Power
24	M9B	Altos 9000/Pro
25	V55LA	Acros, Power, Aspire
29	V60N	AcerPower
2F	M11A	Altos 900/Pro
30	V56LA	Acros, Power, Aspire
33	V58LA	Acros, Power, Aspire
35	V35N	Acros, Power
46	M9N	Altos 920 and 9100
4B	V55LA-2M	Acros, Power, Aspire
5A	X3	Altos 19000 Pro 4
62	V65X	AcerAcros PII

ID	Motherboard	Product
63	V58	Entra
67	V65LA	Acros, Power
6B	A1G4	Acros
6D	V20	AcerPower
89	M5	Altos 7000P
8F	M3 (SCSI)	Altos 9000
8F	M3-EIDE	AcerPower, AcerPower 590
99	A1GX, -2	Acros, Power
9A	V30, -2	Acros, Power
9C	V12LC, -2X	Acros, Power, Aspire

ALR (Gateway) ID Strings

BIOS ID Begins	Motherboard
SU81010A	E-1400
0AAGT	E-1000
0AAKW	PII
404CL0X0	PII
4D4KL0X0	Dual PII
4J4NB0X1	Pentium
4K4UE0X1	E-1200
4M4PB0X1	PII
4M4SG0X0	PII
4R4CB0XA	Pentium 440BX

AMI ID Strings

The BIOS release number is at the top left of the screen for AMI motherboards. The BIOS ID string is at the bottom left for theirs and any others. The AMI BIOS and BIOS Plus series (1986-1990) looks like this (for example):

DINT-**1**123-04990-K8

Or, in other words:

aaaa-**b**bbb-mmddyy-Kc

where:

aaaa	BIOS type
bbbb	Customer Number
mmddyy	Release date
Kc	Keyboard BIOS version number

If the first customer number (in bold above) is **1**,**2**, **8** or a **letter**, it is a non-AMI Taiwanese motherboard. If it is **3**, **4** or **5**, it is from AMI. **50** or **6** means a non-AMI US motherboard and **9** means an evaluation BIOS for a Taiwanese manufacturer. Otherwise, there can be up to three lines (from 1991 onwards) at the bottom left of the screen. The first is displayed automatically, the other two can be seen by pressing the **Insert** key. Aside from version numbers, the 1s and 0s indicate the state of the settings inside. It might look like this:

41-0102-zz**5123**-00111111-101094-AMIS123-P

Again, check the bold numbers in the third set of numbers for the manufacturer.

Non-AMI Taiwanese boards (1xxx, 8xxx)

Code	Manufacturer	Code	Manufacturer
003	QDI	531	Force
045	Vtech/PC Partner	540	BCM
101	Sunlogix	546	Golden Horse
102	Soyo	549	CT Continental
105	Autocomputer	564	Random Technology
106	Dynasty	576	Jetta
107	Dataexpert	585	Gleem
108	Chaplet	588	Boser
109	Fair Friend	593	Advantech
111	Paoku	608	Consolidated Marketing
112	Aquarius Systems	612	Datavan
113	MicroLeader	617	Honotron
114	Iwill	618	Union Genius
115	Senior Science	621	New Paradise
116	Chicony	622	RPT Intergroups
117	A-Trend	628	Digital Eqpt Intl
120	Unicorn	630	Iston
121	First International	647	Lantic
122	MicroStar	652	Ase
123	Magtron	655	Kingston Tech
124	Tekram	656	Storage System
126	Chuntex	658	Macrotek
128	Chaintech	666	Cast Technology
130	Pai Jung	671	Cordial Far East
131	ECS (Elite Group)	672	Lapro
132	Dkine	675	Advanced Scientific
133	Seritech	685	High Ability
135	Acer	691	Gain Technology
136	Sun Electronics	707	Chaining Computer
138	Win Win	708	E-San
140	Angine	719	Taiwan Turbo

Code	Manufacturer	Code	Manufacturer
141	Nuseed	720	Fantas
142	Firich	723	NTK
143	Crete	727	Tripod
144	Vista	737	Ay Ruey
146	Taste	739	Jetpro
146	Integrated Tech Express	743	Mitac
150	Achitec	762	Ansoon
151	Accos	770	Acer Incorp.
152	Top-Thunder	771	Toyen
154	San Li	774	Acer Sertek
156	Technica House	776	Joss
158	Hi-Com	780	Acrosser
159	Twinhead	783	Efar
161	Monterey Intl	788	Systex
163	Softek	792	U-board
165	Mercury	794	CMT
169	MicroStar	796	J & J
170	Taiwan Igel	801	Palit
171	Shing Yunn	806	Interplanetary Info
176	Sigma	807	Expert
178	Clevo	810	Elechands Intl
188	Quanta	815	Powertech
190	Chips & Technologies	820	Ovis
195	GNS	823	Inlog Micro
196	Universal Scientific	826	Tercomputer
197	Golden Way	827	Anpro
247	Abit	828	Axiom
256	Lucky Star	840	New Union KH
258	Four Star	845	PC Direct
259	GVC	846	Garnet Intl
262	Arima	847	Brain Power
266	Modula	850	HTR Asia Pacific
271	Tidal	853	Veridata
273	UFO	856	Smart D & M
274	Full Yes	867	LTH Rong
276	Jet Way	868	Soyo
277	Tarng Bow	879	Aeontech Intl
281	EFA	881	Manuf Tech Resources
283	Advance Creative	888	Seal Intl
284	Lung Hwa	889	Rock
291	TMC	906	Freedom Data
292	Asustek	914	Aquarius Systems
297	DD&TT	917	Source of Computer

Code	Manufacturer	Code	Manufacturer
301	Taken	918	Lanner
304	Dual Enterprises	920	Ipex ITG Intl
309	Protronic	924	Join Corp
317	New Comm	926	Kou Sheng
318	Unitron	927	Seahill Tech
343	Holco	928	Nexcom Intl
346	Snobol	929	CAM Enterprise
351	Singdak	931	Aaeon Techlogu
353	J Bond	932	Kuei Hao
354	Protech	933	ASMT
367	Coxswain	934	Silver Bally
371	ADI	935	Prodisti
373	SiS	936	Codegen
379	Win Technolgies	937	Orientech
391	Aten Intl	938	Project Info
199	Gigabyte	939	Arbor
201	NewtTech Intl	940	Sun Top
203	Sunrex	941	Funtech
204	Bestek	942	Sunflower
209	Puretek	943	Needs System
210	Rise	945	Norm Advanced
211	DFI	947	Ten Yun
214	Rever	948	Beneon
218	Elite (not ECS)	949	National Advantage
223	Biostar	950	MITS
225	Yunglin	951	Macromate
234	Leadman	953	Orlycon
241	Mustek	954	Chung Yu
242	Amptek	955	Yamashita
244	Flytech	957	High Large
246	Cosmotech	958	Young Micro
392	ACC	959	Fastfame
393	Plato Technology	960	Acqutek
396	Tatung	961	Deson Trade
398	Spring Circle	962	Atra Comms
404	Alptech	963	Dimensions Electronics
421	Well Join	964	Micron design
422	Labway	965	Cantta
437	Hsing Tech	968	Khi Way
440	Great Electronics	969	Gemlight
451	Ecel Systems	970	MAT
452	United Hitech	973	Fugutech
453	Kai Mei	974	Green Taiwan

Code	Manufacturer	Code	Manufacturer
461	Hedonic	975	Supertone
462	Arche	977	AT&T
470	Flexus	978	Winco
472	Datacom	980	Teryang
484	Mitac	981	Nexcom
490	Great Tek	982	China Semiconductor
491	President Technology	985	Top Union
493	Artdex	986	DMP
494	Pro Team	988	Concierge
500	Netcon	989	Atherton
503	Up Right	990	Expentech
514	Wuu Lin	994	CBR (Japan Cerebro)
519	Epox	996	Ikon
526	Eagle	998	Chang Tseng

Non-AMI USA boards (6xxx)

Code	Manufacturer	Code	Manufacturer
105	Dolch	326	Crystal
132	Tech Power Enterprises	386	Pacific Info
156	Genoa	389	Supermicro
259	Young Micro		

ID String Line 1

12_4-7_9-14_16-23_25-30_32-39_41 decodes as follows:

Byte	Description		
1	Processor Type	0 2 3	8086/8 80286 80386 80486 Pentium
2	Size of BIOS	0 1	64K 128K
4-5	Major Version Number		
6-7	Minor Version Number		
9-14	Reference Number		
16	Halt on Post Error	Set to 1 if On.	
17	Initialize CMOS every boot	Set to 1 if On.	
18	Block pins 22 & 23 of keyboard controller	Set to 1 if On.	
19	Mouse support in BIOS/keyboard controller	Set to 1 if On.	
20	Wait for if error found	Set to 1 if On.	
21	Display Floppy error during POST	Set to 1 if On.	
22	Display Video error during POST	Set to 1 if On.	

Byte	Description	
23	Display Keyboard error during POST	Set to 1 if On.
25-26	BIOS Date	Month (1-12).
27-28	BIOS Date	Date (1-31).
29-30	BIOS Date	Year (0-99).
32-39	Chipset Identification	BIOS Name.
41	Keyboard controller version number	

ID String Line 2

123 5_7-10_12-13_15-16_18-21_23-24_26-27_29-31

Byte	Description
1-2	Pin no for clock switching through keyboard controller
3	High signal on pin switches clock to High(H) or Low (L)
5	Clock switching through chipset registers 0=Off 1=On
7-10	Port address to switch clock high through special port
12-13	Data value to switch clock high through special port
15-16	Mask value to switch clock high through special port
18-21	Port Address to switch clock low through special port
23-24	Data value to switch clock low through special port
26-27	Mask value to switch clock low through special port
29-31	Turbo Sw Input Pin info (Pin no for Turbo Sw Input Pin)

ID String Line 3

1-3 5 7-10 12-13 15-16 18-21 23-24 26-27 29-30 31 33

Byte	Description	
1y2	Keyboard Controller Pin number for cache control	Pin number for Cache Control
3	Keyboard Controller Pin number for cache control	Whether High signal on pin enables (H) or disables (L) cache.
5	High signal is used on the Keyboard Controller pin	
7-10	Cache Control through Chipset Registers	0=Cache control off 1=Cache Control on
12-13	Port Address to enable cache through special port	
15-16	Data value to enable cache through special port	
18-21	Mask value to enable cache through special port	
23-24	Port Address to disable cache through special port	
26-27	Data value to disable cache through special port	
29-30	Mask value to disable cache through special port	
31	Pin number for Resetting 82335 Memory controller.	
33	BIOS Modified Flag; Incremented each time BIOS is modified from 1-9 then A-Z and reset to 1. If 0 the BIOS has not yet been modified.	

Intel

The AMI version number looks like this when used on Intel motherboards:

```
1.00.XX.??Y
```

where:

XX	BIOS version number
??	Intel Motherboard model
Y	Usually 0 or 1

1.00.07.DH0 would indicate a version 7 BIOS and a TC430HX (Tucson) motherboard.

Aopen ID Strings

In the upper-left corner of the POST screen. It normally starts with R and is found in between the model name and the date:

AP58 **R1.00** July.21.1997

Award ID Strings

The date is at the front:

```
05/31/94-OPTI-596/546/82-2A5UIM200-00
```

The next bit is the chipset and the next to last the BIOS Part Number, of which characters 6 and 7 identify the manufacturer (**M2** in the example – full decode below). The first 5 letters (of the part number) refer to the chipset (here 2A5UI) and the last 2 (00) are the model number. An *i* suffix after the part number means an Intel 12v Flash ROM, whereas *s* refers to an SST 5v (the difference lies in where ESCD data is stored in upper memory).

Manufacturer ID

Code	Manufacturer	Code	Manufacturer
00	Unknown (Micom + others)	FD	DataExpert/Atima/GCT?
99	Beta Unknown	K0	Kapok
A0	Asustek	KF	Kinpo
A1	Abit (Silicon Star)	L1	Lucky Star/Luckstar
A2	A-Trend	L7	Lanner
A3	ASI (Aquarius)/BCOM	L9	Lucky Tiger
A7	Arima Taiwan	M0	Matra
A8	Adcom	M2	Mycomp (TMC)
AB	Aopen (Acer)	M3	Mitac
AC	Spica?	M4	Micro-Star (Achme)

Code	Manufacturer	Code	Manufacturer
AD	Amaquest/Anson	M8	Mustek
AK	Advantech	M9	MLE
AM	Mirage/Acme	MH	Macrotech
AX	Achitec	N0	Nexcom
B0	Biostar	N5	NEC
B1	Bestkey	O0	Ocean
B2	Boser	P1	PC-Chip
B3	BCM	P4	Asus
C1	Clevo	P6	SBC/Protech
C2	Chicony	P8	Azza/Proteam
C3	ChainTech	P9	Powertech
C5	Chaplet	PA	Pronix (Epox)
C9	Computrend	PC	Pine
CF	Flagpoint	PN	Crusader/Procomp
D0	Dataexpert	PS	Palmax
D1	DTK (also Gemlight)	Q0	Quanta
D2	Digital	Q1	QDI
D3	Digicom	R0	Rise (Mtech)
D4	DFI (Diamond Flower)	R2	Rectron
D7	Daewoo	R9	RSAptek
DJ	Darter	S2	Soyo
E1	ECS (Elite Group)	S5	Shuttle (Holco)
E3	EFA	S9	Spring Circle
E4	ESP Co	SA	Seanix/Yukon
E6	Elonex	SC	Sukjung (Auhua)
EC	ENPC	SE	SMT (Sundance?)
EN	ENPC	SH	SYE (Shing Yunn)
F0	FIC	SM	San-Li/Hope Vision?
F1	Flytech	SM	SMT (Superpower)?
F2	Freetech/Flexus	SN	Soltek
F3	FYI (Full Yes)	SW	S & D
F5	Fugutech	T0	Twinhead
F8	Formosa	T1	Taemung/Fentech
F9	Fordlian/Redfox	T4	Taken
FH	Amptron?	T5	Tyan
FN	Amptron?	T6	Trigem
G0	Gigabyte	TB	Totem
G3	Gemlight	TG	Tekram
G5	GVC	TJ	Totem
G9	Global Circuit Technologies	TP	Commate/Ozzo?
GA	Giantec	U0	Uboard
H2	Holco (Shuttle)	U1	USI
H0	HsinTech	U2	AIR (UHC)

Code	Manufacturer	Code	Manufacturer
H2	Holco (Shuttle)	U3	Umax
H9	HsinTech	U4	Unicom
I3	Iwill	U6	Unitron
I4	Inventa	V3	Vtech (PC Partner)
I5	Informtech	V5	Vision Top
I9	ICP	V6	Vobis
IC	Inventech	V7	YKM (Dayton Micron)
IE	Itri	W0	Wintec (Edom)
J1	Jetway (Jetboard, Acorp)	W5	Winco
J2	Jamicon	W7	Winlan
J3	J-Bond	X5	Arima
J4	Jetta	Y2	Yamashita
J6	Joss	Z1	Zida
K1	Karnei		

Chipset ID

Code	Chipset	Code	Chipset
2A69K	440 BX	2A5LE	Apollo (M) VP3
2A69J	440 LX	2A5L7	VIA VT 82C570
2A69H	440 FX	2A5L9	VIA VT82C570M
2A59C	Triton FX	2A5R5	Forex 601A-613
2A59F	Triton II HX	2A5UI	Opti 82C822/896/597
2A59G	Triton VX	2A5UL	Opti 82C822/571/572
2A59H	Triton VX (illegal)	2A5UM	Opti 82C822/546/547
2A59I	Trition TX	2A5UN	Opti Viper(-M) 82C556/7/8
2A59A	Natoma (Neptune)	2A5X7	UMC 82C890
2A597	Mercury	2A5X8	UMC UM8886/8891/8892BF
2A59B	Mercury	2A4H2	Contaq 82C596-9
2B59A	Neptune EISA	2A4IB	SiS 496/497
2A5C7	VIA VT 82C570	2A4KC	Ali 1439/45/31
2A5G7	VLSI VL82C594	2A4KD	Ali 1489
2A5GB	VLSI Lynx VL 82C541/3	2A4L4	VIA 486A/482/505
2A5IA	SiS 501/02/03	2A4L6	VIA 496/406/505
2A5IC	SiS 5501/02/03	2A4UK	Opti 802G 822
2A5ID	SiS 5511/12/13	2A4X5	UMC 8881/8886
2A5IE	SiS 5101-5103	2C403	EFAR EC802G-B
2A5IF	SiS 5596	2C4I8	SiS 471B/E
2A5IH	SiS 5571	2C4I9	SiS 85C471B/E/G
2A5II	SiS 5598	2C4K9	Ali 14296
2A5IK	SiS 5591	2C4L2	VIA 82C486A
2A5KB	Ali 1449/61/51	2C4L6	VIA VT496G
2A5KF	Ali 1521/23	2C4UK	Opti 802G
2A5KI	Ali IV+ M1531/1543 (Spr TX)	2C4X2	UMC UM82C491/493

Code	Chipset	Code	Chipset
2A5LA	Apollo VP1 VT 82C580P (VXPro)	2C4X6	UMC UM498F/496F
2A5LC	Apollo VP2 (AMD 640)	2A431	Cyrix 5510 (Media GX)
2A5LD	VIA VPX (VXPro+)		

Gateway ID Strings

See ALR.

MR BIOS ID Strings

Code	Board
ACER300	Acer/ALI M1209
ACER301	Acer/ALI M1209
ACER304	Acer/ALI M1209
ACER305	Acer/ALI M1209
ACER306	Acer/ALI M1209
ACER307	Acer/ALI M1209
ACER308	Acer/ALI M1209 - Cyrix 486SLC
ACER309	Acer/ALI M1209 - Cyrix 486SLC
ACER30C	Acer/ALI M1209 - Cyrix 486SLC
ACER30D	Acer/ALI M1209 - Cyrix 486SLC
ACER30E	Acer/ALI M1209 - Cyrix 486SLC
ACER30F	Acer/ALI M1209 - Cyrix 486SLC
ACER310	Acer/ALI M1217
ACER311	Acer/ALI M1217
ACER314	Acer/ALI M1217
ACER315	Acer/ALI M1217
ACER316	Acer/ALI M1217
ACER317	Acer/ALI M1217
ACER318	Acer/ALI M1217 - Cyrix 486SLC
ACER319	Acer/ALI M1217 - Cyrix 486SLC
ACER31C	Acer/ALI M1217 - Cyrix 486SLC
ACER31D	Acer/ALI M1217 - Cyrix 486SLC
ACER31E	Acer/ALI M1217 - Cyrix 486SLC
ACER31F	Acer/ALI M1217 - Cyrix 486SLC
C&T_300	Chips & Technologies CS8230
C&T_304	Chips & Technologies CS8230
C&T_305	Chips & Technologies CS8230
C&T_308	Chips & Technologies CS8230
C&T_309	Chips & Technologies CS8230
CNTQ400	Contaq 82C591/82C592 WriteBack
CNTQ404	Contaq 82C591/82C592 WriteBack

Code	Board
CNTQ405	Contaq 82C591/82C592 WriteBack
CNTQ406	Contaq 82C591/82C592 WriteBack
CNTQ407	Contaq 82C591/82C592 WriteBack
CNTQ410	Contaq 82C596 WriteBack
CNTQ411	Contaq 82C596 WriteBack
CNTQ412	Contaq 82C596 WriteBack
EFAR400	Efar Microsystems 82EC495 WriteBack
EFAR401	Efar Microsystems 82EC495 WriteBack - 82C711 Combo I/O
EFAR402	Efar Microsystems 82EC495 WriteBack - PC87310 Super I/O
EFAR404	Efar Microsystems 82EC495 WriteBack
EFAR405	Efar Microsystems 82EC495 WriteBack
EFAR406	Efar Microsystems 82EC495 WriteBack
EFAR407	Efar Microsystems 82EC495 WriteBack
EFAR408	Efar Microsystems 82EC495 WriteBack - 82C711 Combo I/O
EFAR409	Efar Microsystems 82EC495 WriteBack - 82C711 Combo I/O
EFAR40A	Efar Microsystems 82EC495 WriteBack - 82C711 Combo I/O
EFAR40B	Efar Microsystems 82EC495 WriteBack - 82C711 Combo I/O
EFAR40C	Efar Microsystems 82EC495 WriteBack - PC87310 Super I/O
EFAR40D	Efar Microsystems 82EC495 WriteBack - PC87310 Super I/O
EFAR40E	Efar Microsystems 82EC495 WriteBack - PC87310 Super I/O
EFAR40F	Efar Microsystems 82EC495 WriteBack - PC87310 Super I/O
EFAR410	Efar Microsystems 82EC798 WriteBack
EFAR411	Efar Microsystems 82EC798 WriteBack - 82C711 Combo I/O
EFAR412	Efar Microsystems 82EC798 WriteBack - PC87310 Super I/O
EFAR414	Efar Microsystems 82EC798 WriteBack
EFAR415	Efar Microsystems 82EC798 WriteBack
EFAR416	Efar Microsystems 82EC798 WriteBack
EFAR417	Efar Microsystems 82EC798 WriteBack
EFAR418	Efar Microsystems 82EC798 WriteBack - 82C711 Combo I/O
EFAR419	Efar Microsystems 82EC798 WriteBack - 82C711 Combo I/O
EFAR41A	Efar Microsystems 82EC798 WriteBack - 82C711 Combo I/O
EFAR41B	Efar Microsystems 82EC798 WriteBack - 82C711 Combo I/O
EFAR41C	Efar Microsystems 82EC798 WriteBack - PC87310 Super I/O
EFAR41D	Efar Microsystems 82EC798 WriteBack - PC87310 Super I/O
EFAR41E	Efar Microsystems 82EC798 WriteBack - PC87310 Super I/O
EFAR41F	Efar Microsystems 82EC798 WriteBack - PC87310 Super I/O
EFAR41G	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC
EFAR41H	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC - 82C711 Combo I/O
EFAR41J	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC - PC87310 Super I/O
EFAR41K	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC
EFAR41L	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC
EFAR41M	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC
EFAR41N	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC

Code	Board
EFAR41P	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC - 82C711 Combo I/O
EFAR41Q	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC - 82C711 Combo I/O
EFAR41R	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC - 82C711 Combo I/O
EFAR41S	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC - 82C711 Combo I/O
EFAR41T	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC - PC87310 Super I/O
EFAR41U	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC - PC87310 Super I/O
EFAR41V	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC - PC87310 Super I/O
EFAR41W	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC - PC87310 Super I/O
EFAR41X	Efar Microsystems 82EC798 WriteBack - Cyrix 486DLC
ELIT320	Elite Microelectronics Eagle Rev. A1
ELIT324	Elite Microelectronics Eagle Rev. A1
ELIT325	Elite Microelectronics Eagle Rev. A1
ELIT420	Elite Microelectronics Eagle Rev. A1
ELIT424	Elite Microelectronics Eagle Rev. A1
ELIT425	Elite Microelectronics Eagle Rev. A1
ELIT426	Elite Microelectronics Eagle Rev. A1
ELIT427	Elite Microelectronics Eagle Rev. A1
ETEQ301	Eteq Microsystems 82C491/82C493 Bobcat Rev. A
ETEQ303	Eteq Microsystems 82C491/82C492 Cougar Rev. B, C
ETEQ304	Eteq Microsystems 82C491/82C492 Cougar Rev. B, C
ETEQ305	Eteq Microsystems 82C491/82C492 Cougar Rev. B, C
ETEQ311	Eteq Microsystems 82C491/82C493 Bobcat Rev. A
ETEQ314	Eteq Microsystems 82C491/82C493 Bobcat Rev. A
ETEQ315	Eteq Microsystems 82C491/82C493 Bobcat Rev. A
ETEQ321	Eteq Microsystems 82C4901/82C4902 Bengal WriteBack
ETEQ324	Eteq Microsystems 82C4901/82C4902 Bengal WriteBack
ETEQ325	Eteq Microsystems 82C4901/82C4902 Bengal WriteBack
ETEQ421	Eteq Microsystems 82C4901/82C4902 Bengal WriteBack
ETEQ428	Eteq Microsystems 82C4901/82C4902 Bengal WriteBack
ETEQ429	Eteq Microsystems 82C4901/82C4902 Bengal WriteBack
ETEQ401	Eteq Microsystems 82C491/82C493 Bobcat Rev. A
ETEQ403	Eteq Microsystems 82C491/82C492 Cougar Rev. B, C
ETEQ404	Eteq Microsystems 82C491/82C492 Cougar Rev. B, C
ETEQ405	Eteq Microsystems 82C491/82C492 Cougar Rev. B, C
HDK_200	EverTech 286 Hedaka
HDK_210	EverTech 286 Hedaka - built-in EMS
FORX300	Forex 36C300/200 [36C300/46C402] WriteThru
FORX303	Forex 36C300/200 [36C300/46C402] WriteThru
FORX320	Forex 36C311 Single Chip 386SX with Cache
FORX323	Forex 36C311 Single Chip 386SX with Cache
FORX410	Forex 46C411/402 WriteThru
FORX413	Forex 46C411/402 WriteThru
FORX418	Forex 46C411/402 WriteThru

Code	Board
FORX419	Forex 46C411/402 WriteThru
FORX420	Forex 46C521 WriteBack Forex 46C421A/422 WriteBack
FORX421	Forex 46C521 WriteBack Forex 46C421A/422 WriteBack
FORX422	Forex 46C521 WriteBack Forex 46C421A/422 WriteBack
FORX423	Forex 46C521 WriteBack Forex 46C421A/422 WriteBack
FORX424	Forex 46C521 WriteBack Forex 46C421A/422 WriteBack
FORX425	Forex 46C521 WriteBack Forex 46C421A/422 WriteBack
FORX426	Forex 46C521 WriteBack Forex 46C421A/422 WriteBack
FORX427	Forex 46C521 WriteBack Forex 46C421A/422 WriteBack
FORX428	Forex 46C521 WriteBack Forex 46C421A/422 WriteBack
FORX429	Forex 46C521 WriteBack Forex 46C421A/422 WriteBack
FTDI400	FTDI 82C3480 WriteBack/WriteThru
FTDI401	FTDI 82C3480 WriteBack/WriteThru with 82C711 Combo I/O
FTDI402	FTDI 82C3480 WriteBack/WriteThru with PC87310 Super I/O
FTDI408	FTDI 82C3480 WriteBack/WriteThru
FTDI409	FTDI 82C3480 WriteBack/WriteThru with 82C711 Combo I/O
FTDI40A	FTDI 82C3480 WriteBack/WriteThru with PC87310 Super I/O
HKT_301	Hong Kong Technology HK3000 (Phoenix 8242 Keyboard Controller)
HKT_302	Hong Kong Technology HK3000 (MR BIOS 8042 Keyboard Controller)
HT12200	Headland Technologies HT12/HT12+
HT12201	Headland Technologies HT12/HT12+
HT12202	Headland Technologies HT12/HT12+
HT12210	Headland Technologies HT12/HT12+ with built-in EMS
HT12211	Headland Technologies HT12/HT12+ with built-in EMS
HT12211	Headland Technologies HT12/HT12+ with built-in EMS
HT22300	Headland Technologies HT22/HT18C
HT22302	Headland Technologies HT22/HT18C
HT22303	Headland Technologies HT22/HT18C
HT2230A	Headland Technologies HT22/HT18C with 82C711 Combo I/O
HT2230B	Headland Technologies HT22/HT18C with PC87310 Super I/O
HT2230C	Headland Technologies HT22/HT18C with 82C711 Combo I/O
HT2230D	Headland Technologies HT22/HT18C with PC87310 Super I/O
HT2230E	Headland Technologies HT22/HT18C with 82C711 Combo I/O
HT2230F	Headland Technologies HT22/HT18C with PC87310 Super I/O
HT32300	Headland Technologies HT320 Shasta
HT32302	Headland Technologies HT320 Shasta
HT32303	Headland Technologies HT320 Shasta
HT3230A	Headland Technologies HT320 Shasta with 82C711 Combo I/O
HT3230B	Headland Technologies HT320 Shasta with PC87310 Super I/O
HT3230C	Headland Technologies HT320 Shasta with 82C711 Combo I/O
HT3230D	Headland Technologies HT320 Shasta with PC87310 Super I/O
HT3230E	Headland Technologies HT320 Shasta with 82C711 Combo I/O
HT3230F	Headland Technologies HT320 Shasta with PC87310 Super I/O

Code	Board
HT34400	Headland Technologies HT340 Shasta
HT34408	Headland Technologies HT340 Shasta
HT34409	Headland Technologies HT340 Shasta
HT3440A	Headland Technologies HT340 Shasta with 82C711 Combo I/O
HT3440B	Headland Technologies HT340 Shasta with PC87310 Super I/O
HT3440C	Headland Technologies HT340 Shasta with 82C711 Combo I/O
HT3440D	Headland Technologies HT340 Shasta with PC87310 Super I/O
HT3440E	Headland Technologies HT340 Shasta with 82C711 Combo I/O
HT3440F	Headland Technologies HT340 Shasta with PC87310 Super I/O
MOSL400	Mosel MS400 Single Chip
MOSL403	Mosel MS400 Single Chip
MOSL404	Mosel MS400 Single Chip
MOSL410	Mosel MS400 Single Chip with 82C711 Combo I/O
MOSL413	Mosel MS400 Single Chip with 82C711 Combo I/O
MOSL415	Mosel MS400 Single Chip with 82C711 Combo I/O
MXIC300	Micronix MX83C305/306 (with built-in 8Kb cache)
MXIC302	Micronix MX83C305/306 (with built-in 8Kb cache)
MXIC303	Micronix MX83C305/306 (with built-in 8Kb cache)
MXIC304	Micronix MX83C305/306 (with built-in 8Kb cache)
MXIC305	Micronix MX83C305/306 (with built-in 8Kb cache)
MXIC308	Micronix MX83C305/306 (with built-in 8Kb cache)
MXIC30A	Micronix MX83C305/306 (with built-in 8Kb cache)
MXIC30B	Micronix MX83C305/306 (with built-in 8Kb cache)
MXIC30C	Micronix MX83C305/306 (with built-in 8Kb cache)
MXIC30D	Micronix MX83C305/306 (with built-in 8Kb cache)
OPTI306	OPTi 82C381 WriteThru
OPTI308	OPTi 82C381 WriteThru
OPTI309	OPTi 82C381 WriteThru
OPTI315	OPTi 82C281 SxPW Single-Chip Posted-Write
OPTI316	OPTi 82C281 SxPW Single-Chip Posted-Write
OPTI319	OPTi 82C281 SxPW Single-Chip Posted-Write with 82C711 Combo I/O
OPTI31A	OPTi 82C281 SxPW Single-Chip Posted-Write with PC87310 Super I/O
OPTI31K	OPTi 82C281 SxPW Single-Chip Posted-Write
OPTI31L	OPTi 82C281 SxPW Single-Chip Posted-Write
OPTI31M	OPTi 82C281 SxPW Single-Chip Posted-Write with 82C711 Combo I/O
OPTI31N	OPTi 82C281 SxPW Single-Chip Posted-Write with 82C711 Combo I/O
OPTI31P	OPTi 82C281 SxPW Single-Chip Posted-Write with PC87310 Super I/O
OPTI31Q	OPTi 82C281 SxPW Single-Chip Posted-Write with PC87310 Super I/O
OPTI317	OPTi 82C283 SxPI Single-Chip
OPTI318	OPTi 82C283 SxPI Single-Chip
OPTI31B	OPTi 82C283 SxPI Single-Chip with 82C711 Combo I/O
OPTI31C	OPTi 82C283 SxPI Single-Chip with PC87310 Super I/O
OPTI31D	OPTi 82C283 SxPI Single-Chip

Code	Board
OPTI31E	OPTi 82C283 SxPI Single-Chip
OPTI31F	OPTi 82C283 SxPI Single-Chip with 82C711 Combo I/O
OPTI31G	OPTi 82C283 SxPI Single-Chip with 82C711 Combo I/O
OPTI31H	OPTi 82C283 SxPI Single-Chip with PC87310 Super I/O
OPTI31J	OPTi 82C283 SxPI Single-Chip with PC87310 Super I/O
OPTI324	OPTi 82C391 WriteBack Rev. A & Rev. B
OPTI32B	OPTi 82C391 WriteBack Rev. A & Rev. B with 82C711 Combo I/O
OPTI32C	OPTi 82C391 WriteBack Rev. A & Rev. B with PC87310 Super I/O
OPTI32E	OPTi 82C391 WriteBack Rev. A & Rev. B
OPTI32F	OPTi 82C391 WriteBack Rev. A & Rev. B
OPTI32G	OPTi 82C391 WriteBack Rev. A & Rev. B
OPTI32H	OPTi 82C391 WriteBack Rev. A & Rev. B
OPTI32J	OPTi 82C391 WriteBack Rev. A & Rev. B with 82C711 Combo I/O
OPTI32K	OPTi 82C391 WriteBack Rev. A & Rev. B with 82C711 Combo I/O
OPTI32L	OPTi 82C391 WriteBack Rev. A & Rev. B with 82C711 Combo I/O
OPTI32M	OPTi 82C391 WriteBack Rev. A & Rev. B with 82C711 Combo I/O
OPTI32P	OPTi 82C391 WriteBack Rev. A & Rev. B with PC87310 Super I/O
OPTI32Q	OPTi 82C391 WriteBack Rev. A & Rev. B with PC87310 Super I/O
OPTI32R	OPTi 82C391 WriteBack Rev. A & Rev. B with PC87310 Super I/O
OPTI32S	OPTi 82C391 WriteBack Rev. A & Rev. B with PC87310 Super I/O
OPTI330	OPTi 82C496/497 DxPI Rev. A & Rev. B
OPTI331	OPTi 82C496/497 DxPI Rev. A & Rev. B with 82C711 Combo I/O
OPTI332	OPTi 82C496/497 DxPI Rev. A & Rev. B with PC87310 Super I/O
OPTI334	OPTi 82C496/497 DxPI Rev. A & Rev. B
OPTI335	OPTi 82C496/497 DxPI Rev. A & Rev. B
OPTI336	OPTi 82C496/497 DxPI Rev. A & Rev. B
OPTI337	OPTi 82C496/497 DxPI Rev. A & Rev. B
OPTI338	OPTi 82C496/497 DxPI Rev. A & Rev. B with 82C711 Combo I/O
OPTI339	OPTi 82C496/497 DxPI Rev. A & Rev. B with 82C711 Combo I/O
OPTI33A	OPTi 82C496/497 DxPI Rev. A & Rev. B with 82C711 Combo I/O
OPTI33B	OPTi 82C496/497 DxPI Rev. A & Rev. B with 82C711 Combo I/O
OPTI33C	OPTi 82C496/497 DxPI Rev. A & Rev. B with PC87310 Super I/O
OPTI33D	OPTi 82C496/497 DxPI Rev. A & Rev. B with PC87310 Super I/O
OPTI33E	OPTi 82C496/497 DxPI Rev. A & Rev. B with PC87310 Super I/O
OPTI33F	OPTi 82C496/497 DxPI Rev. A & Rev. B with PC87310 Super I/O
OPTI340	OPTi 82C291 SxWB Single-Chip WriteBack
OPTI341	OPTi 82C291 SxWB Single-Chip WriteBack with 82C711 Combo I/O
OPTI342	OPTi 82C291 SxWB Single-Chip WriteBack with PC87310 Super I/O
OPTI344	OPTi 82C291 SxWB Single-Chip WriteBack
OPTI345	OPTi 82C291 SxWB Single-Chip WriteBack
OPTI346	OPTi 82C291 SxWB Single-Chip WriteBack
OPTI347	OPTi 82C291 SxWB Single-Chip WriteBack
OPTI348	OPTi 82C291 SxWB Single-Chip WriteBack with 82C711 Combo I/O

Code	Board
OPTI349	OPTi 82C291 SxWB Single-Chip WriteBack with 82C711 Combo I/O
OPTI34A	OPTi 82C291 SxWB Single-Chip WriteBack with 82C711 Combo I/O
OPTI34B	OPTi 82C291 SxWB Single-Chip WriteBack with 82C711 Combo I/O
OPTI34C	OPTi 82C291 SxWB Single-Chip WriteBack with PC87310 Super I/O
OPTI34D	OPTi 82C291 SxWB Single-Chip WriteBack with PC87310 Super I/O
OPTI34E	OPTi 82C291 SxWB Single-Chip WriteBack with PC87310 Super I/O
OPTI34F	OPTi 82C291 SxWB Single-Chip WriteBack with PC87310 Super I/O
OPTI406	OPTi 82C481 WriteThru
OPTI408	OPTi 82C481 WriteThru
OPTI409	OPTi 82C481 WriteThru
OPTI424	OPTi 82C491 WriteBack (original)
OPTI428	OPTi 82C491 WriteBack Rev. A & Rev. B
OPTI42B	OPTi 82C491 WriteBack Rev. A & Rev. B with 82C711 Combo I/O
OPTI42C	OPTi 82C491 WriteBack Rev. A & Rev. B with PC87310 Super I/O
OPTI42E	OPTi 82C491 WriteBack Rev. A & Rev. B
OPTI42F	OPTi 82C491 WriteBack Rev. A & Rev. B
OPTI42G	OPTi 82C491 WriteBack Rev. A & Rev. B
OPTI42H	OPTi 82C491 WriteBack Rev. A & Rev. B
OPTI42J	OPTi 82C491 WriteBack Rev. A & Rev. B with 82C711 Combo I/O
OPTI42K	OPTi 82C491 WriteBack Rev. A & Rev. B with 82C711 Combo I/O
OPTI42L	OPTi 82C491 WriteBack Rev. A & Rev. B with 82C711 Combo I/O
OPTI42M	OPTi 82C491 WriteBack Rev. A & Rev. B with 82C711 Combo I/O
OPTI42P	OPTi 82C491 WriteBack Rev. A & Rev. B with PC87310 Super I/O
OPTI42Q	OPTi 82C491 WriteBack Rev. A & Rev. B with PC87310 Super I/O
OPTI42R	OPTi 82C491 WriteBack Rev. A & Rev. B with PC87310 Super I/O
OPTI42S	OPTi 82C491 WriteBack Rev. A & Rev. B with PC87310 Super I/O
OPTI430	OPTi 82C496/497 DxPI Rev. A & Rev. B
OPTI431	OPTi 82C496/497 DxPI Rev. A & Rev. B with 82C711 Combo I/O
OPTI432	OPTi 82C496/497 DxPI Rev. A & Rev. B with PC87310 Super I/O
OPTI434	OPTi 82C496/497 DxPI Rev. A & Rev. B
OPTI435	OPTi 82C496/497 DxPI Rev. A & Rev. B
OPTI436	OPTi 82C496/497 DxPI Rev. A & Rev. B
OPTI437	OPTi 82C496/497 DxPI Rev. A & Rev. B
OPTI438	OPTi 82C496/497 DxPI Rev. A & Rev. B with 82C711 Combo I/O
OPTI439	OPTi 82C496/497 DxPI Rev. A & Rev. B with 82C711 Combo I/O
OPTI43A	OPTi 82C496/497 DxPI Rev. A & Rev. B with 82C711 Combo I/O
OPTI43B	OPTi 82C496/497 DxPI Rev. A & Rev. B with 82C711 Combo I/O
OPTI43C	OPTi 82C496/497 DxPI Rev. A & Rev. B with PC87310 Super I/O
OPTI43D	OPTi 82C496/497 DxPI Rev. A & Rev. B with PC87310 Super I/O
OPTI43E	OPTi 82C496/497 DxPI Rev. A & Rev. B with PC87310 Super I/O
OPTI43F	OPTi 82C496/497 DxPI Rev. A & Rev. B with PC87310 Super I/O
OPTI450	OPTi 82C498 DxWB WriteBack
OPTI451	OPTi 82C498 DxWB WriteBack with 82C711 Combo I/O

Code	Board
OPTI452	OPTi 82C498 DxWB WriteBack with PC87310 Super I/O
OPTI454	OPTi 82C498 DxWB WriteBack
OPTI455	OPTi 82C498 DxWB WriteBack
OPTI456	OPTi 82C498 DxWB WriteBack
OPTI457	OPTi 82C498 DxWB WriteBack
OPTI458	OPTi 82C498 DxWB WriteBack with 82C711 Combo I/O
OPTI459	OPTi 82C498 DxWB WriteBack with 82C711 Combo I/O
OPTI45A	OPTi 82C498 DxWB WriteBack with 82C711 Combo I/O
OPTI45B	OPTi 82C498 DxWB WriteBack with 82C711 Combo I/O
OPTI45C	OPTi 82C498 DxWB WriteBack with PC87310 Super I/O
OPTI45D	OPTi 82C498 DxWB WriteBack with PC87310 Super I/O
OPTI45E	OPTi 82C498 DxWB WriteBack with PC87310 Super I/O
OPTI45F	OPTi 82C498 DxWB WriteBack with PC87310 Super I/O
OPTI470	OPTi 82C495SxLC
OPTI471	OPTi 82C495SxLC with 82C711 Combo I/O
OPTI472	OPTi 82C495SxLC with PC87310 Super I/O
OPTI474	OPTi 82C495SxLC
OPTI475	OPTi 82C495SxLC
OPTI476	OPTi 82C495SxLC
OPTI477	OPTi 82C495SxLC
OPTI478	OPTi 82C495SxLC with 82C711 Combo I/O
OPTI479	OPTi 82C495SxLC with 82C711 Combo I/O
OPTI47A	OPTi 82C495SxLC with 82C711 Combo I/O
OPTI47B	OPTi 82C495SxLC with 82C711 Combo I/O
OPTI47C	OPTi 82C495SxLC with PC87310 Super I/O
OPTI47D	OPTi 82C495SxLC with PC87310 Super I/O
OPTI47E	OPTi 82C495SxLC with PC87310 Super I/O
OPTI47F	OPTi 82C495SxLC with PC87310 Super I/O
OPTI47G	OPTi 82C495SxLC
OPTI47H	OPTi 82C495SxLC with 82C711 Combo I/O
OPTI47J	OPTi 82C495SxLC with PC87310 Super I/O
OPTI47K	OPTi 82C495SxLC
OPTI47L	OPTi 82C495SxLC
OPTI47M	OPTi 82C495SxLC
OPTI47N	OPTi 82C495SxLC
OPTI47P	OPTi 82C495SxLC with 82C711 Combo I/O
OPTI47Q	OPTi 82C495SxLC with 82C711 Combo I/O
OPTI47R	OPTi 82C495SxLC with 82C711 Combo I/O
OPTI47S	OPTi 82C495SxLC with 82C711 Combo I/O
OPTI47T	OPTi 82C495SxLC with PC87310 Super I/O
OPTI47U	OPTi 82C495SxLC with PC87310 Super I/O
OPTI47V	OPTi 82C495SxLC with PC87310 Super I/O
OPTI47W	OPTi 82C495SxLC with PC87310 Super I/O

Code	Board
OPTI480	OPTi 82C499 DxSC Single Chip
OPTI481	OPTi 82C499 DxSC Single Chip with 82C711 Combo I/O
OPTI482	OPTi 82C499 DxSC Single Chip with PC87310 Super I/O
OPTI484	OPTi 82C499 DxSC Single Chip
OPTI485	OPTi 82C499 DxSC Single Chip
OPTI486	OPTi 82C499 DxSC Single Chip
OPTI487	OPTi 82C499 DxSC Single Chip
OPTI488	OPTi 82C499 DxSC Single Chip with 82C711 Combo I/O
OPTI489	OPTi 82C499 DxSC Single Chip with 82C711 Combo I/O
OPTI48A	OPTi 82C499 DxSC Single Chip with 82C711 Combo I/O
OPTI48B	OPTi 82C499 DxSC Single Chip with 82C711 Combo I/O
OPTI48C	OPTi 82C499 DxSC Single Chip with PC87310 Super I/O
OPTI48D	OPTi 82C499 DxSC Single Chip with PC87310 Super I/O
OPTI48E	OPTi 82C499 DxSC Single Chip with PC87310 Super I/O
OPTI48F	OPTi 82C499 DxSC Single Chip with PC87310 Super I/O
OPTI48G	OPTi 82C499 DxSC Single Chip
OPTI48H	OPTi 82C499 DxSC Single Chip with 82C711 Combo I/O
OPTI48J	OPTi 82C499 DxSC Single Chip with PC87310 Super I/O
OPTI48K	OPTi 82C499 DxSC Single Chip
OPTI48L	OPTi 82C499 DxSC Single Chip
OPTI48M	OPTi 82C499 DxSC Single Chip
OPTI48N	OPTi 82C499 DxSC Single Chip
OPTI48P	OPTi 82C499 DxSC Single Chip with 82C711 Combo I/O
OPTI48Q	OPTi 82C499 DxSC Single Chip with 82C711 Combo I/O
OPTI48R	OPTi 82C499 DxSC Single Chip with 82C711 Combo I/O
OPTI48S	OPTi 82C499 DxSC Single Chip with 82C711 Combo I/O
OPTI48T	OPTi 82C499 DxSC Single Chip with PC87310 Super I/O
OPTI48U	OPTi 82C499 DxSC Single Chip with PC87310 Super I/O
OPTI48V	OPTi 82C499 DxSC Single Chip with PC87310 Super I/O
OPTI48W	OPTi 82C499 DxSC Single Chip with PC87310 Super I/O
OPTI48Z	OPTi 82C499 DxSC Single Chip with PC87311/312 Super I/O
OPTI490	OPTi 82C495 SLC
OPTI491	OPTi 82C495 SLC with 82C711 Combo I/O
OPTI492	OPTi 82C495 SLC with PC87310 Super I/O
OPTI493	OPTi 82C495 SLC
OPTI494	OPTi 82C495 SLC with 82C711 Combo I/O
OPTI495	OPTi 82C495 SLC with PC87310 Super I/O
OPTI496	OPTi 82C495 SLC
OPTI497	OPTi 82C495 SLC with 82C711 Combo I/O
OPTI498	OPTi 82C495 SLC with PC87310 Super I/O
OPTI499	OPTi 82C495 SLC
OPTI49A	OPTi 82C495 SLC with 82C711 Combo I/O
OPTI49B	OPTi 82C495 SLC with PC87310 Super I/O

Code	Board
OPTI4A0	OPTi 82C801 SCWB2 Single Chip WriteBack
OPTI4A1	OPTi 82C801 SCWB2 Single Chip WriteBack with 82C711 Combo I/O
OPTI4A2	OPTi 82C801 SCWB2 Single Chip WriteBack with PC87310 Super I/O
OPTI4A3	OPTi 82C801 SCWB2 Single Chip WriteBack with PC87311 Super I/O
OPTI500	OPTi 586 VHP Pentium Chipset
PKDM301	Chips & Technologies CS82310 PEAKset DM Rev-0
PKDM304	Chips & Technologies CS82310 PEAKset DM Rev-0
PKDM305	Chips & Technologies CS82310 PEAKset DM Rev-0
PKDM311	Chips & Technologies CS82310 PEAKset DM Rev-0 - 82C711 Combo I/O
PKDM314	Chips & Technologies CS82310 PEAKset DM Rev-0 - 82C711 Combo I/O
PKDM315	Chips & Technologies CS82310 PEAKset DM Rev-0 - 82C711 Combo I/O
PKDM321	Chips & Technologies CS82310 PEAKset DM Rev-B1
PKDM322	Chips & Technologies CS82310 PEAKset DM Rev-B1
PKDM323	Chips & Technologies CS82310 PEAKset DM Rev-B1
PKDM324	Chips & Technologies CS82310 PEAKset DM Rev-B1
PKDM325	Chips & Technologies CS82310 PEAKset DM Rev-B1
PKDM331	Chips & Technologies CS82310 PEAKset DM Rev-B1 - 82C711 Combo I/O
PKDM332	Chips & Technologies CS82310 PEAKset DM Rev-B1 - 82C711 Combo I/O
PKDM333	Chips & Technologies CS82310 PEAKset DM Rev-B1 - 82C711 Combo I/O
PKDM334	Chips & Technologies CS82310 PEAKset DM Rev-B1 - 82C711 Combo I/O
PKDM335	Chips & Technologies CS82310 PEAKset DM Rev-B1 - 82C711 Combo I/O
PKDM420	Chips & Technologies CS82310 PEAKset DM Rev-B1
PKDM421	Chips & Technologies CS82310 PEAKset DM Rev-B1
PKDM424	Chips & Technologies CS82310 PEAKset DM Rev-B1
PKDM425	Chips & Technologies CS82310 PEAKset DM Rev-B1
PKDM428	Chips & Technologies CS82310 PEAKset DM Rev-B1
PKDM429	Chips & Technologies CS82310 PEAKset DM Rev-B1
PKDM430	Chips & Technologies CS82310 PEAKset DM Rev-B1 - 82C711 Combo I/O
PKDM431	Chips & Technologies CS82310 PEAKset DM Rev-B1 - 82C711 Combo I/O
PKDM434	Chips & Technologies CS82310 PEAKset DM Rev-B1 - 82C711 Combo I/O
PKDM435	Chips & Technologies CS82310 PEAKset DM Rev-B1 - 82C711 Combo I/O
PKDM438	Chips & Technologies CS82310 PEAKset DM Rev-B1 - 82C711 Combo I/O
PKDM439	Chips & Technologies CS82310 PEAKset DM Rev-B1 - 82C711 Combo I/O
SARC302	SARC RC2016A Rev. A3 (standard)
SARC306	SARC RC2016A Rev. A3 with built-in EMS
SARC30A	SARC RC2016A Rev. A3 Cyrix
SARC30E	SARC RC2016A Rev. A3 Cyrix, with built-in EMS
SCAT300	Chips & Technologies 82C236 SCATsx
SCAT304	Chips & Technologies 82C236 SCATsx
SCAT305	Chips & Technologies 82C236 SCATsx
SIS_303	SiS 85C310/320/330 Rabbit Rev. A, B & C
SIS_306	SiS 85C310/320/330 Rabbit Rev. A, B & C
SIS_307	SiS 85C310/320/330 Rabbit Rev. A, B & C

Code	Board
SIS_308	SiS 85C310/320/330 Rabbit Rev. A, B & C
SIS_309	SiS 85C310/320/330 Rabbit Rev. A, B & C
SIS_400	SiS 85C460 & 85C461V Single-Chip
SIS_404	SiS 85C460 & 85C461V Single-Chip
SIS_405	SiS 85C460 & 85C461V Single-Chip
SLGC301	SysLogic 386 non-cache
SLGC302	SysLogic 386 with cache
SLGC304	SysLogic 386 non-cache
SLGC305	SysLogic 386 non-cache
SLGC306	SysLogic 386 with cache
SLGC307	SysLogic 386 with cache
SLGC401	SysLogic 486 no external cache
SLGC404	SysLogic 486 no external cache
SLGC405	SysLogic 486 no external cache
STD_286	Generic 286 (TTL/Discrete Logic)
STD_202	Generic 286 (TTL/Discrete Logic)
STD_203	Generic 286 (TTL/Discrete Logic)
STD_386	Generic 386 (TTL/Discrete Logic)
STD_302	Generic 386 (TTL/Discrete Logic)
STD_303	Generic 386 (TTL/Discrete Logic)
STD_486	Generic 486 (TTL/Discrete Logic)
STD_408	Generic 486 (TTL/Discrete Logic)
STD_409	Generic 486 (TTL/Discrete Logic)
SYML401	Symphony Labs SL82C46x Haydn Rev. 1.1
SYML402	Symphony Labs SL82C46x Haydn Rev. 1.1 with 82C711 Combo I/O
SYML403	Symphony Labs SL82C46x Haydn Rev. 1.1 with PC87310 Super I/O
SYML404	Symphony Labs SL82C46x Haydn Rev. 1.1
SYML405	Symphony Labs SL82C46x Haydn Rev. 1.1
SYML406	Symphony Labs SL82C46x Haydn Rev. 1.1 with 82C711 Combo I/O
SYML407	Symphony Labs SL82C46x Haydn Rev. 1.1 with 82C711 Combo I/O
SYML408	Symphony Labs SL82C46x Haydn Rev. 1.1 with PC87310 Super I/O
SYML409	Symphony Labs SL82C46x Haydn Rev. 1.1 with PC87310 Super I/O
SYML411	Symphony Labs SL82C46x Haydn Rev. 1.2
SYML412	Symphony Labs SL82C46x Haydn Rev. 1.2 with 82C711 Combo I/O
SYML413	Symphony Labs SL82C46x Haydn Rev. 1.2 with PC87310 Super I/O
SYML414	Symphony Labs SL82C46x Haydn Rev. 1.2
SYML415	Symphony Labs SL82C46x Haydn Rev. 1.2
SYML416	Symphony Labs SL82C46x Haydn Rev. 1.2 with 82C711 Combo I/O
SYML417	Symphony Labs SL82C46x Haydn Rev. 1.2 with 82C711 Combo I/O
SYML418	Symphony Labs SL82C46x Haydn Rev. 1.2 with PC87310 Super I/O
SYML419	Symphony Labs SL82C46x Haydn Rev. 1.2 with PC87310 Super I/O
TACT300	Texas Instruments TACT83000 Tiger non-cache
TACT302	Texas Instruments TACT83000 Tiger with Intel 82385 cache

Code	Board
TACT303	Texas Instruments TACT83000 Tiger with Austek cache
TACT30A	Texas Instruments TACT83000 Tiger non-cache
TACT30B	Texas Instruments TACT83000 Tiger non-cache
TACT30C	Texas Instruments TACT83000 Tiger with Austek cache
TACT30D	Texas Instruments TACT83000 Tiger with Austek cache
TACT30E	Texas Instruments TACT83000 Tiger with Intel 82385 cache
TACT30F	Texas Instruments TACT83000 Tiger with Intel 82385 cache
TACT400	Texas Instruments TACT83000 Tiger no external cache
TACT40A	Texas Instruments TACT83000 Tiger no external cache
TACT40B	Texas Instruments TACT83000 Tiger no external cache
UMC_301	UMC 82C48x WriteBack Rev. 0
UMC_302	UMC 82C48x WriteBack Rev. A & Rev. B
UMC_304	UMC 82C48x WriteBack Rev. A & Rev. B
UMC_310	UMC 82C330 Twinstar
UMC_314	UMC 82C330 Twinstar
UMC_315	UMC 82C330 Twinstar
UMC_401	UMC 82C48x WriteBack Rev. 0
UMC_402	UMC 82C48x WriteBack Rev. A & Rev. B
UMC_403	UMC 82C48x WriteBack Rev. A & Rev. B
UMC_404	UMC 82C48x WriteBack Rev. A & Rev. B
UMC_405	UMC 82C48x WriteBack Rev. A & Rev. B
UMC_406	UMC 82C48x WriteBack Rev. A & Rev. B
UMC_407	UMC 82C48x WriteBack Rev. A & Rev. B
UMC_40A	UMC 82C48x WriteBack Rev. B
UMC_40B	UMC 82C48x WriteBack Rev. B
UMC_40C	UMC 82C48x WriteBack Rev. B
UMC_40D	UMC 82C48x WriteBack Rev. B
UMC_40E	UMC 82C48x WriteBack Rev. B
UMC_40F	UMC 82C48x WriteBack Rev. B
UMC_40G	UMC 82C48x WriteBack Rev. A & Rev. B
UMC_410	UMC 82C491 Single-Chip
VLSI301	VLSI Technology 386 Topcat - Intel 82340 non-cache
VLSI302	VLSI Technology 386 Topcat - Intel 82340 non-cache with 82C106 IPC
VLSI312	VLSI Technology 386 Topcat - Intel 82340 with 82385 cache and 82C106 IPC
VLSI401	VLSI Technology 386 Topcat - Intel 82340
VLSI402	VLSI Technology 386 Topcat - Intel 82340 with 82C106 IPC
VLSI404	VLSI Technology 386 Topcat - Intel 82340 with 82C106 IPC

Packard Bell ID Strings

Normally identified by the FCC ID number on the back of the system unit.

For example:

```
400-409 = PB400
410-449 = PB410 or 430
450-459 = PB450
```

Phoenix ID Strings

These start with a product family identifier (4A3NT0X in this example):

```
4A3NT0X0.86A.0047.P03.9704071222
```

It decodes to AN430TX (i.e. Anchorage). 4L3TT0X would be LT430TX (Lonetree). The number after the X is the revision. 86 is the BIOS OEM ID (Intel here), and the next letter indicates the type of motherboard:

A Consumer Desktop
B Corporate Desktop
C Server Products

0047 is the BIOS build number. P is the BIOS release type:

P Production (03 is the production release number)
D Development
A Alpha
B Beta

9704071222 is the BIOS build date and time (here, 7 April 1997 at 12.22).

Using The Registry

Check the *BIOSDate*, *BIOSName*, and *BIOSVersion string* values in **HKEY_LOCAL_MACHINE\Enum\Root*PNP0C01\0000**, assuming you haven't updated or changed anythinhg since you last ran Setup.

What's in my machine?

Here's how to see what equipment your machine has with **debug**. During boot, the BIOS examines the computer's connectors and sets an equipment-list word, which lives at absolute address 410 hex or segment 0000, offset 0410 (hex). Interrupt 11 hex returns the word in the AX register. The bits of the word are as listed below, although some early versions of DOS (i.e. pre 4.0) ignore this information and use their own methods.

Bit	Description
0	Set if floppies are present
1	Set if maths coprocessor installed
2	Set if pointing device attached (PS/2)
3-2	RAM size (only for original IBM PC, PCjr):

Bit	Description
	00 = 16K 01 = 32K 10 = 48K 11 = 64K
5-4	Initial video mode: 00 = reserved 01 = 40-column color 10 = 80-column color 11 = 80-column mono
7-6	Number of floppies (if bit 0 set): 00 = 1 drive 01 = 2 drives 10 = 3 drives 11 = 4 drives
8	Reserved
11-9	Serial ports
12	Game adapter installed
13	Serial printer attached (PCjr) or internal modem installed (PC/XT only)
15-14	Parallel ports

Where Can I Get A New BIOS?

In the early days, it was enough to be "IBM compatible" and you could literally swap BIOS ROMs between motherboards. It's not the case these days, as they are matched to a particular chipset *by the motherboard manufacturer* and are therefore specific to each other, even though they might work up to about 80% at DOS level. Before spending too much time on this, be aware that it's often easier (and cheaper) just to buy a new motherboard! If you have a Flash BIOS (see below), aside from your motherboard manufacturer, you may get one from:

```
MR          www.unicore.com
Award       www.unicore.com
AST         www.centercomp.com/ast
AMI         www.megatrends.com
```

MR has many shareware versions, for as little as $15.

For Olivetti (and maybe others relatively less available), try *PC Care* in UK on 44 1992 462882. AMI BIOS and BIOS Plus series (with 16 character ID code) for cached motherboards are customised, and only obtainable from the OEM, except:

- Those with E307 as the first 4 characters (**aaaa**), which can often be replaced with a standard type.

- Northgate or Motherboard Factory motherboards (except the Northgate slimline), which can take a standard type.

- Those with **aaaa** = DAMI, DAMX or EDAMI are usually for cached boards designed and/or built by AMI.

Gateway use Intel motherboards and modify the AMI BIOS, so don't expect an their upgrades to work. Gateway use a T suffix. Here are some others:

H	Vobis
K	NEC
L	Hewlett Packard
Q	AST
R	Packard Bell

Otherwise, call *Upgrades Etc* at (800) 541 1943 or *Unicore* on (508) 686-6468 (for MR and Award Software). Phoenix resells through *Micro Firmware*, on (800) 767 5465. Try also *Silicon Pacific* in UK on 44 1491 638275, who are AMI resellers. See also *Useful Numbers*. You need the proper information when you call; if you already have an AMI BIOS, for example, you will need the reference or part number in the ID string. If not, you must know what speed the board is and what chipset is on it (e.g. C&T, OPTi, etc).

Flash BIOS Upgrades

Your motherboard manual should state whether the board has a Flash BIOS (most modern ones do), but if you don't have one, or just want to make sure, look under the sticker for these codes on the chip (*xxx* just denotes the capacity):

Code	Type
28Fxxx	12v
29Cxxx	5v
29LVxxx	3v (not often seen)
28Cxxx	EEPROM (similar to Flash, but you need a special device – Flash works in the motherboard)
27Cxxx	EPROM, so you need UV to erase it and a programmer to rewrite it.
PH29EE010	SST flashable ROM chip
29EE011	5v flashable Winbond chip
29C010	5v flashable Amtel chip

All the software you need will fit onto a boot floppy, which should naturally be checked for viruses. Aside from DOS, you will need the upgrade utility and the data file for your motherboard. Both will be obtainable from the web site or BBS of either your motherboard or BIOS manufacturer (try the former first). It will usually be a self-extracting compressed file with a **.bin** extension. The disk should have the DOS boot files only – no memory drivers! However, you might want to include an **autoexec.bat** file to automate the process, in case you have to do the job blind. If something goes wrong, Award BIOS chips have a small amount code hardwired into them that will allow at least a boot from a floppy, although you will have to use an ISA video card, as the code only supports that type of bus. Intel motherboards have the same arrangement, and the code is activated by moving a Flash Recovery jumper, which activates a small amount of code in the boot block area (which, luckily, is non-eraseable). In this case, put the jumper in the recovery position, start up with a bootable diskette, listen to the speaker and watch the floppy access light (there's no video, due to the size of the code). When you hear a beep and the light comes on, the recovery code is being reloaded. When the light goes out, switch the machine off, put the jumper back to its normal position and continue.

The Flash ROM requires relatively high voltage to burn it, and this is usually set with a jumper on the motherboard (it may be marked 12v or 5v). If you don't have a jumper, it will probably be done by the Flash software. The chips concerned can only be flashed for a limited number of times, and not a high one at that.

Take note of the *current* settings, so you can reinstall them after you have upgraded – turn off the *System BIOS Cacheable* option as well. In fact, it's a good idea to save your BIOS contents to the floppy when given the option, just in case you have to go back to it (but see below for *Recovering a Corrupt BIOS*). If updating a portable, run it from the mains, as a failure during the upgrade will cause severe problems. You may need to set a jumper or switch on the motherboard to allow the ROM to be written to, or to enable *Boot Block Programming*, if you want the official phrase.

Boot from the upgrade floppy, and run the utility. The command line will include the name of the utility and the file for the upgrade, typically:

```
flash p5_aw.14g
```

In the above example, **flash** is the name of the utility (**flash.exe**) and **p5_aw.14g** is the file containing the code for the BIOS; in this case, it's for the P5 motherboard, which has an Award BIOS (aw), revision 14g. Always save the current BIOS, if asked, so you can recover later. *Do not turn the machine off during the upgrade*, even if there is a recovery procedure—just repeat the process. If the problem persists, reload the BIOS you saved earlier. It's not a good idea to use another manufacturer's software, but, if you have an emergency, it would appear that Award's works with all except Asus boards, and MR's **29C010.exe** is good, too.

Once everything has finished, check for a successful upgrade with the BIOS identifier on the screen, turn the machine off, reset the jumper, reboot and enter all the previous settings (though you may have to accept the defaults). Reboot again.

Tip: If you get problems after upgrading an AMI BIOS, press F5 in Setup to clear the CMOS.

There's lots of lots of good stuff about Flash BIOSes at **www.ping.be/bios**.

Recovering A Corrupt BIOS

Do this with care...

Generally, all you need is a BIOS chip from a similar motherboard – although they are specifically made, very often you can use one where the chipset doesn't vary too much, say, between an FX or HX motherboard. It helps if the I/O chip is the same, as well, but all you need to do is be able to boot to DOS so you can change the chip when the machine is running. So, remove the corrupt chip, fit the good one, boot the machine with DOS and swap the chips again. By this time, the BIOS will have been shadowed, and running from RAM, so the machine will still work. Reflash the chip.

DMI

DMI (*Desktop Management Interface*) is a system which works with a Flash BIOS to keep a *Management Information Format* database up to date so you can find out what's inside a PC without opening it up, including device settings, so it's for managing system components, hardware or software. Version 2.0 will allow remote network access, although this capability is unofficially available from some vendors with 1.1.

DMI can autodetect and record information concerning the computer, such as the CPU type and speed, and memory size—the BIOS stores the information in a 4K block in the Flash ROM, from where DMI can retrieve it. Plug and Play technology allows this to be updated by the operating system, which is better than having you update the whole BIOS every time. Indeed, NT occasionally flashes up a message that it's "updating DMI" as it boots.

Motherboards that can use DMI have a configuration utility that allows you to put other information in, like serial numbers, company addresses, etc.

Facilities Provided

The BIOS ROM will include a bootstrap loader, Power On Self Test (POST), hardware initialisation, software interrupts and CMOS Setup routines, possibly with diagnostic or utility software and other facilities.

The Power On Self Test

The POST verifies that:

- The motherboard is working, and
- The equipment in the machine is in the same condition (i.e. working) as when it was switched off. The testing is an exercising of the components; that is, it checks they are working, but not how well they are working.

The Bootstrap Loader

Looks for an operating system, and hands over to it, if found, on a floppy or a hard drive (Late Phoenix BIOSes will boot from a CD-ROM, and AMI from a Zip drive; Award BIOSes can boot from CD-ROMs, SCSI drives, Zip drives and LS-120 diskettes). If an error is encountered before the display is initialized, some Nasty Noises will tell you what's wrong. Otherwise, you will see an error message (again, later in the book). A hard reset goes through the whole POST procedure. A soft reset (**ctrl-alt-del**) just runs a subset of POST and initialisation, after calling INT 19 from the BIOS.

CMOS settings

In AT-class computers, hardware setup information is kept in the CMOS RAM so the POST can refer to it. CMOS stands for *Complementary Metal Oxide Semiconductor*, which actually refers to a way of making chips with low power requirements, but has also come to mean the memory area which retains the information, because the clock chip that stored it was made that way (back in 286 days, this may have been the only such chip on a motherboard, so it became known as *the* CMOS chip). Anyway, the purpose of the CMOS is to remember what equipment the computer has, and the setup routine which initialises the CMOS must be run before you can use your computer for the first time. Some computers have this program separately on a disk, e.g. with early NEAT chipsets, Award v2.x or Samsungs, but now it's commonly included in the System BIOS.

Every machine has Standard CMOS settings, but some will have *Advanced CMOS or Chipset Features* (the whole point of this), discussed later.

Utilities

Many utilities come with the BIOS, particularly diagnostic and low-level format routines for the hard disk. The main menu to the setup may have this heading:

```
HARD DISK UTILITY
```

It allows you to low-level format the drive attached to your computer.

**DO NOT USE IT TO
LOW LEVEL FORMAT
AN IDE DISK!**

Not that it will, anyway. Sorry for shouting, by the way, but that's quite important, because it will erase the head positioning tracks. You need manufacturer's software to do it properly.

Performance

Although computers may have basic similarities, that is, they all look the same on the supermarket shelf, performance will differ markedly between them, just the same as it does with cars—it's all too easy to put a big engine in (or a fast processor) and forget to improve the brakes and suspension, so you can't hold the road properly. Aside from that, you will never get a PC set up properly from the shop because there simply isn't enough incentive in terms of time or money for the builders to do so. They will just choose the safe settings to suit the widest variety of circumstances and leave you to it, which is where this book comes in. As an example, the default for some BIOSes is to have *both* internal and external CPU caches off, which is the slowest option!

The PC contains several processes running at the same time, often at different speeds, so a fair amount of co-ordination is required to ensure that they don't work against each other. Most performance problems arise from bottlenecks between components that are not necessarily the best for a job, but a result of compromise between price and performance. Usually, price wins out and you have to work around the problems this creates. The trick to getting the most out of any machine is to make sure that each part is giving of its best, then eliminate bottlenecks between them. You can get a bottleneck simply by having an old piece of equipment that is not designed to work at modern high speeds (a computer is only as fast as its slowest component), but you might also have badly written software.

System Timing

The clock is responsible for the speed at which numbers are crunched and instructions executed. It results in an electrical signal that switches constantly between high and low voltage several million times a second. The *System Clock*, or CLKIN, is the frequency used by the processor; on 286s and 386s, it's half the speed of the main crystal on the motherboard (the CPU divides it by two), which is often called CLK2IN. 486 processors run at the same speed as the main crystal, because they use both edges of the timing signal, which is a square wave. A clock generator chip (82284 or similar) is used to synchronise timing signals around the computer, and the data bus would be run at a slower speed synchronously with the CPU, e.g. CLKIN/4 for an ISA bus with a 33 MHz CPU, resulting in the "standard" 8 MHz or so, although it was never properly established.

ATCLK is a separate clock for the bus, when it's run asynchronously, or not derived from CLK2IN. There is also a 14.31818 MHz crystal which was used for all system timing on XTs. Now it's generally used for the colour frequency of the video controller (6845), although some chipsets (i.e. the BX) still use it for timing through a variety of feedback loops and phase shifts. Setting up the BIOS to get the best performance (or rate of data transfer around the machine, at least) involves quite a bit of tedious trial and error, rebooting your system time and again to check the results. For this reason, you want a quick and easily used diagnostic program (e.g. the Core hard disk performance test, or the Quake 1.06 benchmark) with which to check your hard disk data transfer rate, or whatever. It doesn't matter about the figures; they will only be used for comparison purposes. In fact, increases in performance will often not be indicated by the figures, but by your own judgments.

Anyway, performance can be affected by the chipset, or who makes the support chips for the CPU, so much so that a 200 MHz Pentium with a slow chipset can be seriously outperformed by a 133 MHz one supported properly. The *Advanced Chipset Setup* helps you to tweak the settings provided if required. You want to concentrate on the following areas:

- **Burst Mode**—used on 486s and above, where a single address cycle precedes four data cycles; 4 32-bit words can move in only 5 cycles, not 8. You need long bursts with low wait states; 1 wait state during a burst loses half the bandwidth.

- **Optimising Memory Cycles**—for example, *Concurrent Refresh* allows the CPU to read cache memory during a RAM refresh cycle – however, this should be the first to be turned off if you get a problem. You can also control *SDRAM Precharge Time*, *RAS to CAS Delay* and *Latency Times*.

- **Interleaving**—allows memory access while refreshing other blocks, though you don't have much control, and it's not so important on newer machines. It's done automatically in SDRAM.

- **I/O recovery time**—that is, the timing parameters of your main board and its relation to cards on the ISA bus (use *No*, *Disabled* or the lowest settings for best performance!). Preferred to increasing bus speeds.

- **Shadow RAM**—ROM contents are transferred to main memory, which is given the same electronic address as the original ROM, and run much faster. Not much good with NetWare or NT, and possibly '95 & '98, as they use their own drivers.

- **Latency**, especially on the PCI bus, but also with memory. In other words, how long the bus may be tied up before being released to either another card or the ISA bus. A short latency time means the bus is given up more quickly, which is good for speed but not when you're mastering CDs, where you want long data streams with as few interruptions as possible. Using higher numbers with any form of latency allows you to run faster, but 32-64 seem to be best for most PCs.

Take a note of all the settings in your *Advanced Chipset Setup* (you can use **PrtScrn**), and vary them one at a time, taking a note of the test results each time. You will probably find, perversely, that relatively high wait states and low bus speeds will actually result in better performance because the components are better matched. For example, a 60 MHz bus with a 120 MHz Pentium will run with zero wait states, whereas the 100 MHz version may need one. Just remember that the faster you go, the less stability you have, or, in other words, you can have speed or stability, but not both.

Changing DMA settings often affects reliability rather than performance. Phoenix recommends that the first place to start if you have a problem is to turn off any *Hidden* or *Concurrent Refresh* options.

Operating systems like Windows 95/98 (that is, those that supply their own 32-bit drivers) will often override some of these settings, especially when it comes to hard disk operation (PIO, Block Mode) or other I/O operations. Also, cacheing will often tend to mask the effects of any changes you make.

In any case, the notes that follow will at least give you a place to start, and the meaning of the various items you can adjust will (hopefully) become clear.

Notes

Open Sesame

The ways of getting into a BIOS are many and varied; if your PC doesn't actually need a setup disk, you could try any one of the following, in no particular order (of course, whether they work or not often depends on which keyboard driver you have loaded). Thanks to pellefsen, jfreeman, bruff, snafu, tankman, jdm17, sanity, pr, julesp, halftone, apel, and markjones, all on @cix.co.uk for some of the following:

- Press **del** during boot (AMI, Award).
- Press **Esc** during boot—Toshiba.
- Press **F1** during boot (Toshiba; some Phoenix; Late PS/1 Value Point and 330s).
- Press **F2** during boot (NEC, newer Phoenix).
- Press **F10** when square in top RH corner of screen (Compaq).
- Press **Ins** during boot—IBM PS/2 with reference partition.
- Press **reset** twice—some Dells.
- **Ctrl Alt Enter**—Dell.
- **Ctrl Alt ?**—some PS/2s, such as 75 and 90.
- **Ctrl-Esc**
- **Ctrl Ins—**some PS/2s when pointer at top right of screen.
- **Ctrl Alt Esc** -AST Advantage, Award, Tandon, older Phoenix.
- **Ctrl Alt +**
- **Ctrl Alt S**—older Phoenix.
- **Ctrl Alt Ins** (Zenith, Phoenix)
- **Ctrl S** (Phoenix).
- **Ctrl Shift Esc**—Tandon 386.
- **Shift Ctrl Alt +** Num Pad **del—**Olivetti PC Pro.
- **Setup disk**—Old Compaqs, Epson (Gemini), IBM, IBM PS/2, Toshiba, old 286s.
- **Fn+F2.** AST Ascentia 950N

Setup Programs

Compaq

In a partition on the hard disk.

Epson

Try **www.epson.com/connects/ftp.shtml**

GRiD

Originally made laptops, but were bought by Tandy, and later AST, so try **support.tandy.com/grid.htm** or **www.ast.com/americas/files.htm**.

NEC

Try **support.neccsdeast.com/ftp/pmate_2.asp**

Panasonic

Try **www.panasonic.com/host/support**

Samsung

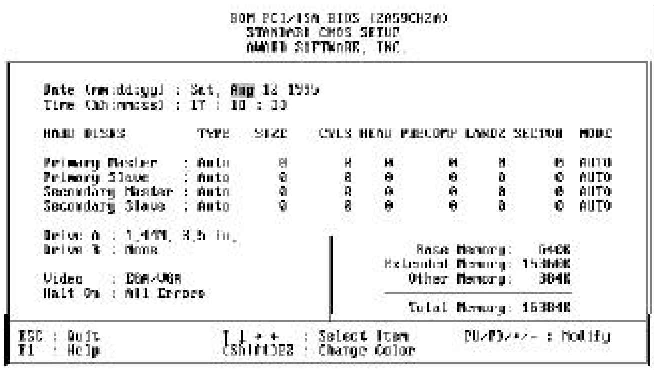
Try **www.sosimple.com/service/bbs.htm**

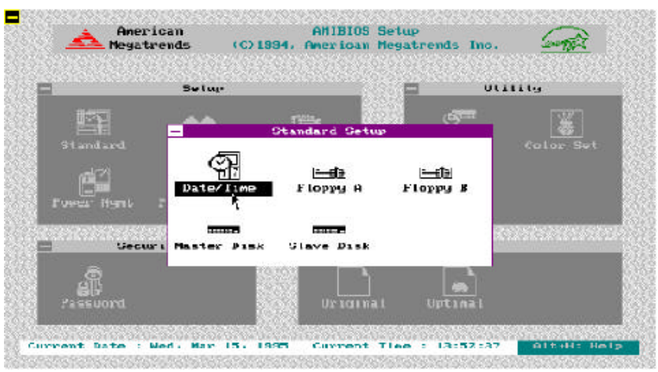
Wyse

BBS is (408) 922 4400/1/2/3/4/5

Standard Setup

This deals with the basic information, such as time of day, what disk drives and memory you have, etc. It is mostly self-explanatory, and will be found in every AT-class machine. Memory settings are usually dealt with automatically.





Date and Time

Speak for themselves, really, except the timekeeping won't be wonderful, due to variations in voltages, etc (see *The Year 2000 Problem*).

Daylight Saving

American for automatically adding an hour during Summer, at 0200 on the first Sunday in April; the clock chip is hardwired for it and activated by this setting. It resets to Standard Time on the first Sunday in October. Only relevant for North America, and Windows '95 does this by itself anyway.

Hard Disk (C and D).

Several types of hard disk are catered for (from *Not Installed* up to as many as 125). Choose a drive size *equal to or lower than* the one you propose to fit. User-defined fields are provided for anything strange you may want to fit, in which case you need to specify the following for each drive (see also the *Hard Disk Database*):

- **Cyln**—number of cylinders.
- **Head**—number of heads on the drive.
- **WPcom**—The cylinder when compensation for timing differences between inner and outer edges of the disk is given. Not needed for most modern drives, but some manufacturers (e.g. Conner) specify 0. Be careful with this; what they really mean to say is "disabled", so set 65535 or 1 more than the last cylinder. Setting 0 may mean that WPC actually starts at 0 and confuses the drive.
- **LZone**—the landing zone of the heads, which is where they will go when the system is shut down or they are deliberately parked. Not needed if your drive is autoparking (most are).
- **Sectors per Track**—Usually 17 (MFM) or 26 (RLL), but otherwise varies (for ESDI, SCSI, IDE).
- **Capacity**—the formatted capacity of the drive based on the formula below (the calculation is automatically made):

$$\frac{\text{Hds x Cyls x Secs/track x 512 bytes (per cyl)}}{1048{,}576}$$

- **Mode type**. That is, the *PIO Mode* (0, 1, 2, 3, 4), and only applies to IDE drives. Usually *Auto* does the trick, and allows you to change drives without entering setup, but if the drive responds incorrectly, you may have to set it manually. This may also be a *size selection* (with a different CMOS setting for each):

- **Normal**, through the BIOS, with only one translation step in the drive (so is invisible) and a maximum drive size of 528 Mb, derived from 1024 cylinders, 16 heads and 63 sectors per track (see Large, below, for an explanation). Use if your drive is below 528 Mb, or your OS has a problem with translation.

- **Large**, using CHS translation for drives over 1024 cylinders, but without LBA support (see below). The number of cylinders is divided by 2 and the heads multiplied by 2 automatically, with the calculation reversed inside INT 13, so one translation is used between the drive and BIOS, and another between the BIOS and the rest of the machine, but not at the same time, which is the real trick. This is sometimes known as Extended CHS, and is often best for performance, if not for compatibility.

  CHS stands for *Cylinders, Heads, Sectors-per-track*. As Intel-based PC's use 16 bit registers, all processes must use them for compatibility purposes. In case you're interested:

  - DX uses 8 bits for head number and 8 for the drive.

  - CX uses 10 bits for cylinder number, 6 for the sector.

  The largest 10-bit number you can have is 1024 (0-1023), which is where the limit on cylinder numbers comes from, and the largest 6 bit number is 63 (1-63), allowing 63 sectors per track, but as the DX register with 8 bits actually allows up to 256 heads (0-255), you can use translation for drives up to 8 Gb and still remain compatible. Although you would be forgiven for using the same logic to support up to 255 drives as well (8 bits for the drive number in DX), the Interrupt Vector Table only has pointers to two I/O addresses (104h and 118h) in the *BIOS Data Area*, where such data is stored as the machine boots.

  In addition, the WD 1003 controller, on which INT 13 is based, only allowed 4 bits for the head number and one for the drive (SCSI bypasses all this by setting the drive type as *Not Installed*, and including its own ROM on the controller). With translation, you end up with two levels of CHS—one for INT 13H and one for the device. The device CHS stops at 16 heads, hence 528 Mb.

  Operating Systems still have to check the drive types using INT 13 when they start, however much they may bypass them with their own code later, so everything you need to get things running in the first place should be inside the first 1024 cylinders.

- **LBA**, where CHS is internally translated into sequentially numbered blocks, a system stolen from SCSI. It allows drives larger than 528 Mb to be used (8.4 Gb), but only in conjunction with CHS and has nothing to do with performance. In fact, it can make things slower, as it only reduces CPU overhead in operating systems that use LBA themselves (more CPU cycles are used). Even then, they must still boot with CHS and not use any sectors beyond those allowed by it, so the drive size is the same in either case.

It must be supported by the drive and the BIOS, and the BIOS in turn must support the INT 13 extensions, as must any operating system or application to get the best effect; for example, with Phoenix BIOS 4.03, if LBA is enabled with an appropriate drive, LBA will be used on all accesses to the drive. With 4.05, LBA will only be used if the INT 13 extensions are invoked, which saves an extra translation step by the BIOS.

LBA can therefore be enabled, but not necessarily used. Windows '95 supports INT 13, but LBA calls will only be made if '95 's **fdisk** has been used and a new partition type (0E or 0F) created.

You may lose data if LBA is enabled or disabled after the drive has been partitioned with it (or not), but it depends on the BIOS. Phoenix is OK in this respect.

A Phoenix BIOS converts between the device CHS and INT 13, with LBA in the middle. Others use their own methods, and 32-bit drivers, such as those used in Windows, must be able to cope with all the variations, especially when they have to provide backwards compatibility for older drives, since most people insist on using their previous drive when they add a new one.

As there so many variations, it is possible that LBA mode may be slower with your particular BIOS, in which case use the Large setting instead. Also, be aware that logical block 100 won't necessarily be in the same place on the same drive between different machines.

Large and *LBA* may not be supported by Unix, as it can already handle big drives. Also, if your OS replaces INT 13, the drive may not be accessed properly.

For Netware 286, you should shadow the system BIOS for user-defined settings. ESDI drives should be set to type 1, and SCSI to 0, or *not installed*, but some SCSI controllers, such as the Mylex DCE 376, require drive type 1.

When it comes to translation, later Phoenix, AMI, Award and MR BIOSes are based on the Microsoft/IBM specification, which is the standard. Others may use the WD EIDE system, which could mean problems when moving drives between machines.

Many new BIOSes can set all the above automatically by fetching the ID string from the (IDE) drive (with *Hard Disk Autodetect* on the main setup screen), so you would only set them manually if you are using a drive partitioned to something other than the standard.

Some PCI motherboards can cope with up to four drives (2 each for PCI and ISA). Drive letters will be assigned to primary partitions first, so logical drive names in extended partitions could be all over the place.

Some older AMI (pre 4-6-90) and Award BIOSes have compatibility problems with IDE and SCSI drives (see *Known BIOS Problems*).

AMI BIOSes dated 7-25-94 and later and support translation, as do some versions of Award 4.0G, which implies various versions of the same BIOS! Revision 1.41a is the latest I have seen, but if yours is earlier than 12/13/1994, the address translation table is faulty, so for drives with more than 1024 cylinders, you must use LBA rather than Large. MR have supported it since early 1990.

Only BIOSes conforming to the IBM/Microsoft/Phoenix standards allow access to disks larger than 8GB.

Two devices on the same channel should be configured as Master or Slave in relation to each other, and a device on its own should be a Master (some CD-ROMs come out of the box as Slaves). The hard drive should be the Master if it coexists with a CD-ROM on the same channel. Note that with a master and slave on the same channel, only one device can be active at the same time – putting an HD and CD-ROM as two masters on two channels will improve performance, but if you set the detection to *Auto*, bootup will be slower as the BIOS will look for Slaves that aren't there. 2 master hard drives on different channels will only waste an interrupt and make the CPU work harder to cover them both.

The configuration is usually done with jumpers or switches on the device itself, but increasingly, *Cable Selection* (CS) is used, where both are Masters, and the difference is resolved by the way the cable is made.

It's best not to have EIDE CD-ROMs on IDE channels by themselves, (say, in a SCSI system) as 32-bit addressing may only be turned on with a suitable hard drive installed as well. 24x CD ROMs cannot reach full speed in 16-bit mode.

See also *IDE Translation Mode*.

Primary Master/Primary Slave, etc.

As above, for the primary and secondary EIDE channels.

Floppy Disks

Again, these speak for themselves. 360K drives can be automatically detected, but the BIOS can only tell whether others have 80 tracks or not, so you will get the default of 1.2 Mb.

Sometimes you have to put the 360K drive as B: if used with another (on Vanilla PCs). With MR, you can also set the *step rate*, or track to track speed of the recording heads.

- *Fast* gives you improved performance on modern equipment.
- *Slow* gives you backwards compatibility with anything older.

2.88 Mb drives need an i82077 or NSC8744 controller. You can use this capacity to increase performance of QIC80 or Travan tape drives on the floppy cable. They are known as *Extra Density* drives. Microsoft has yet another format which stores 1.7 Mb on a floppy, called *Distribution Media Format*, or DMF. Neither are supported by DOS.

Keyboard Installed

Disables keyboard checking and is for fileservers, which don't need keyboards once they're up and running, mainly to discourage people from interfering with them.

Video Display

Mostly autodetects, since all screens except Mono can identify themselves to the system. If you have two monitors, you can assign the primary one from here.

Halt on

When the computer stops if an error is detected on startup. Choices are:

All errors	Every time a non-fatal error is detected
No errors	System will not stop at all.
All but keyboard	System will not stop for a keyboard error.
All but diskette	System will not stop for a disk error.
All but Disk/Key	System will not stop for keyboard or disk errors

Disks and keyboards are excepted because you may have a server which doesn't need them anyway.

Floppy 3 Mode Support

This is for the Japanese standard floppy, which gets 1.2 Mb onto a 3.5" diskette. Normally disable, unless you have one installed.

Boot Sequence

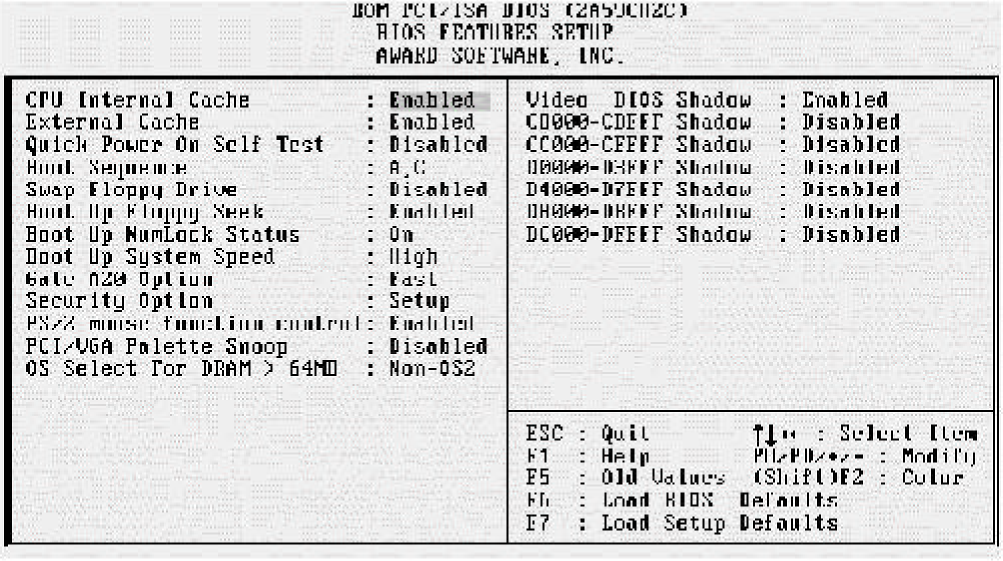
Fairly self-explanatory, but it's worth noting that some motherboards, such as the Abit BE6 or BP6) have an extra onboard IDE controller, which comes under the EXT option here, which replaces SCSI. See also below.

Boot Sequence EXT means

This is only valid if the *Boot Sequence* function above has been set to **EXT**. It allows you to specify booting from an IDE hard disk connected to any extra IDE ports found on some motherboards, or a SCSI hard disk.

Advanced Setup

This allows you to tinker more deeply. Particularly important is the *Password* setting, which is often responsible for locking people out of their own computer.



Typematic Rate Programming

Concerns keyboard sensitivity, or the rate at which keystrokes are repeated, and subsequently the speed of the cursor.

- The *Typematic Rate Delay* is the point at which characters are repeated when the key is continually pressed. Default is usually 250milliseconds, or approx .25 secs.
- The *Typematic Rate* is how many characters per second are generated (max 30 under DOS).

The **alt**, **shift**, **ctrl**, **numlock**, **caps lock** and **scroll lock** keys are excluded. Possibly disable for NetWare servers.

Above 1 Mb Memory Test

Invokes tests on extended memory, and is usually disabled in the interests of saving time during startup (unless you've got a slow-to-boot hard drive), but the drawback is that only the first 1Mb of memory is tested—the rest is just cleared (**himem.sys** does it better anyway). Inoperative address lines are also detected.

Memory Priming

Found with the MR BIOS and similar to the above. The *Full Test* works at a rate of 1 Mb per second, and *Quick Scan* at 8, but the latter only primes memory by writing zeros to it. *Skip Test* means what it says.

Memory Test Tick Sound

Enable if you want to hear memory being tested.

Memory Parity Error Check

Tests for errors when data is read into memory. If disabled, only the first Mb is checked. If a parity error occurs, you get an error message:

```
Parity Error
System Halted
Have A Nice Day
```

(only joking!) A lot of people find they get many more of these immediately after upgrading from Windows 3.x. They are usually caused by defective memory chips, but they could also be mismatched (in which case change the wait states), or the wrong ones for that motherboard.

Parity is a very basic check of information integrity, where each byte of data actually requires nine bits; the ninth is the parity bit, used for error checking (it was introduced in the early 80s because of doubts about the reliability of memory chips, but the problem was actually found to be emissions from the plastic packaging!). In fact, as cache is used for 80-90% of CPU memory accesses, and DRAM only 1-4% of the time, less errors now result (actually a lower *Soft Error*

Rate), so the need for parity checking is reduced, but '95 uses much more 32-bit code. In Windows 3.x, 32-bit code lives at the low end of physical memory, inside the first 4 Mb, hence the increase in detection of parity errors on upgrading—very likely the memory with a problem has never been exercised properly.

Some memory checking programs use read/write cycles where Windows would use execute cycles, which are more vulnerable to parity errors, so memory would have to be extremely bad for memory checkers to actually find a problem. As it happens, parity is not checked during reads anyway.

Other machines, on the other hand, like the Mac, use only eight-bit RAM, and you can use it in motherboards with this option disabled (they are cheaper, after all). The Intel Triton chipset doesn't use parity.

Hit <Del> Message Display

Suppresses the instruction to hit **Del** to enter the setup routine during startup. You can still hit **Del** to get into it, but the message won't be there (helps keep ignoramuses out!).

Hard Disk Type 47 Data Area

Sometimes called an *Extended BIOS RAM Area*, or *Extended Data Segment Area*. Hard disk parameters (for the Standard CMOS Setup) are normally kept in the BIOS ROM, but you can also specify your own parameters for those not already catered for. As the ROM can't be changed, these extra *Type 47* details are kept in a small area of reserved memory, normally in an unused area of interrupt vector address space in lower system RAM (at 0:300), or a 1Kb area at the top of base memory, using up DOS address space, in which case you go down to 639K. If using Multiuser DOS, select :300 to prevent fragmentation of memory used for the TPA, or if you find difficulties booting from the hard disk, especially SCSI. On the other hand, some network operating systems may object to :300 (ROM address :300 is *not* the same as I/O address 300!).

This is sometimes ignored if *Shadow RAM* or *PS/2 Mouse Support* is enabled because the memory it needs is already being used.

Scratch RAM Option

See *Hard Disk Type 47 Data Area*.

Wait For <F1> If Any Error

Stops the computer until the **F1** key is pressed when a *non-fatal* error is encountered during start up tests. In other words, if disabled, the system does not halt after this message is displayed.

System Boot Up <Num Lock>

Allows you to specify in what mode the calculator pad on the keyboard wakes up in. If you have a 102-key keyboard, and therefore have a separate cursor-control pad, you should keep this *On* (usually the default). With the 84-key version, you have the choice. If set to Off, both sets of arrow keys can be used.

Boot Up NumLock Status

See *System Boot Up <Num Lock>*, above.

Numeric co-processor

Whether you have one present or not (a 486SX doesn't).

Weitek Processor

Used to tell the computer if a Weitek maths co-processor (3167/4167) is present. The Weitek, beloved of scientists, and having 2-3 times the performance of Intel's version, uses memory address space which must be remapped, which is why the computer needs to know about it. Note that the Weitek processor needs to be the same speed as the CPU.

System Boot Up Sequence

Specifies in which order drives are searched for an operating system, assuming you haven't disabled the floppy drive search (above), in which case this setting will have no effect.

The fastest (and least virus inducing) method is **C:, A:**, but if you have the MR BIOS, there may be other choices:

Auto Search searches all floppies (you may have more than 2) before defaulting to drive C:, which is useful if you have a 5.25" boot disk and a 3.5" first drive!

Network 1st lets you use a Boot ROM, whether your C: drive is bootable or not.

Screen Prompt You can choose from a short menu.

With *Multiboot*, from Phoenix, the BIOS identifies all boot devices and prioritises them according to your choice (v4.0 of the Phoenix BIOS, and later AMI BIOSes will boot from a Zip drive, while Award's *Elite* BIOS supports CD-ROMs, SCSI, LS-120 and Zip drives). Multiboot is only relevant to Plug and Play, and devices that the BIOS is aware of. Your only adjustment is the boot priority. Only certain systems, such as NT, have bootable CD ROMs.

Boot Up Sequence

See *System Boot Up Sequence*.

Boot Sequence

As for *Boot Up Sequence*, with a menu (Award Software).

Permit Boot from...

Stops the system seeking a boot sector on A: or C: (MR BIOS), for speed.

Drive C: Assignment

Whether to boot from a primary IDE drive or the first bootable SCSI drive, if you have both.

Boot E000 Adapters

Works with *Drive C: Assignment* to boot from a ROM at E000 (i.e. SCSI).

Floppy Drive Seek At Boot

Allows you to stop the computer checking if floppy drives are available for reading or writing when it starts, saving time on startup and possible wear and tear on the drive heads when they are initialised. It's also good for security as it stops people booting up with their own disks and giving you viruses, though it apparently doesn't stop the disk being used once the machine has started, or even when it starts if you have it listed as a possible boot source, so you may need to go to the peripherals section to completely disable it.

Boot Up Floppy Seek

See *Floppy Drive Seek At Boot*.

This one comes with the Award BIOS, and looks for a 360K drive. Later versions determine whether the drive is 40 or 80 track. As the only drive to have 40 tracks is a 360K, and the BIOS can't tell the capacity of the others anyway (it can only determine track size), disable this in the interests of speed and security, and make the machine use the CMOS settings instead, or if you don't have a 360K drive.

HDD Sequence SCSI/IDE First

Normally the IDE drive would be the boot disk where it coexists with SCSI in a system, but this option allows you to set the SCSI drive as the boot device instead.

Quick Power On Self Test

Skips retesting a second, third or fourth time.

Swap Floppy Drive

Changes floppy assignments, so the 1st and 2nd drives can exchange drive letters (Award BIOS). Useful if your system diskette is the wrong type for your first drive, such as with a combination of 1.4 and 1.2 Mb drives, but few people have the latter these days anyway.

Floppy Disk Access Control

Allows reads from the floppy (*Read Only*), but not writes, for security purposes. *R/W* allows reads and writes.

Legacy Diskette A:

The type of diskette drive used as the first drive.

Legacy Diskette B:

The type of diskette drive used as the second drive.

System Boot Up CPU Speed

Sets the computer's operating speed during the POST, *High* or *Low*. Low = ½ speed and should be set for 40 MHz CPUs or if you get problems booting. Bus timing is based on the CPU clock at boot time, and may be set low if your CPU speed is high.

Boot Up System Speed

Similar to the above - *High* selects the default speed, *Low* the speed of the AT bus, to cater for older peripherals. Normally, set High, but this apparently only affects the machine during startup anyway.

Cold Boot Delay

Gives slow devices more time to get their act together - some IDE drives won't work if they're accessed too early, but ignore this for modern equipment. Many SCSI drives have a problem, too, because they may get a separate spin up signal. Usually disabled by selecting *None*. (MR BIOS). The 0 (zero) setting gives faster booting.

System Warmup Delay

As above, between 0-30 seconds.

Delay IDE Initial (sec)

As above.

External Cache Memory

Sometimes called *Internal Cache Memory* on 386 boards (as 386s don't have internal cache), this refers to the Level 2 static RAM on the motherboard used as a cache between the CPU and main memory, anywhere between 64-256K. Usually, you will want this *Enabled*, or *Present*, but disabling sometimes helps problem ROMs or interface cards to work. Don't enable this if you don't have cache memory, or when you see the

```
Cache memory bad, do not enable
```

error message. There are two types of cache, *write-back* or *write-through*, and there are cost/performance tradeoffs with each; write-back is a better choice for performance.

Talking of management, often you get better performance by using 1 bank of DRAM with only one bank of cache RAM, e.g. 128K with 4 Mb. This seems to provide better balance.

Internal Cache Memory

Refers to the 8K (or 1K if using a Cyrix) of cache memory found on 486 chips. This should be *Enabled* for best performance. Also known as *CPU Internal Cache* with Award.

Fast Gate A20 Option

Or *Turbo Switch Function*, determines how Gate A20 is used to access memory above 1 Mb, which is usually handled through the keyboard controller chip (the 8042 or 8742).

The 8088 in the original PC would wrap around to lowest memory when it got to 1 Mb, but the problem was that some software addressed low memory by addressing high memory (Wordstar 3.3 would complain loudly if you had too much available!).

For these older programs, an AND Gate was installed on CPU address line 20 that could switch to allow either wraparound to 1 Mb or access to the 16 Mb address space on the 286 by forcing A20 to zero. A convenient TTL signal from a spare pin on the keyboard controller was used to control the gate, either through the BIOS or with software that knew about it.

The keyboard controller is actually a computer in its own right; at least there is a PROM and a microcomputer in it (hence keyboard BIOS), and it had some spare programming space for code that was left out of the 286.

Programs such as Windows and OS/2 enter and leave protected mode through the BIOS, so Gate A20 needs to be continually enabled and disabled, at the same time as another command to reset the CPU into the required mode is sent.

Enabling this gives the best Windows performance, as a faster method of switching is used in place of using the (slower) keyboard controller, using I/O ports, to optimise the sending of the two commands required; the *Fast Gate A20* sequence is generated by writing D1h to port 64h, and data 02h to port 60h. The fast CPU warm reset is generated when a port 64h write cycle with data FEh is decoded (see *Gate A20 Emulation*). Some BIOSes use Port 92.

You will notice very little difference if all your programs operate inside conventional memory (that is, under DOS). However, this may cause Multiuser DOS not to boot. If you get keyboard errors, enable this, as the switching is probably going too fast.

One problem can occur with this option in AMI BIOSes dated 2/2/91 and later; it doesn't always work with the DOS 5.00 version of **himem.sys**. If you get an error message, disable this. If the error persists, there is a physical problem with the Gate A20 logic, part of which is contained in the keyboard BIOS chip, in which case try changing this chip. Some machines can take up to 20 minutes to boot when this is enabled.

This is nothing to do with the Turbo switch on the front of the computer (see below); the alternative heading could be *Turbo Switching Function*.

Gate A20 Option

See above. Some modern BIOSes suggest leaving this at the *Normal* setting, as it is provided for compatibility with older 286 software.

Low A20# Select

You can choose whether the Low A20# signal is generated by the chipset or keyboard controller.

Turbo Switch Function

As above, but could also enable or disable the system Turbo Switch; that is, if this is disabled (*no*), computer speed is controlled through setup or the keyboard. On some machines the 486 internal cache is switched on or off as a means of speed control; on others the CPU clock is altered as well. Others still extend the refresh duration of DRAM.

With power saving systems, you can set the turbo pin to place the system into a power management Suspend mode instead of changing the speed, in which case the other choice will be *Break Key*. Sometimes known as *Set Turbo Pin Function*.

Gate A20 Emulation

As for *Fast Gate A20 Option*, but you get the choice of *Keyboard Controller* (if disabled) or *Chipset*, which is faster. This is for programs that use BIOS calls or I/O ports 60/64H for A20 operations, where the chipset will intercept those commands and emulate the keyboard controller to allow the generation of the relevant signals (see above). The sequence is to write D1h to port 64h, followed by an I/O write to 60h with 00h. A fast reset is an I/O write to 64h with 1111XXX0b.

Fast means that the A20 gate is controlled by I/O port 92H where programs use BIOS calls. *Both* means Gate A20 is controlled by the keyboard controller and chipset where programs use I/O port 60/64H.

Gateway A20 Option

See *Gate A20 Emulation*.

Fast Reset Emulation

Enhances the speed of switching into and out of protected mode by delaying certain signals (INIT or CPURST) by a certain time and holding them for 25 CPUCLK. Switching from Protected to Real Mode requires a "reboot" at chip level, and this setting allows the BIOS to re-boot your system without having to re-initialize all of the hardware. In fact, a pulse is used to take the CPU out of protected mode, which is left set on a fast CPU reset, so is detectable by software (in a bootup, a bit is looked for which indicates whether this is a "boot-start" or a return to 8088. If the latter, the contents of the registers are kept). This setting helps solve problems caused by switching in and out of protected mode too fast.

See above and *Fast Reset Latency* (below).

Fast Reset Latency

The time in microseconds for software reset, between real and protected modes. The lower the figure, the better the performance, but this may affect reliability.

Keyboard Emulation

Enabling this allows the chipset to generate the signal normally provided by the keyboard controller, that is, Gate A20 and software reset emulation for an external keyboard controller are enabled. It also enables *Fast Reset Emulation*, above. See also *Gate A20 Emulation*, above, whose setting should match this one.

KBC Input Clock

The frequency for the keyboard controller input clock.

Keyboard Controller Clock

Either a fixed speed of 7.16 MHz or a fraction of PCICLKI, the timing signal of the PCI bus.

Video ROM Shadow C000, 32K

Allows you to shadow (or electronically move) the contents of the Video ROM at the specified address, e.g. C000, into extended memory for better performance. The extended memory is then given the same address so the code thinks it's where it should be, and then write-protected (if you're programming or debugging you can sometimes set shadowed areas as Read/Write).

ROM instructions are 8-bit, and s-l-o-w—that is, accessed one bit at a time. Shadowing copies the contents of the ROM into 32-bit (or 16-bit on a 286 or 386SX) memory, disables the ROM and makes that memory look as if it's in the original location, so the code is executed faster. However, you will lose a corresponding amount of extended memory. If your video card has 16K of ROM, shadow at C400 only. If it has 32K (most do), you should include C000 as well. If you have more than that, ensure you include C800 or you might get instability when only part of the code is shadowed.

Windows NT and (presumably) 95/98 derive no benefit from shadowing, so disabling this makes more RAM available. However, if you use a lot of older DOS games, you may well see a difference, though increasing the bus clock speed may be better.

On the other hand, today's video cards use Flash ROM, which is faster, and may not need this setting - sometimes, disabling this with such cards can increase graphics performance, because the Video BIOS does not handle acceleration tasks – this is done by the driver, which may well bypass the BIOS anyway. Note that the 3D part of a video card does not require a BIOS, but uses that on the 2D section.

Shadowed ROMs can also be **cached** in their new locations through the *Advanced Chipset Setup*, although this is not always adviseable (see below). Some video cards can't be shadowed because they use an EEPROM (or flash ROM) to store configuration data, and you won't be able to change the contents if this is enabled. Never mind! If you've got a large cache this setting may not be needed anyway.

C000 cacheing has one drawback, in that it's done *in the 486 internal cache*, which cannot be write-protected. Whenever a diagnostic test is done, the program sees there is a BIOS present, but has no knowledge of the cacheing, so it will treat the code as being a non-write-protected BIOS, which is regarded as an error condition. If you get failures in this area, disable this option. The same applies to later CPUs, which use the L2 cache for this. It's a waste of cache bandwidth, anyway, since modern OSes don't use the System BIOS, and the video signals require much more than the cache can provide.

Video BIOS Shadow

See also *Video ROM Shadow C000, 32K*, above.

Adapter ROM Shadow C800, 16K

Together with others, this functions in the same way as *Video ROM Shadow*, above, but refers to 16K blocks of Upper Memory which cover ROMs on adapter cards, such as hard disk controllers. To use this item effectively, you need to know what memory addresses your expansion cards use (but you could enable them all if you don't know). However, some ROMs don't like being shadowed, particularly those on hard disk controllers, so the best you can do is experiment. Using this reduces available extended memory.

Windows NT and (presumably) 95/98 derive no benefit from shadowing, and more RAM is available.

System ROM Shadow

Allows the 64K block of upper memory containing the system BIOS (starting at F000) to be shadowed for better performance, but only when using DOS or another single-user operating system. Disable for Linux, Unix, Xenix or similar, as they have their own arrangements.

Windows NT ans (presumably) 95/98 do not use the BIOS (except during startup), so there is no benefit from shadowing, and more RAM is available.

C8000-CFFFF Shadow/D0000-DFFFF Shadow

See *System ROM Shadow*.

C8000-CFFFF Shadow/E0000-EFFFF Shadow

See *System ROM Shadow*.

CPU Internal Core Speed

When you select whatever speed your CPU should be running at, the correct host bus speed and bus frequency multiplier will automatically be selected. However, if you choose the *Manual* setting, as when overclocking, you will also see:

CPU Host Bust Frequency

Whatever you want the bus speed to be.

CPU Core: Bus Freq. Multiple

Whatever you want the CPU multiplier to be

CPU Core Voltage

If you choose the *Default* setting, it will be set automatically.

CPU Clock Failed Reset

If you enable this, and your system crashes three times because your overclocking is too much, your CPU speed will automatically be reset to twice the bus speed.

CIH Buster Protection

Protects against viruses that try to destroy the BIOS.

Anti-Virus Protection

Protects against viruses that affect the boot sector and partition table.

Password Checking Option

You can use a password during the computer's startup sequence. The options are:

- ❑ *Always*, which means every time the system is started.
- ❑ *Setup*, which only protects the BIOS routine from being tampered with, or
- ❑ *Disabled*.

You can still boot from a floppy and alter things with a diagnostic program, though.

You get three attempts to enter the correct password, after which the system will have to be rebooted. The default is usually the manufacturer's initials (try **ami**), or **biostar, AWARD?SW, LKWPETER, 589589, aLLy, SWITCHES?SW** or **AWARD_SW** for Award (before 19 Dec 96), but if this doesn't work, or you forget your own password, you must discharge the CMOS. One way to do this is simply to wait for five years until the battery discharges (ten if you've got a Dallas clock chip)! You could also remove the CMOS chip or the battery and just hang on for twenty minutes or so. Look for the chips mentioned below, under *Clearing Chips*.

Note: Since 19 Dec 96, Award Software has not used a default password, leaving it for OEMs. Discharging the battery will not clear the OEM password.

Note: When CMOS RAM loses power, a bit is set which indicates this to the BIOS during the POST test. As a result, you will normally get slightly more aggressive default values.

If your battery is soldered in, you could discharge it enough so the CMOS loses power, but make sure it is rechargeable so you can get it up to speed again. To discharge it, connect a small resistor (say 39 ohms, or a 6v lantern lamp) across the battery and leave it for about half an hour.

Some motherboards use a jumper for discharging the CMOS; it may be marked CMOS DRAIN. Sometimes, you can connect P15 of the keyboard controller (pin 32, usually) to GND and switch the machine on. This makes the POST run, which deletes the password after one diagnostic test. Then reboot.

Very much a last resort is to get a multimeter and set it to a low resistance check (i.e. 4 ohms), place one probe on pin 1 of the chip concerned, and draw the other over the other pins. This will shock out the chip and scramble its brains. **This is not for the faint hearted, and only for the desperate**—use a paperclip or desolder the battery first! We assume no responsibility for damage!

The minimum standby voltage for the 146818 is 2.7v, but your settings can remain even down to around 2.2v. Usually, the clock will stop first, as the oscillator needs a higher voltage to operate. 3v across a CMOS is common with 3.6v nicad & lithium batteries, as the silicon diodes often used in the battery changeover circuit have a voltage drop of 0.6v (3.6v-.6v = 3v). If your CMOS settings get lost when you switch off and the battery is OK, the problem may be in the changeover circuit - the 146818 can be sensitive to small spikes caused by it at power down.

Clearing Chips

The CMOS can mostly be cleared by shorting together appropriate pins with something like a bent paperclip (with the power off!). You could try a debug script if you are able to boot:

```
A:\DEBUG
- o 70 2E
- o 71 FF
- q
```

The CMOS RAM is often incorporated into larger chips:

- **P82C206** (Square). Also has 2 DMA controllers, 2 Interrupt controllers, a Timer, and RTC (Real-Time Clock). It's usually marked CHIPS, because it's made by Chips and Technologies. Clear by shorting together pins 12 and 32 on the bottom edge or pins 74 and 75 on the upper left corner.

- **F82C206** (Rectangular). Usually marked OPTi (the manufacturer). Has 2 DMA Controllers, 2 Interrupt Controllers, Timer, and Real Time Clock. Clear by shorting pins 3 and 26 on the bottom edge (third pin in from left and 5th pin from right).

- **Dallas DS1287**, DS1287A, Benchmarq bp3287MT, bq3287AMT. The DS1287 and DS1287A (and compatible Benchmarq bp3287MT and bq3287AMT chips) have a built-in battery, which should last up to 10 years. Clear the 1287A and 3287AMT chips by shorting pins 12 and 21—you cannot clear the 1287 (and 3287MT), so replace them (with a 1287A!). Although these are 24-pin chips, the Dallas chips may be missing 5, which are unused anyway.

- **Motorola MC146818AP** or compatible. Rectangular 24-pin DIP chip, on older machines. Compatibles are made by several manufacturers including Hitachi (HD146818AP) and Samsung (KS82C6818A), but the number should have 6818 somewhere. Although pin-compatible with the 1287/1287A, there is no built-in battery, which means it can be cleared by just removing it from the socket, but you can also short pins 12 and 24.

- **Dallas DS12885S** or Benchmarq bq3258S. Clear by shorting pins 12 and 20, on diagonally opposite corners; lower right and upper left (try also pins 12 and 24).

For reference, the bytes in an AT CMOS with ISA bus are arranged thus:

00	Real Time Clock
10-2F	ISA Configuration Data
30-3F	BIOS-specific information
40-7F	Ext CMOS RAM/Advanced Chipset info

The AMI password is in 37h-3Fh, where the (encrypted) password is at 38h-3Fh. If byte 0Dh is set to 0, the BIOS will think the battery is dead and treat what's in the CMOS as invalid.

One other point, if you have a foreign keyboard (that is, outside the United States)—the computer expects to see a USA keyboard until your keyboard driver is loaded, so DON'T use anything in your password that is not in the USA keyboard!

Supervisor/User Password

Gives two levels of security; *Supervisor* has higher priority, so the other doesn't work if it's enabled. To disable, press **Enter** without entering anything.

Network Password Checking

When set to enabled, you are prompted for a password when connecting to a network. If disabled, password checking is left to the network. Best disabled.

Security Option

As for *Password Checking Option*, with two choices:

- *System*, where the machine will not boot and access to setup will be denied without the correct password.
- *Setup*, where access to setup is denied without the password.

This can be disabled by selecting *Supervisor/User Password Setting* at the main menu and pressing **Enter** without entering anything below).

Boot Sector Virus Protection

All it does is warn you when attempts are made to write to your boot sector or partition table, so it can be annoying when you see the error message every few seconds or so while trying to do something legitimate. Actually, it's useless for those drives that have their own BIOS in the controller (ESDI/SCSI). Disable when using Multiuser DOS, or installing software. Only available for operating systems such as DOS that do not trap INT 13.

Virus Warning

See *Boot Sector Virus Protection* (Award).

ChipAway Virus On Guard

See above. Guards against boot virus threats early in the boot cycle, before they have a chance to load.

Report no FDD for Win 95

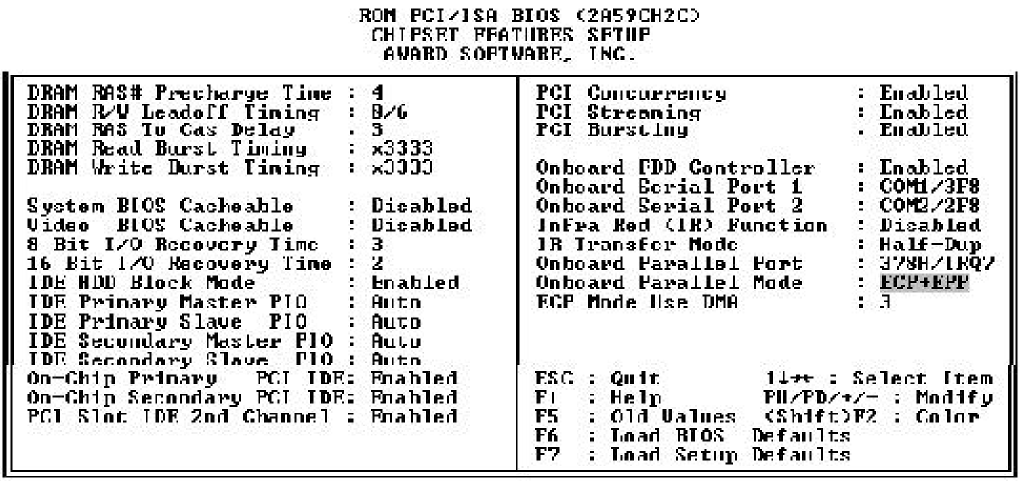
Set to *Yes* if using Windows 95/98 without a floppy to release IRQ6 (this is required to pass Windows 95/98's SCT test and get the logo). Also disable the Onboard FDC Controller in the **Integrated Peripherals** screen.

CPU L2 cache ECC Checking

If enabled, data is checked as it passes through the L2 cache, which reduces performance slightly. However, you must be running a fastish PII or above to see any difference.

Advanced Chipset

What you can do here depends on what facilities the motherboard manufacturer decides to supply you with when you want to program the chipset registers—it is not information used by the BIOS, but by the *chipset*. All the BIOS manufacturer has done is provide a screen so you can make your changes, if the motherboard designer allows you to use them. Bear in mind that the items in this area are actually provided for debugging purposes or to provide some level of tolerance for older expansion cards and slow memory chips; you alter the settings to help the machine cope with them. What one motherboard doesn't like is not necessarily wrong on another, so experiment!



There is a program called **amisetup**, written by Robert Muchsel, which interrogates your chipset settings at a very deep level, often allowing you to tweak settings not displayed. The shareware version can be downloaded from the MCCS BBS in Singen/Germany, on (49) 7731 69523 (use GAST as a username). It's on CIX or Compuserve as well. Try also **ftp://194.163.64.1/pub/sanisoft/amisetup.zip**. There's another one for other BIOSes, called **ctchip**-something, available from **www.sysdoc.pair.com**, but it doesn't work on all of them.

Highly recommended is **TweakBIOS**, which actually programs the chipset and PCI bridges on your motherboard. Available from **www.miro.pair.com/tweakbios/.**

Otherwise, you may find two sets of default settings, for convenience if you don't want to do too much tinkering; *Power-On* or *Setup Defaults* and *BIOS Defaults*. Power-On gives you the optimum (best case) settings for regular use, and BIOS Defaults are more conservative, being minimised for troubleshooting (that is, CPU in slow speed, no cache, etc).

For older AMI BIOSes (pre-1991), you can set the default values by holding down the **Ins** key and turning on the computer. An XCMOS Checksum Error will be generated. This can be corrected by entering XCMOS Setup, writing CMOS registers and exiting, and rebooting.

For newer versions, enter CMOS Setup and select:

```
LOAD DEFAULT VALUES
```

from the menu.

Note: **If your machine hangs** after changing anything, hold down the **Ins** key whilst switching the machine on, or the **Esc** key after rebooting—you can then load the default settings of your choice. Unfortunately, this takes you right back to the start, so take notes as you go along!

If you have a **green BIOS**, you might have *Auto Keyboard Lockout* set, in which case you need to press **Ctrl-Alt-Bksp**. The three keyboard lights will flash on and off and you will be prompted to enter the CMOS password.

Instructions for discharging the CMOS if you forget passwords are in the *Advanced CMOS Setup* section.

Automatic configuration

When this is *Enabled*, the BIOS sets its own values for some items, such as the Bus Clock Speed, Fast Cache Write Hit, Fast Cache Read Hit, Fast Page Mode DRAM, DRAM Wait State, DMA CAS Timing Delay, Keyboard Clock, etc (the items will vary between motherboards). The important thing to note is that *your own settings will be ignored*, so disable this one if you want to play, or have to change any of the above settings to accommodate a particular card, such as a Bus Logic BT-445S on a 50 MHz 486 system.

Refresh

Memory is addressed by row and column, with two strobe signals, *Row Address Strobe* (RAS) and *Column Address Strobe* (CAS). Normally, when a DRAM controller refreshes DRAM, CAS is asserted before RAS, which needs a CPU cycle for each event (known as *cycle steal*), but some techniques allow a RAS signal to be kept active whilst a series of CAS signals can be sent, or delaying a cycle from the CPU (cycle stretch).

The charge in a DRAM cell can go up or down, because it is surrounded by electrically active conductors and other cells, which leak their charges. DRAM refreshes correct for this by reading the charge, deciding on its value (0 or 1) and restoring the bit to a full 0 or 1, if the charge level is above or below a certain threshold. Most DRAM can maintain an accurate charge for 16-128 milliseconds between refreshes, but data loss can result if it is too slow. Every time an address is read, the whole row is refreshed when the access is completed. As long as the cell hasn't leaked so much that it changes state, it begins from scratch after each refresh. Refreshes are sometimes staggered to spread out the current surges, but this takes more memory bandwidth and has some impact on performance - the driver can only supply so much current, so adding DRAM can slow things down. In PCs, DRAM voltage can be nearly 6v because of reflections and ringing driving the +5 up, which can make the memory run hotter.

A *burst refresh* consists of a series of refresh cycles one after the other until all rows have been accessed. A *distributed refresh* is most common, occurring every 15.6 ns when DRQ0 is called by the OUT1 timer. The controller allows the current cycle to be completed and holds all the instructions while a refresh is performed. A *RAS Only refresh* occurs when a row address is put on the address line, and RAS is dropped, whereupon that row is refreshed.

CAS-before-RAS (CBR) is for powersaving. CAS is dropped first, then RAS, with one refresh cycle being performed each time RAS falls. The powersaving occurs because an internal counter is used, not an external address, and the address buffers are powered down.

If using a Cyrix chip, you may need to increase the refresh interval or enable Hidden Refresh (below) if your BIOS has no special handling facilities.

If you don't have EMS, cacheing controllers or laser direct printing cards on the expansion bus, disabling refresh for the bus can improve throughput by 1-3%.

Hidden Refresh

When CAS is low, RAS is made high, then low. Since CAS is low before RAS, you get a CBR refresh. The "hidden" part comes from the fact that data out stays on the line while refresh is being carried out, otherwise this is the same as CBR. If CAS is hidden, you can eliminate a CPU cycle whilst maintaining the cache status if the system starts power saving.

Best system performance is naturally obtained with this enabled, as no HOLD cycles will be asserted to the CPU, but expect to disable it if you are using 4Mb DRAMs (or certain SIMMs), or you get problems. Most of the effects of this setting are masked if you have a cache.

Hidden Refresh Control

See *Hidden Refresh*.

DRAM Refresh Mode

See *Hidden Refresh*.

AT Style Refresh

This happens when the refresh cycle starts with a process called *Hold Arbitration*, and proceeds when the CPU releases control of the memory, but since it holds the CPU up is now out of date. Disable.

Concurrent Refresh

If enabled, the CPU can read cache memory during a DRAM refresh cycle or, in other words, the CPU and refresh system have access to memory at the same time. Otherwise it is idle until refresh is complete, which is slower. Enable for Multiuser DOS on an Intel Express.

Decoupled Refresh Option

This is often called *Hidden Refresh*. Normally, motherboard DRAM and that on the data bus is refreshed separately, that is, the CPU sends refresh signals to both system RAM and the ISA bus; the latter takes longer because it's running slower. If enabled, the bus controller will perform arbitration between the CPU, DMA and memory refresh cycles on the bus, carrying them out in the background (i.e. hidden) so as not to hold the CPU up, and the DRAM controller will sort things out between the CPU and motherboard DRAM, thus the ISA bus refresh finishes while the CPU gets on with another instruction.

The problem is that some expansion cards (particularly video) need to have the CPU handle the first bus refresh cycle. Disable this if you get random characters or snowy pictures during high resolution graphics modes (you may need to disable *Memory Relocation* as well), albeit with the loss of a little performance. This is especially true with S3 801 boards (such as the SPEA V7 Mirage) coupled with Adaptec C cards and Bs fitted with enhanced ROMs for drives greater than 1 Gb.

Burst Refresh

Reduces overheads by performing several refresh cycles during a single Hold sequence.

Refresh When CPU Hold

Causes the CPU to pause whilst refreshing takes place. Slower.

DRAM Burst of 4 Refresh

Allows refreshes to occur in sets of four, at a quarter the frequency of normal, or in bursts occurring at quarter cycles. Enabling increases performance.

Fast DRAM Refresh

Two refresh modes are available here, *Normal*, and *Hidden*. CAS takes place before RAS in both but, in the latter, a cycle can be eliminated by hiding CAS refresh, which is faster and more efficient, allowing the CPU to maintain the cache status even in Suspend mode.

Divide for Refresh

As above, but you will have the choice of 1/1 or 1/4. 1/4 is best for performance.

Hi-speed Refresh

Affects system performance, except with some types of DRAM which cannot support it, in which case disable (especially for a 33MHz CPU). *Slow Refresh* (below) is preferred, since it gives longer between refresh cycles.

Slow Refresh

Enabled, makes refresh periods happen less often (typically 4 times slower than normal, at 64 rather than 16 ns, which is AT-compatible), so there is less conflict between refreshes and the CPU's activities, thus increasing performance (in other words, there is a longer time between refresh cycles, as modern memory chips can retain their contents better). You might use it if you were getting corruption because your DRAMs aren't fast enough. The timing is measured in microseconds.

Slow Refresh also saves power, which is useful on laptops. Not all DRAMs support this, so don't be surprised if you get parity errors! It requires proper DRAMs, and use 125ns if you get the option.

Slow Refresh Enable

See above.

DRAM Slow Refresh

See above.

DRAM Refresh Period

As for *Slow Memory Refresh Divider*; sets the time, in microseconds, between DRAM refresh cycles. The longer the interval, the better the performance because the CPU will not be interrupted as often, assuming your DRAM is capable. If you lose data, knock this figure down a bit. Choices are:

15us	15 microseconds (default)
30us	30 microseconds
60us	60 microseconds
120us	120 microseconds

Staggered Refresh

Where memory banks are refreshed one after the other. This limits the current used and helps stop interference, or power noise, between banks. The RAS of odd banks will go active 1T after even banks.

Slow Memory Refresh Divider

Normally, in the AT, DRAM is refreshed every 16 ns. A higher setting, say 64 ns, will give best performance. Sometimes *4* sets *60 ns*.

Refresh Value

Sets the refresh value for System RAM by programming the refresh timer (many shareware programs do this as well).

Refresh RAS active time

The time needed for the Row Address Strobe when DRAM is being refreshed, in T states. The lower the figure, the better the performance. Choices are:

6T Six CPU cycles (default).

5T Five CPU cycles.

Refresh RAS# Assertion

The number of clock ticks for which RAS# is asserted for refresh cycles – the type of refresh clock delay. The lower the better for performance.

DRAM RAS Only Refresh

An older alternative to CBR. Leave disabled unless needed for older DRAMs.

DRAM Refresh Queue

Enabled, permits queueing of up to 4 DRAM refresh requests so DRAM can refresh at the best time, with the 4th request taking priority. Otherwise, all refreshes take priority as normal. Most DRAMs can support this.

DRAM Refresh Method

Specifies the timing pulse width where the Row Address Strobe (RAS) will be on the falling edge and followed by the Column Address Strobe (CAS). You get the choice of *RAS Only* or *CAS before RAS*. A *RAS Only refresh* occurs when a row address is put on the address line, and RAS is dropped, whereupon that row is refreshed.

CAS-before-RAS (CBR) is for powersaving. CAS is dropped first, then RAS, with one refresh cycle being performed each time RAS falls. The powersaving occurs because an internal counter is used, not an external address, and the address buffers are powered down.

DRAM Refresh Rate

Use *15.6* for SDRAM and EDO/FPM, and *31.2* for EDO/FPM only.

DRAM Refresh Stagger By

The number of clock ticks (0-7) between refreshing rows in the memory array. Zero refreshes all rows at once.

DRAM Read Burst (EDO/FPM)

The lower the timing for reads from EDO or FPM memory, the faster memory is accessed, at the expense of stability and preservation of data.

Refresh Cycle Time (187.2 us)

The default of 187.2 us is safest against data loss.

Data Bus

To avoid confusion, a private message is sent along the data bus for 16-bit cards, before data is sent. The high part of the target address is sent out first, so 16-bit cards are alerted as to where instructions are headed. As these are sent out over the extra 4 address lines on the extended bus (20-23), the only information the cards really get is which of the 16 possible megabytes is the destination, so 3 of the original 8-bit lines are duplicated (17-19), narrowing it down to the nearest 128K.

Once a card decides the message is for itself, it places a signal on **memcs16**, a line on the extended bus, which triggers a 16-bit signal transfer (without the signal, the message is sent as 8-bit). When the CPU sees **memcs16**, it assumes the current access will be to a 16-bit device, and begins to assemble data so any mismatches are transparent to the CPU and adapter card. The trouble is that there's no specification governing the amount of time between the advance notice and the actual transfer, and some cards don't request 16-bit transfers quickly enough, so it gets its data as 8-bit, hence confusion, and the need for wait states. VGA cards can switch into 8-bit mode automatically, but many others cannot. I/O operations on the bus generally have an extra wait state compared to memory.

AT Cycle Wait State

This figure represents the number of wait states inserted before an operation is performed on the AT bus. The effect is to lengthen the I/O cycle for expansion cards that have a tight tolerance on speed, such as high-end graphics cards, or you might be overclocking and the ISA bus is tied to the PCI bus speed and you can’t change it.. The higher the delay in bus timing, the slower your system will run; 1 wait state can half the bus speed, and you will also need to set a higher DMA wait state.

Extra AT Cycle Wait State

See above. Inserts 1 wait state in the standard AT bus cycle.

16-bit Memory, I/O Wait State

The number of wait states inserted before 16-bit memory and I/O operations. You can often set this to the smallest value, since the device itself will activate the I/O-CHRDY signal, which allows it to extend the bus cycle by itself if required. If the bus is running faster than 8 MHz, 2 is generally safest. Try between 1-2 when running the bus slower.

8-bit Memory, I/O Wait State

If you get bus timing problems, this setting will insert wait states when accessing devices on the bus. You can often set this to the smallest value, since the device itself will activate the I/O-CHRDY signal, allowing it to extend the bus cycle by itself if required. If the bus is running faster than 8 MHz, 1 is generally safest. Try 0 when running the bus slower.

Command Delay

The length of the *address phase* of 8- or 16-bit bus cycles (data phases are controlled elsewhere), expressed in wait states, typically 0-3.

AT Bus I/O Command Delay

See *AT Bus 16-bit I/O Recovery Time* (below). Refers to a delay before *starting* an operation.

AT Bus 16 Bit Command Delay

Specifies the length of the *address phase* of 16 Bit AT Bus Cycles (data phases are controlled elsewhere – see *AT Bus n Bit Wait States*, below). The typical delay will vary from 1-4 cycles (0-3 wait states), but the 82C211 to which this refers defaults to 2 normally and this may be ignored. Leave alone normally.

AT Bus Address Hold Time

See *AT Bus 16-bit Command Delay* (above).

AT Bus n Bit Wait States

Specifies the duration (in wait states) of the *data phase* of I/O operations on the AT bus (see *AT Bus 16 Bit Command Delay*, above for address phases). 16 bit values vary between 0-3 wait states and 8 bit values from 2-5, though this may vary. Again, normally, leave this alone.

16-bit I/O Recovery Time

Specifies the length of an additional delay inserted *after* 16-bit operations, for older ISA cards; in other words, the system allows more time for devices to respond before assuming a malfunction and stopping requests for I/O. There is usually an automatic minimum delay of four SYSCLKs between back-to-back I/O cycles to the ISA bus, so these are extra. SYSCLKs are complete machine clock cycles; get best performance with the lowest figure. On PCI systems, bus clock cycles are added between PCI-originated I/O to the ISA bus.

8-bit I/O Recovery Time

As for *16-bit I/O Recovery Time*.

ISA I/O Recovery

As for *16-bit I/O Recovery Time*.

ISA I/O wait state

Adds wait states to the bus so expansion cards can cope with higher speeds better. *Normal* is compatible with standard AT timing, and wait states are on top of that.

ISA memory wait state

Adds wait states to the bus so memory on expansion cards can cope with higher speeds better. *Normal* is compatible with standard AT timing, and wait states are in addition to that.

ISA write insert w/s

If your ISA card doesn't like the write cycles on the bus, you can extend the timing here.

W/S in 32-bit ISA

Selects the 32-bit ISA cycle wait state. Lower numbers mean better performance.

16 Bit ISA I/O Command WS

The number of wait states between back-to-back I/O to 16-bit ISA devices, which will be slower than the main system – if a device doesn't respond quickly enough, the system may think it has malfunctioned and stop its request for I/O.

16 Bit ISA Mem Command WS

The wait states between back-to-back memory reads or writes to 16-bit ISA devices, which will be slower than system memory and may need some allowance.

AT Bus Clock Source

The AT bus clock is an output clock for the I/O channel. This allows you to change the *access speed* of the (ISA) bus, which should be between 6-8.33 MHz to be compatible with AT specifications (not that any were officially issued), so if your motherboard or PCI bus is running at 33 MHz, divide this by 4 (CLKIN/4, or PCI/4) for memory rated at 70 ns. Choosing *Autosync* sets this item based on the CPU clock speed. Only valid when *Auto Config* is disabled. A 16-bit card run too fast may revert to 8-bit mode, and others may inject wait states. Values from CLKIN are synchronous – the 7.159 MHz option, if you have one, is asynchronous.

AT Clock

See *AT Bus Clock Source* (above).

AT Bus Clock

The speed of memory access (not ISA bus speed, as above), set to various fractions of PCI clock speed (default PCI/3, or 11MHz, which allows about 90 ns per memory access. This comes from the Opti Viper chipset – most others use wait states. In some chipsets, this refers to generating the ISA bus clock speed from PCICLK, and setting the AT bus speed in terms of CPU speed or 7.16 MHz.

AT Clock Option

Whether the AT bus clock is synchronised with the CPU clock or is asynchronous. See also above.

ATCLK Stretch

Stops the I/O bus clock when there is no activity on the bus. ATCLK is used if the bus is asynchronous.

Synchronous AT Clock

Measured as a fraction of CLK, the CPU timing signal.

Bus Clock Selection

As for *ATCLK Stretch*.

ISA Bus Speed

As for *ATCLK Stretch*, but for PCI Pentiums. What speeds you get for the compatible and enhanced selections depends on the CPU speed:

CPU Speed	Compatible	Enhanced
60	7.5	10
66	8.25	16

Bus Mode

You can set the bus to run synchronously or asynchronously with the CPU. When synchronous, the bus will run at a speed in sympathy with the CPU clock, e.g. 33 MHz=CLKIN/4.

Fast AT Cycle

Similar to *Bus Mode*, affecting wait states. May speed up transfer rates if enabled by shortening AT bus cycles by one ATCLK signal.

ISA IRQ

To let PCI cards know which IRQs are in use by ISA cards so the Plug and Play system doesn't use them.

Master Mode Byte Swap

For bus mastering cards, such as SCSI controllers and fast network cards, affecting transfers from the bus master to 8-bit peripherals; *Low*, then *High* and back. Normally disabled.

DMA clock source

The DMA controllers allow certain peripherals to access memory directly (hence *Direct Memory Access*). Usually, only the floppy controller uses it, but tape streamers, network cards and SCSI adapters might, amongst others. This setting selects the source for the DMA clock, which runs at ½ the bus clock speed (e.g. ATCLK/2). Maximum is usually 5 MHz.

DMA Clock

As above – sets DMA speed at equal to or ½ the speed of SYSCLK.

DMA Wait States

Affects the number of wait states inserted before DMA commands are executed. Often appears separately for 8 and 16-bit transfers (as 8 is used for floppy transfers, adjusting the 16-bit variety doesn't affect them). In general, slower cards may require more wait states. DMA settings often affect reliability rather than performance. For low CPU speeds (<= 25 MHz, this should be 0; otherwise set to 1).

DMA Command Width

You can compress the "normal" DMA transfer cycle of 4 clocks to 3 with this setting.

MEMR# Signal

Concerning DMA transfers, you can set the MEMORY READ control signal to start one clock cycle earlier than normal with this setting. Affects reliability.

MEMW# Signal

As above, but for the MEMORY WRITE signal.

DMA Address/Data Hold Time

"During the DMA/Master cycle, address and data from the X or S-buses are latched and held to local bus-DRAM/CACHE RAM operation". I haven't a clue what that means, but the X-bus is the peripheral bus where the support chips are located (e.g. 82C206 or equivalent), and the S-bus is the expansion bus. Perhaps it means that when DMA mode is operative, data in the local bus, cache or DRAM is held where it is. Latch is techie-speak for "read".

DMA MEMR Assertion Delay

Whether the signal to write to memory is delayed by a cycle from the signal to read the I/O port during DMA operations. This affects reliability and should normally be left alone.

I/O Recovery Time Delay

The AT Bus uses wait states to increase the width of an AT BUS cycle, for slower-reacting expansion cards, and this refers to the delay *before* starting Input/Output cycles. The lower the value, the better the performance, but you might have to change DMA settings as well.

I/O Recovery Select

As for *I/O Recovery Time Delay*.

AT Bus Precharge Wait State

Set to 0 for best performance, but you may need 1 for some devices, such as the AHA 1542B, at high speeds.

I/O Cmd Recovery Control

If enabled, a minimum of 7 bus clocks will be inserted *between* any 2 back-to-back I/O commands. This helps with problematic expansion cards and can affect ROM wait states, DMA and bus timing. Disable this, or set to *Normal* or the lowest figure available for best performance. Also known as *Timing Parameter Selection*.

Single ALE Enable

ALE stands for *Address Latch Enable*, an ISA bus signal used by 808x processors when moving data inside the memory map; it is used by DMA controllers to tell the CPU it can move data along the data bus, or that a valid address is posted. Conversely, they can stop this signal and make the CPU wait while data is moved by the controller, so set to *No* for normal use.

When the CPU wants data, it places the addresses it wants to look at on the bus, followed by a control signal to let the memory controller know the address is there, which then latches the address, decodes it and puts what the CPU wants on the bus, where it can be latched in turn by the CPU (*latch* means *read*).

If enabled, single instead of multiple ALEs will be activated during data bus access cycles. *Yes* is compatible with AT bus specifications, giving less performance, as multiple ALE signals during a single bus cycle effectively increase the bus speed, if the hardware can handle it. This sometimes appears in older BIOSes as *Quick Mode*, and you might see *Extended ALE* instead of *Multiple*. May slow the video if enabled, or you might get missing characters on screen.

ALE During Bus Conversion

Selects single or multiple ALE signals during bus conversion cycles. Depends on system speed.

E0000 ROM belongs to AT BUS

Officially, the E000 area of upper memory is reserved for System BIOS code, together with F000, but many machines don't use it, so E000 can often be used for other purposes (note, however, that this 64K is needed to run protected mode software, such as Windows, OS/2, or

Multiuser DOS, which loads Advanced BIOS code into it). This will only tend to appear on older machines, as PCI needs it too. It determines whether access to the E area of upper memory is directed to the system board, or to the AT bus. Set *Yes* if you want to use it for anything like a page frame or a Boot ROM), or if you're using Multiuser DOS and want the maximum TPA to be available. Can also turn up as *E000 ROM Addressable*.

Internal MUX Clock Source

Mux means *Multiplex*. Controls the frequency of polling the IRQ, DRQ and IOCHCK# signals. Sometimes this has an AUTO setting which sets the frequency according to CPU speed, but usually SCLK/1 is recommended. I don't think it refers to *Memory, Upper* and *XMS* specified in some operating systems, like Novell DOS 7.

Fast Decode Enable

According to one motherboard manual, DRAM access is speeded up if this is enabled, and it's possibly ignored if internal/external cache is present. Otherwise, it enables a chipset initiated reset of the CPU when the keyboard controller is instructed to do it, speeding up the transition from protected to real mode on 80286 CPUs and above. See also *Fast Gate A20 Option*, and *Fast Reset Emulation*.

Fast CPU Reset

See *Fast Reset Emulation*.

Extended I/O Decode

In (8-bit) ISA systems, ten address lines are normally used for I/O address decoding, that is, in ports 000-03FF. If your motherboard uses more, enable this for better performance to get 0000-FFFF. Some cards can use the same lower 10 bits by accident, in which case enable this. Otherwise, leave it (more in *Base I/O Address* in *Expansion Cards*).

Local Bus Ready Delay 1 Wait

Mostly disable this in systems running at 33 MHz or below, but some VL-bus devices may need 1 wait state anyway. You may need to enable this (i.e. insert 1 wait state) for 50 MHz.

Local Bus Ready

Selects the timing the system will use to exchange data with a VL-bus device after it has signalled that it is ready. The choices are:

Synchronize Synchronize and pass to VESA slot in the next clock (def).

Transparent Enable the exchange immediately, i.e. pass the LRDY# signal directly from VESA slot via chipset to CPU.

Local Bus Latch Timing

Specifies the time period in the AT machine cycle when the VL-bus is latched (read), so data can be transferred reliably, that is, to hold data stable during transactions with the local bus, the local bus will be latched after a read command and before the end of the AT cycle. This determines how long the system will wait to latch the bus after the read command has gone inactive. Use *T2* (2 clocks) for 25/33 MHz, or *T3* (3 clocks) for 40/50 MHz. T2 is earlier in the cycle than T3.

Latch Local Bus

See *Local Bus Latch Timing*.

ADS Delay

Concerns the local bus. If set to enabled, it affects performance; the default is disabled, or no delay. ADS# is a bus control signal, or an *Address Status* strobe driven by the CPU to indicate the start of a CPU bus cycle. It indicates that a valid command and address is stable on the bus. When enabled, more time will be allocated for ADS; you would only need this if a faster processor has been added.

CPU ADS# Delay 1T or Not

With a CPU clock is 50Mhz, choose *Delay 1T*. Otherwise, disable. Probably only for BIOSes that support PS/2 mice.

Fast Programmed I/O Mode

Controls the speed at which Programmed I/O (PIO) transfers occur on the PCI IDE interface. If disabled, Mode 0 (e.g. unoptimised) is used, so only use this if a device cannot function with advanced timings.

IDE Multi Block Mode

This setting may only be relevant under DOS or Win 3.x, as 95/98 and NT have their own drivers. It enables suitably configured IDE hard drives to transfer multiple sectors per interrupt, as opposed to one (there may be an option to specify the number of sectors), using the ATA Read Multiple and Write Multiple commands. For example, setting 16 saves 1920 (2048-128) interrupts - this is to avoid situations where the CPU can take some time to reply to an interrupt. There are several modes available, often dependent on the size of your hard disk cache, because if there isn’t one, data cannot be queued properly.

The first three, 0-2, are from the old ATA standard. The others (3 and 4) are ATA-2 specific and use the IORDY line to slow the interface down if necessary. Interfaces without proper IORDY support may cause data corruption, so don't expect to mix two drives with different modes on the same channel. If you must mix, and you get problems, force each drive to its proper mode.

Mode 0 Standard Mode; conforms to the original PC, compatible with all drives. Single sectors transferred with interrupts.

Mode 1 Polls the drive to see if it's ready to transfer data (no interrupts).

Mode 2 Groups of sectors are transferred in a single burst.

Mode 3 Uses 32-bit instructions, up to 11.1 Mb/sec.

Mode 4 Up to 16.7 Mb/sec. Two versions; the second supports 32-bit transfer, possibly to cope with 32-bit disk access.

Mode 5 Up to 20 Mb/sec, but now abandoned in favour of Ultra DMA, due to electrical noise.

This setting only concerns transactions between the CPU and the IDE controller – UDMA or Ultra ATA are not the same thing and concern themselves with the IDE controller and the device. It can mess up comms software when up- or downloading, because multi block transfers cannot be interrupted, and you may lose characters. For example, you need to run **telix** with the D option (e.g. drop DTR when writing to disk), or use buffered UARTS for terminals with Multiuser DOS. Consider also disabling Smartdrive. The T I Chipset has problems with this as well, due to its plumbing arrangements; it gets its timing from the PCI clock, with a minimum (fastest) cycle of 5 clocks, so the maximum transfer rates achievable are:

PCI Clock (MHz)	Transfer Rate (Mb/sec)
25	10
30	12
33	13.3

There is also a reliability problem, and you will probably get data corruption if you try and get more than 11 Mb/sec or so with Mode 4 (Microsoft also suggest that this should be disabled for Windows NT – see article **Q152/3/07.asp**), so the MR BIOS doesn't select rates beyond that automatically. If you're allowed to set block sizes, the FAT system seems to like them the same as the cluster size, and as what's best for the drive is not necessarily best for the system as a whole, check this with a high level benchmark, that is, at application level. Quantum have a document called *ATA Signal Integrity Issues* that explains more.

It's best not to have EIDE CD-ROMs on IDE channels by themselves, (say, in a SCSI system) as 32-bit addressing may only be turned on with a suitable hard drive installed as well. 24x CD ROMs cannot reach full speed in 16-bit mode.

IDE Block Mode Transfer

As for *IDE Multi Block Mode*.

Multi-Sector Transfers

As for *IDE Multi Block Mode*, allowing you the choice of 2, 4, 8 or 16 sectors. An *auto* setting queries the drive and allows it to set itself.

IDE Multiple Sector Mode

If *IDE Multi Block Mode* (or similar) is enabled, this sets the number of sectors per burst. Setting 64 gives the largest size your drive supports. Watch this with comms; when multiple sectors are being transferred, they can't be interrupted, so you may lose characters if you don't have buffered UARTS. See *IDE Multi Block Mode* above.

Multiple Sector Setting

As for *IDE Multi Block Mode*. The number of sectors transferred per interrupt. If disabled, an interrupt will be generated for each sector transferred. You get a choice of 4, 8 or AUTO.

IDE (HDD) Block Mode

Makes multi-sector transfers, as opposed to single-sector transfers, or reads and writes using large blocks of data rather than single bytes. It affects the number of sectors that can be transferred per interrupt. Only appears in BIOSes dated approximately 08/08/93 or later. This can also be called *block transfer, multiple commands* or *multiple sector read/write*. The automatic setting will sort out the optimum rates.

IDE 32-bit Transfer

Many local bus interfaces can combine two 16-bit words into a 32-bit doubleword when reading data to and from the disk, since the IDE channel itself is only 16-bit. This is particularly useful with bus mastering, and is often called *32-bit access*, though it's really 32-bit host bus transfers. Either way, more efficient use is made of the bus and CPU, so this may or may not make much difference if you don't actually have a bottleneck. This is not the same as Windows' 32-bit features, which are also misnamed as they just work in protected mode.

Like Block Mode, this setting only concerns transactions between the CPU and the IDE controller – UDMA or Ultra ATA are not the same thing and concern themselves with the IDE controller and the device. If disabled, 16-bit data transfers are used, so performance will be less. If enabled, hard disk data is read twice before request signals are sent to the CPU. This setting can only be enabled if *IDE Prefetch Mode* is also enabled (below). As far as AMI are concerned, the WinBIOS will initialise the hard disk firmware for 32-bit I/O, assuming your hard disk is capable—it refers to the new release of high performance Mode 4 drives. Microsoft suggest that this should be disabled for Windows NT - see article **Q152/3/07.asp**.

IDE Primary Master PIO

Enables PIO mode, as opposed to DMA. With PIO, all data is passed thru the CPU, which is inefficient, but at least it maintains cache coherency and allows the Operating System to move buffers around without problems. Phoenix have recommended using fast IDE timing and Block Mode instead of PIO Mode 3.

IDE Primary/Secondary Master/Slave PIO

You can set a PIO mode (see above) for each of the four IDE devices your system supports. *Auto* is usually best, especially if you change drives a lot.

IDE Primary/Secondary Master/Slave UDMA

See above.

IDE DMA Transfer Mode

The default is *Disabled* (=PIO), but you have the choice of:

- ❑ *Type B* (for EISA).
- ❑ *F* or *Standard* (PCI) as well (EIDE supports B/F, for 8.53-13.33 Mb/sec).

Type F is an 8.33 MHz EISA-style PCI DMA (normal is 5 MHz) for PCI/ISA, which replaces EISA type C, although A and B type transfers are supported. C is a burst mode that needs special controller logic. However, with F, you cannot DMA into ISA memory, only PCI, and neither does Type F apply to PCI bus mastering. The Standard setting is the same as *Disabled*, but you can set the number of sectors per burst (see below). Type F is fastest, but there may be conflicts with multimedia. IDE CD ROM drives require Standard or Disabled.

Channel 0 DMA Type F

What DMA channel the *first drive* (0) in the system uses when set to F (see *IDE DMA Transfer Mode*). Choices are *Disabled* (no drive capable), *0*, *1*, *2*, or *3*.

Channel 1 DMA Type F

As for *Channel 0 DMA Type F*, but for the second drive.

ISA IRQ 9,10,11

These may be used by the PCI bus if they are available, so set them as *Used* if you want to reserve them. Some VGA cards like to use 9, but many don't, so you might save yourself an interrupt.

Large Disk DOS Compatibility

For drives greater than 528 Mb *not* using LBA. This and LBA are not supported by all operating systems (e.g. UNIX R3.2.4).

IDE Translation Mode

For using large IDE drives. Disable for smaller drives below 528 Mb.

Choices are:

Standard CHS	(Cylinders, Heads, Sector)—limit is 528 Mb.
LBA	*Logical Block Addressing*; both BIOS and drive must support it. CHS addresses are used to create a 28-bit

Logical Block Address rather than being mapped separately; in short, LBA sequentially assigns unique numbers to sectors, which are not necessarily in the same place if the drive is used on another machine.

Extended CHS Similar to LBA, but not quite. Also known as *Large*. Can better performance of LBA.

Different systems cope with the above in different ways; Unix does its own thing, OS/2 2.1 can support them all, as can DOS and Windows, but if you're running Windows' 32-bit Disk Access, select *Standard CHS*, unless you have a version of **wdcddrv.386** that supports advanced geometries. OS/2 2.0 and Netware cannot support LBA. If set to *Auto Detect*, the BIOS will detect what the drive is capable of, not what it is formatted with. Your hard drive may require different input to the CMOS for each method. See also *Hard Disk (C and D)*.

Onboard CMD IDE Mode 3

Found where CMD Enhanced IDE chipsets are built in to the motherboard. The code is kept in a ROM at E800, and this setting allows access to it. Enable for best performance, as the code will still be used to optimise hard disk useage, with 32-bit I/O, even if it is not compatible with Mode 3.

Note: There are considerable problems with many PCI motherboards and CMD controllers, especially with true 32-bit operating systems, where subtle changes are made to your files; that is, bytes are randomly changed once in a while. The problems also appear with Windows for Workgroups in 32-bit mode during floppy backup and restore.

More information from **http://tcp.ca/Nov95/PCIController.html**.

IDE LBA Translations

See *IDE Translation Mode*.

LBA Mode Control

See *IDE Translation Mode*. Turns LBA on or off.

IDE Prefetch Mode

Enables prefetching for IDE drive interfaces that support it. If you are getting drive errors, change the setting to omit the drive interface where the errors occur. Does not appear when *Internal PCI/IDE* is disabled.

Enhanced ISA Timing

Gives higher bus speeds, set by manufacturer.

Back To Back I/O Delay

Inserts a slight pause (say 3 ATCLK signals) in between processes talking to the same I/O port.

DMA FLOW THRU Mode

Enable this if you enable write buffers to avoid inconsistencies; this makes the DMA wait until all write buffers are empty. You won't increase performance by increasing the DMA clock by itself but, since it's often linked to the bus clock, will increase in sympathy with it. Generally, only floppies use DMA anyway, but some tape streamers and sound cards do.

Extended DMA Registers

DMA normally takes place inside the first 16 Mb of address space on an AT. This setting allows you to use the whole 4 Gb of a 32-bit processor.

Hard Disk Pre-Delay

POST procedures are quite fast these days. This setting delays the BIOS's attempts to initialise the first IDE drive in the system, so slower devices can have a chance to get their act together; some drives may hang if they are accessed too soon. Set this in conjunction with *Initialisation Timeout* (below). See also *Cold Boot Delay*.

Initialisation Timeout

The number of seconds the BIOS will wait to see if an IDE drive is there before proceeding. Works with *Hard Disk Pre-Delay*. If your drive doesn't respond within the specified period, the system will not recognize it.

Hold PD Bus

Sets the timeout function of the processor data bus, presumably before it assumes a malfunction. The default is 1-2T.

DMA Channel Select

Helps you change IRQ and DMA channels of a built-in SCSI controller.

Concurrent Mode

Allows DMA access for floppies and tapes, as QIC and other systems commonly share controllers with floppy disks. However, many computers will not support this.

Fast Programmed I/O Modes

Controls the speed at which PIO transfers occur over the PCI IDE interface:

Disabled Mode 0

Autodetect Rated maximum of the drive

Only set disabled if a drive incorrectly reports its capabilities. Do not use mixed mode drives on the same channel; at least, don't let the BIOS on a board with a Triton chipset make its own decision, as it seems unable to handle two drives with separate EIDE rates; they share a common timing register. The MR BIOS can handle this better than most.

Data Transfer

You have the following choices:

PIO Polling mode; the CPU controls everything and fetches each byte from the controller through I/O addresses.

DMA Transfer is done by DMA, which is faster when multitasking, as the CPU can get on with something else whilst data is being transferred. With ISA, this only works below 16 Mb.

Don't switch on DMA mode with a PIO device installed.

DMA Frequency Select

Sets the frequency at which DMA (Direct Memory Access) data transfers take place as a function of the system clock. Choices are:

SYSCLK/1 Enable one full system clock cycles

SYSCLK/2 Enable one-half system clock cycle (default)

Local Device Syn. Mode

Concerns *Synchronous* and *Bypass* mode for the CPU's signal to terminate Local Bus cycles. Bypass mode, or *transparent mode*, gives better performance, but is limited to 33 MHz or below because it is not compatible with VL bus cards.

Cacheing

Disabling cacheing often cures obscure memory problems; it may be because non-32-bit address cycles are redirected to the AT Bus. Certainly, with cacheing enabled, only 32-bit cycles are affected, but *Hidden Refresh* is often automatic as well. Also, Shadow RAM is cached here. Be aware that some chipsets do more than just disable the cache when you select *Disable*. Cache SRAM can be tested in the same way as DRAM, except for Tag RAM, which cannot be written to directly, so there is a special access channel for testing. Data is written, read and checked for consistency. If this can be done in a certain time, say by the end of T2, it is likely to be Burst SRAM. SRAM chips share a common data bus with other memory processor devices which need to control the bus at some time or other. If you minimise the cycle times for each, you get the maximum performance. *Bus contention* occurs when 2 devices are trying to use the bus at the same time. Any settings with regard to this therefore affect reliability.

Certain cycles are non-cacheable anyway, such as I/O cycles, interrupt acknowledge cycles, halt/shutdown cycles and some memory areas.

Cacheable cycles come in four varieties:

- *Read Hit* means the system reads the data from the cache, therefore not needing to go to system memory.
- *Read Miss* means the data is not in the cache, so it goes to system memory and will copy the same data to the cache.
- *Write Hit* means the system writes the data the cache and main memory.
- *Write Miss* means the system only writes the data to system memory.

Cache RAM (SRAM) Types

Here you can tell the machine what sort of Level 2 cache RAM it has to deal with, *Pipeline*, *Burst* or *Synchronous*. They are fully described in the *Memory* section.

Pipeline Cache Timing

Two choices, *Faster* and *Fastest*, to suit the speed of your memory. Select the former for a one-bank L2 cache, and the latter for two banks.

Cache Timing

As above.

F000 Shadow Cacheable

When enabled, accesses to the System BIOS between F0000H-FFFFFH are cached, if the cache controller is enabled.

Fast Cache Read/Write

Usually used if you have two banks of external SRAM cache chips, that is, 64 or 256K. It's similar to Page Mode for DRAM.

Flush 486 cache every cycle

Enabled, flushes the internal 8K cache of the 486 every cycle, which seems to defeat the object somewhat. Disable this.

Read/Write Leadoff*

Before data can be accessed, the core logic must issue the memory address signal, the column address strobe (CAS) signal and the row address strobe (RAS) signal to the DRAM. However, these signals are not issued at the same time—the time difference between them is called the lead-off time, and often equates to the timing of the first cycle in a burst. It varies for read and write actions, depending on the DRAM—some may require longer delays.

Async SRAM Read WS

Allows you to choose the timing combination for your motherboard and memory with regard to read cycles.

Async SRAM Write WS

Allows you to choose the timing combination for your motherboard and memory with regard to write cycles.

Async SRAM Leadoff Time

Sets the number of CPU clock cycles your asynchronous SRAM needs before each read from or write to the cache. See also *Read/Write Leadoff*.

Sync SRAM Leadoff Time

Sets the number of CPU clock cycles your asynchronous SRAM needs before each read from or write to the cache. See also *Read/Write Leadoff*.

Async SRAM Burst Time

Sets the timing for burst mode cache operations. The fewer the faster.

Cache Read Hit Burst

Burst Mode is a 486 function for optimising memory fetches if you need to go off-chip, which works by reading groups of four double-words in quick succession, hence *burst*. The first cycle has to cope with the start address as well as its data, so it takes the longest (the other three addresses are deduced). Once the transfer has been started, 4 32-bit words could therefore move in only 5 cycles, as opposed to 8, by interleaving the address and data cycles after the first one. For this, you need fast RAM capable of *Page Mode*.

This setting determines the number of cycle times to be inserted when the CPU reads data from the external (Level 2) cache, when it can't catch up with the CPU (you may see similar figures allocated to L1 cache, on chip). The *Secondary Cache Read Hit* can be set to 2-1-1-1, 3-1-1-1, 2-2-2-2 or 3-2-2-2 (3-1-1-1 means the first 32-bit word needs three clock cycles and the remainder need one, giving a total of 6 clock cycles for the operation).

Performance is affected most by the first value; the lower the better; 2-1-1-1 is fastest. You can alter it with the *Cache Read Hit 1st Cycle WS* setting. This will have no effect if all the code executes inside the chip.

For example, the setting for 33 MHz may need to be changed to 3-2-2-2 if you only have 128K, or with Asynchronous SRAM. The following may be useful as a starting point (1 bank cache/2 banks cache):

Item	20 MHz	25 MHz	33 MHz	50 MHz
SRAM Read Burst Control	3222/2111	3222/2111	3222/3111	3222

Item	20 MHz	25 MHz	33 MHz	50 MHz
SRAM Write Wait States	0W	0W	1/0W	1W
DRAM Write Wait States	0W	0W	1W	1W
DRAM Read Wait States	1W	2W	2W	3W
RAS# to CAS# Delay	1 Sysclk	1 Sysclk	1 Sysclk	2 Sysclk

Pentiums can perform Burst Writes as well as Burst Reads, so you might have a separate selection for these. 4-1-1-1 is usually recommended.

Cache Burst Read Cycle Time

See *Cache Read Hit Burst*. Automatically set to 2T if only one bank of Level 2 cache is available, that is, the whole cycle takes place inside 2 T-states.

Cache Read Burst

This covers how data is read from the cache, depending on the cache size and speed of its memory. In this particular case, the default may be best.

Cache Write Burst

Similar to above, but for writes to the cache.

SRAM Read Timing

Similar to *Cache Read Hit Burst*. Relates the number of cycles taken for the SRAM address signal to the number allocated for the actual read. 2-1-1-1 is the default.

SRAM WriteTiming

Sets timing, in CPU wait states, for writes to external cache. *0 WS* is the default.

Burst SRAM Burst Cycle

This sets the precise timing of the burst mode read and write cycles to and from the external cache. Choices are:

4-1-1-1 Slower.

3-1-1-1 Fastest (Default).

SRAM Back-to-Back

Reduces the latency between 32-bit data transfers, so it is transferred in 64-bit bursts.

SRAM Type

Which type, *Async* or *Synchronous*, is installed.

Cache Mapping

Direct mapping is where data is loaded in one block. *N-way* is divided into *n*-banks (2-way, 4-way, etc). Further explained in the *Memory* chapter.

Data Pipeline

With reference to cache mapping above, after accessing DRAM for the first time, the data is stored in a pipeline. Enabling this is best for performance.

Cache Wait State

0 for best performance, but 1 may be required for VL bus devices at higher speeds. SRAM used for cacheing has a minimum access time requirement, otherwise you will get malfunctions. The trick is to use the least number of wait states that don't cause failures.

Cache Read Burst Mode

An Award setting, for 486s. See *Cache Wait State,* above.

Cache Write Burst Mode

An Award setting. See *Cache Wait State,* but delete *Read* and insert *Write.*

Cache Read Cycle

As for *Cache Wait State.*

Cache Read Wait State

Sets the number of wait states to be added on reads from cache memory, just in case you're using slow cache chips, or you wish to preserve data integrity. This affects the cache output enable signals, specifically CROEA# and CROEB#. They are active for 2 CPU clocks at 0 wait states, or 3 at 1, which should be used for 40 MHz 486s (you can use 0 wait states at 33 MHz). Some VL bus devices need 1 wait state on 50 MHz systems. Whatever you set here is automatically adjusted anyway during L2 write-back-to-DRAM cycles for synchronisation purposes with the DRAM controller.

Cache Write Wait State

Similar to above, but for writes. May be selected by the board designer.

CPU Internal Cache/External Cache

Enables or disables L1 and L2 caches.

Cache Write (Hit) Wait State

Sets the wait states to be added on writes to cache memory. 1 should be used for 40 MHz systems, and you can use 0 at 33 MHz. Some VL bus devices need 1 on 50 MHz systems.

CPU Cycle Cache Hit WS.

Normal Refresh with normal CPU cycles.

Fast Refresh without CPU cycles for CAS.

The second option saves a CPU cycle; see also *Hidden Refresh*.

Fast Cache Read Hit

Should be enabled if you have 64 or 256K of cache memory installed; otherwise it should be disabled.

Fast Cache Write Hit

See *Fast Cache Read Hit*.

Cache Tag Hit Wait States

This is similar to *Cache Read Wait States*, in that it allows you to set the number of wait states, 0 or 1, used to test for a cache tag hit.

Tag Compare Wait States

The tag sample point can be in the first T2 cycle (0 wait states) or the second (1 wait state). For the former, you need 12 ns SRAM or faster.

Cache Scheme

Concerns the Level 2 cache on the motherboard, between the CPU and memory, and whether it is to be *Write Back* (WB) or *Write Thru* (WT). The latter means that memory is updated with cache data every time the CPU issues a write cycle. Write Back causes main memory updates only under certain conditions, such as read requests to memory locations with contents currently in the cache, so the CPU to work with fewer interruptions, increasing efficiency, but is not as safe in the event of power loss.

HITMJ Timing

For a write-back L1 cache, you can select the HITM# signal as inactive to the timing relating to IOCHRDY inactive. The choices are 2, 3, 4 or 6T. With only write-through, this cannot be used. 1t is equal to 1 CPU clock.

Internal Cache WB/WT

See *Cache Scheme*.

External Cache WB/WT

See *Cache Scheme*.

CPU Level 1 Cache

Enables or disables the internal CPU cache. You might disable it for stability reasons, or for performance when playing games or manipulating really large files. This will not make the machine run faster, but will stop it running slower when working with those items.

CPU Level 2 Cache

See above.

CPU Level 2 Cache ECC Checking

Error Correction Code works with the memory controller to add bits to each bit sent to memory. The extras are decoded to make sure that data is valid, and are used to duplicate the information should it be necessary. This setting enables or disables ECC checking by the L2 cache, to detect and correct single-bit errors in data stored there. Multi-bit errors are also detected but not corrected. There might be a slight overhead from the extra checking, but the performance difference is negligible.

Cache Write Back

See *Cache Scheme*.

L2 Cache Write Policy

See *Cache Scheme*.

L1 Cache Write Policy

As for *Cache Scheme*, for L1 (internal) cache on the CPU.

L1 Cache Policy

See above.

L1 Cache Update Mode

See *Cache Scheme*.

L2 Cache Write Policy

Similar to above, but you might also see Adaptive WB1 and Adaptive WB2, which try to reduce the disadvantages of write-back and write-thru caches.

L2 Cache Enable

When disabled, any cache addresses are regarded as misses, so the CPU talks directly to main memory; the effect is the same as not having it, as the cache is not actually turned off, and you just can't read from it. This is so that if it does become enabled, you can get coherent data immediately, as it is still being updated.

L2 Cache Zero Wait State

With a slower cache, disable this to have one wait state when accessing the external cache controller. When enabled, the chipset will not wait.

L2 Cache Cacheable Size

The size of the system memory that L2 cache has to cope with. Up to 64 Mb or 512 Mb on HX motherboards, and must be set at least as high as the memory you have. Chips with an integrated L2 cache (i.e. Pentium Pro, PII, etc) will not use this.

L2 Cache Cacheable DRAM Size

See above.

L2 Cache Latency

In theory, the lower the value, the faster the performance, at the expense of stability, until it is set too low, whereupon the cache will not work at all and neither will the system - the best way to find out the optimum value is to test. Performance gains are reported to be small, but high values here help with overclocking, which is probably why it was included. The default setting, for the Celeron anyway, is 5.

Cache Over 64 Mb of DRAM

See above.

Linear Mode SRAM Support

Enable if you have an IBM/Cyrix CPU and linear mode SRAM, to get slightly better performance. Disable for Intel CPUs, as they only support Toggle Mode.

M1 Linear Burst Mode

See above. Enable for a Cyrix M1.

Cache Write Cycle

Affects the data hold time for writes to DRAM.

Posted Write Enable

A Posted Write Cache has "write buffers" that buffer data and write when things are quiet or, rather, when they don't interfere with reads. It's somewhere in between a write thru and write back cache. With write back, if the CPU writes a single byte to memory, and that address is in the L1 cache, the cache line with the newly written data is marked 'dirty' to indicate there is a difference between it and main memory. When the dirty cache line needs to be overwritten with newer information, the cache management routine uploads the new line (16 bytes) from lower memory, from which it cannot tell the new data, so it first writes all 16 bytes to memory, which can use as many as 18 clocks (6-4-4-4). Once the dirty line is written, the upload of the new line can begin. A good posted write system can accept the CPU write operation in a single clock, write the data to main memory when the bus is otherwise not in use, and never have to suffer the 18 clock penalty.

Write Back cache is therefore best when most or all of a line is made dirty and writes occur to addresses inside the cache system, which is not usual with multitasking and large active memory windows. Posted Write Buffers are typically used between PCI bus and IDE interface by decoupling the wait states effect from the slower IDE side, but also between the CPU and PCI bus. Read-ahead buffers eliminate idle cycles.

Posted Write Framebuffer

Good for video card performance, especially for the Matrox G200, so disable only if you have instability.

Posted I/O Write

Disable if using Multiuser DOS on an Intel Express.

Tag Ram Includes Dirty

Enabling this tells the system that the SRAM needed for the machine to remember that the Level 2 cache and main memory contents are different is actually present on the motherboard (not often the case). If you can enable this, you will get about 10% extra performance, because unnecessary line replacement cycles can be eliminated (e.g. when you have to flush the old data then replace it with the new).

Tag RAM is used as a directory between main memory and cache RAM, storing the addresses of whatever data is in cache memory. The CPU checks TAG Ram for the address of any data it requires, which is how it knows it has to go to main memory if it's not there.

Some cache controllers support two methods of determining the state of data in the cache. One separates the tag signal from the alter (or dirty) signal, which imposes a minimal performance decrease, since the system must assume that some cache lines have been altered. When the dirty and tag bits are combined, the system performs more efficiently, but less cache will be available (default).

Alt Bit Tag RAM

Choices are *7+1* or *8+0*. 7+1 is recommended. The Alt Bit means *Alter Bit*, or dirty bit, which indicates the particular line in L2 cache that contains modified data, so it keeps a note of the state of data in the cache. If you have selected *Write Back* for the L2 cache, 7+1 bits (the default) provides better error detection. With 8+0 Bits, the Alt bit is always assumed active.

Tag Option

If you have WB (*Write Back*) for L2 cache, 7 + 1 provides better error detection. It means 7-bit tag cache RAM with one dirty bit.

Tag RAM Size

Tag bits are used to determine the status of data in the cache. Set the specifications here, whether 7 or 8 bits.

Non-cacheable Block-1 Size

Depending on the chipset, this concerns memory regions (including ROMs) *not* within the 32-bit memory space, e.g. those on 16-bit expansion cards *on the expansion bus* (video cards, cacheing disk controllers, etc) that should not be cached because RAM on them is updated by the card itself, and the main board cache controller can't tell if the contents change. These devices communicate as if they were DRAM memory (that is, they are *memory-mapped*), which means they need to react in real time and would be seriously affected by cacheing. You would also use this to lock out ROMs you can't otherwise disable cacheing for; certain cacheing IDE controllers use a space at the top end of base memory for hard disk details, and therefore cause timing problems if the information is cached; symptoms include consistent bad sectors when formatting floppies, or a scrambled hard disk.

Also, video cards sometimes use a 1 Mb area in the 16 Mb address space of the ISA bus so they don't have to bank switch through the usual 64K page (early Video Blaster cards are notable for this requirement; they won't work in a machine with more than 15 Mb RAM).

You might get a choice of *System Bus* or *Local DRAM*. The former produces a hole in Local DRAM. NCB areas can be separate, contiguous or overlapped. With Asustek cache controllers, include the video buffer at A000-BFFF. This setting is closely linked to the next.

Note: Some chipsets (e.g. SiS) use this to define non-cacheable regions *only in local DRAM*; with them, memory on PCI or VESA add-ons is *always* non-cacheable. Where memory space is occupied by both local DRAM and an add-on card, the local DRAM will take priority (as does VESA over PCI), so disable this to allow access or give priority to the card.

Non-cacheable Block-1 Base

The base address of the above block must be a multiple number of its size; e.g. if 512K was selected above, the starting address should be a multiple of 512K. In other words, if the previous option has a number other than *Disable*, this option will increment by that number.

Non-cacheable Block-2 Size

Can be 64K-16 Mb; otherwise, as above.

Non-cacheable Block-2 Base

See *Non-cacheable Block-2 Size.*

Memory above 16 Mb Cacheable

See *Cacheable RAM Address Range.*

Cacheable RAM Address Range

Memory is cached only up to the 16 or 32 Mb boundaries to reduce the bits that need to be saved. The lower the setting here, the better, corresponding to your main memory; that is, if you have 4 Mb, set 4 Mb. This memory is cached into SRAM.

XXXX Memory Cacheable

Some shadowed memory segments (e.g. starting at address C800) can be cached (or not). However, cacheing certain code (video or ROM BIOS) is sometimes inefficient because it is constantly updated, and you may get "cache thrash", where data feeds on itself in a circular fashion as new data constantly replaces the old. Also, certain programs that depend on timing loops could run too fast. Where you can select Associativity, you can improve on the normal direct mapped cache, where alternating references are made to main memory cells that map to the same cache cell, and all attempts to use the cache therefore result in misses. Associativity concerns the amount of blocks that the cache memory is split into. For example, a *4-Way Set Associative* cache is in four blocks, and is used as four locations in which different parts of main memory are cached at the same time; a lot to keep track of. Its performance yield is not normally enough over a 2 Way Set to justify its use. Direct mapping is known as 1-way Associativity. Non-cacheable regions set elsewhere (above) override this.

C000 Shadow Cacheable

See *XXXX Memory Cacheable*.

Video BIOS Area cacheable

See also *XXXX Memory Cacheable*. Only valid when *Video BIOS Shadow* is enabled, in which case the shadowed BIOS code will be cacheable. Be prepared to say No for an accelerator card which does its own thing, as the CPU needs to be kept informed of its activities, and if you have write-back cacheing enabled, your video won't be updated properly because the data will not reach the video board until the cache line it's in needs flushing. See *also XXXX Memory Cacheable*, above.

Cacheing RAM that is already shadowed is not often a good idea, as the data often ends up in the internal cache of the CPU. Disable for safety, though it might work.

Video BIOS cacheable

See above.

Video Buffer Cacheable

When enabled, the video BIOS (C0000h-C7FFFh) is cached.

System video cacheable

See above.

System BIOS Cacheable

Enables or disables caching of the System BIOS at F0000h-FFFFFh inside the L2 cache, which not only has the potential for trouble if a program writes to this area, but is a waste because operating systems such as Windows, etc do not access the system BIOS much these days.

Video BIOS Cacheable

As above, but enables or disables caching of the video BIOS ROM at C0000h-C7FFFh, also inside the L2 cache. Disable for the same reasons as explained above.

Video RAM Cacheable

Cache technology (in L2) for the contents of video RAM (used by the graphics adapter) at A0000h-AFFFFh, not the same as cacheing the video BIOS instructions that are already shadowed (see *Video BIOS Area cacheable* above). Leave on the default setting of ***Disabled*** if your display card does not support it, otherwise your system may not boot (and programs writing into this memory area will crash the sytem). It also reduces performance, as high-bandwidth video RAM contents are transferred to L2 over the AGP/PCI bus, and back when needed, so its moving twice in a slower environment than its natural habitat. That is, although the L2 cache is faster than system memory, the graphics chip can only access the data there though the AGP (or PCI) bottleneck.

Shadow RAM cacheable

Again, not often a good idea, as the data often ends up in the internal cache of the CPU. Disable for safety, though it might work.

Cache Early Rising

Whether your computer wakes up before you do! Seriously, this allows you to select the fast write-pulse rising edge technique of writing to the external cache over the normal timing, which is faster.

Use this to cope with older DRAMs.

Enable	Write pulse on the rising edge (Default)
Disabled	Normal write pulse to the cache

VESA L2 Cache Write

Allows you to set the timing of writes from the VESA bus to the external cache. Using a long cycle gives you greater system stability, but you lose some performance.

Normal	VESA to cache writes handled normally (Default)
Long	Longer timing used in VESA to cache writes

SRAM Speed Option

The speed of standard SRAM cache during normal read. Similar to *DRAM Speed*.

SRAM Burst R/W Cycle

The speed of the SRAM burst read/write cycles. The lower figure is fastest.

L2 Cache Tag Bits

Cache tag bits report the status of data in the cache. Select the number of bits used.

8 Bits Eight tag bits (Default)

7 Bits Seven tag bits

L2 (WB) Tag Bit Length

See *L2 Cache Tag Bits*. For 8-bit, *Enhanced Memory Write* must be disabled.

Tag/Dirty Implement

One way of checking the data in the cache separates the tag from the dirty signal, while the other combines them into a single 8- or 9-bit signal.

Combine Tag and Dirty combined in one 8- or 9-bit signal, depending on whether 7 or 8 bits are selected in *Tag RAM Size* (default)

Separate Tag and Dirty signals are separate

SYNC SRAM Support

If synchronous cache memory is installed, this setting allows you to specify whether it is the standard synchronous or less expensive pipelined SRAM.

Dirty pin selection

When *Combine* is selected above, this chooses which pin the dirty data is tied to.

I/O means Bi-directional input/output (default)

IN means Input only

Shortened 1/2 CLK2 of L2 cache

Working on this. It probably means a shortened timing sequence.

VESA L2 Cache Read

See *VESA L2 Cache Write*.

1MB Cache Memory

Informs the system that a larger than usual L2 cache is present.

Cache Memory Data Buffer

Activate half T state earlier when a cache hit is made during a read cycle. Enable if your system runs faster than 33 MHz.

Cache Cycle Check

L2 cache checkpoint for hit or miss.

Pipeline Burst Cache NA#

With pipeline burst cache in the L2 cache, or L2 cache is disabled, enabling this may improve performance. NA# means *assertion next address*.

Cache Read Pipeline

Disable for stability, enable for performance. FIC motherboard, VIA MVP3 chipset.

Memory

RAM is organised into rows and columns, and is accessed by electrical signals called *strobes*, which are sent along rows to the columns; when data is needed, the CPU activates the RAS (*Row Access Strobe*) line to specify the row in memory where the data is to be found (high bits), then, after a short time, the CAS, or *Column Access Strobe*, to specify the column (low bits). After that, the data goes to the output line and to its destination on the next clock tick. With PC100 SDRAM (see below), the first transfer takes about 50 ns, and the remaining three inside one cycle, assuming burst mode is active and they are in the same column. If not, the extra time is determined by CAS Latency, or the ratio between column access time and clock cycle time, derived from dividing the former by the clock frequency, and rounding up to the next whole number.

The combination of RAS and CAS therefore specifies a particular RAM location in a particular RAM chip, where they intersect. Unfortunately, a lot of time is taken up with transferring these values rather than data. Rather than have separate pins providing power and data for both, each pin does double duty, serving rows or columns according to whether the RAS or the CAS pin is being asserted (that is, receiving current). Your system will operate most efficiently when the RAS and CAS timings are optimized, but you lose stability as speed is gained. With *page mode*, any column of DRAMS in a row can be accessed any number of times within a short period; since the row is already specified, only the CAS needs to be applied on subsequent memory accesses, making things quicker.

RAS and CAS are measured in nanoseconds; the lower the value, the faster the RAM can be accessed, so the T state delay is similar to wait states. The RAS access time is actually the speed rating marked on the chip; CAS access time is around 50% less. Generally, choose the same speed for DRAM reading and writing, with as few wait states as possible. Burst cycles work the same way as they do for SRAM, consisting of four figures, with the first being larger because that's where the address is read; the remaining figures indicate the clock cycles for the reading of data. They might look like this on the screen:

```
x222/x333
```

The first set would be for EDO and the second for Fast Page Mode RAM. The 430 HX chipset can use lower figures than the VX. The idea is to keep the figures as low as possible, consistent with your machine working properly. Note that EDO is only faster when being read from; writes take place at the same speed as FPM RAM.

DRAM (Read/Write) Wait States

Sets the cycles the CPU should be idle for whilst memory is being refreshed, such as 1 W/S for 80 nanosecond DRAMs (for 40 MHz machines, 2 is suggested). This won't affect performance with internal or external cache memory. A rule of thumb is:

$$\text{Wait States} = \frac{\text{ns} + 10 \times \text{Clock Speed}}{1000 - 2}$$

So:

$$.97 = \frac{80 + 10 \times 33}{1000 - 2}$$

gives you (almost) 1 wait state for 80 ns RAM at 33 MHz. For machines with clock-doubled CPUs, you should use the motherboard speed. This chart should be a useful starting point:

CPU	Write	Read	Speed (ns)
386DX-25/33/40	1	2	80
	0	1	70
	0	0	60
485-20/25	0	2	80
	0	1	70
	0	0	60
486DX-33/DX2-50	1	2	80
	0	1	70
	0	0	60
486DX-50/DX2-66	1	3	80
	0	2	70
	0	1	60

Actually, wait states are *additional* to those built in by the motherboard manufacturer. 0 wait states probably means 6, so 1 would mean you get 7. Each wait state adds about 30ns to the RAM access cycle here.

Theoretically, 9-chip 30-pin SIMMs are faster, because it can be marginally longer getting data from the 4-bit chips on the 3-chip variety. Windows has been known to work with less GPFs with 9-chip SIMMs. Certainly, never mix in the same bank.

DRAM Read/Write Timing

See above.

RAS# To CAS# Delay

Adds a delay between the assertion of RAS# and CAS#. In other words, this allows you to set the time it takes to move between RAS and CAS, or insert a timing delay between them. Reads, writes or refreshes will therefore take slightly longer, but you get more reliability.

Add Extra Wait for RAS#

Same as above.

Add Extra Wait for CAS#

Same as above.

Memory Read Wait State

You can use slower DRAMs by inserting wait states (e.g. use 1 wait state for chips rated at 80ns at 33 MHz). This setting concerns the number of wait states inserted between DRAM write operations.

Memory Write Wait State

As for *Memory Read Wait State* (above).

DRAM Read Wait State

As for *Memory Read Wait State* (above).

DRAM Burst Write Mode

Enabled is best for performance.

DRAM Read Burst Timing

Of burst data transfers to and from DRAM. Similar to *Cache Read Hit Burst*. With EDO, select x222 for best performance.

DRAM Read Burst (B/E/P)

The timing for burst mode reads from DRAM, depending on the type on a per-row basis (Burst/EDO/Page) The lower the timing numbers, the faster the system addresses memory, so select higher numbers for slower memory. With EDO, select x222 for best performance.

DRAM Write Burst (B/E/P)

See *DRAM Read Burst (B/E/P),* above.

DRAM Read /FPM

Sets the timing for burst mode reads according to your type of memory, EDO or Fast Page Mode. With EDO, select x222 for best performance.

FP Mode DRAM Read WS

This configures the exact timing of the read cycle from Fast Page (FP) mode memory, which consists of an address cycle, where the location of the read to take place is indicated, and three data cycles, where the data is actually read. The shorter each phase (or cycle) is, the better the performance, but you will lose data if you don't allow enough time for each cycle.

Choices are:

```
7-3-3-3
7-2-2-2
6-3-3-3
6-2-2-2 Default
```

Try the lowest figures first till your machine is running successfully.

DRAM Write Burst Timing

See *FP Mode DRAM Read WS*.

DRAM Timing Option

See *DRAM Speed*.

DRAM Timing

The speed of the RAM in your system. With Award, the choices are 60 or 70 ns. What you set here affects the settings for *Auto Configuration*.

DRAM Post Write

An Award setting. Still working on it, but see *Posted Write Enable*.

DRAM Speed

Set CPU speed instead of tinkering with RAS/CAS timings (these are for 100ns chips; push it a bit with faster ones). There may also be a *Normal* setting, which seems to be automatic.

Fastest 25 MHz (25/33 with Award)

Faster 33 MHz (40/50 with Award)

Slower 40 MHz

Slowest 50 MHz

Here's a comparison chart that may give you a good start:

CPU	DRAM Speed	Write CAS Width	Cache Write	Cache Read	BUSCLK
486SX-20	Fastest	1T	2T	1T	1/5
486SX-25	Fastest	1T	2T	1T	1/3
486DX2-50	Fastest	1T	2T	1T	1/3
486DX-33	Faster	1T	3T	2T	1/4
486DX2-66	Faster	1T	3T	2T	1/4
486DX-50	Slowest	2T	3T	2T	1/6

Notice that the higher the chip speed is, the more the wait states. Turbo mode reduces CAS access time by 1 clock tick.

DRAM Timing Control

See above.

Fast DRAM

The system expects memory to run at the fastest speed—if you have mixed speed SIMMs, you might experience data loss. Disable this to use slower timing for all access to DRAM.

DRAM Last Write to CAS#

Sets how much time (or how many cycles) will elapse between the time when the last data has been signalled to when CAS# is asserted. This time is used as setup time for the CAS signal. Choices are 2 (default), 3 or 4.

DRAM Write Page Mode

Enabled, RAS is not generated during a page hit in page mode, so a cycle is eliminated and makes things faster as more data is written at once.

DRAM Code Read Page Mode

Affects access speeds when program code is being executed, based on its sequential character, so enabling page mode here will be more efficient, to allow the CPU to access DRAM more efficiently during read cycles. If your code is not sequential, you may be better off without this enabled.

Page Code Read

See *DRAM Write Page Mode*.

Page Hit Control

For testing the controller.

DRAM RAS# Precharge Time

See also *FP DRAM CAS Prec. Timing*. The CPU clocks allocated for the RAS# signal to accumulates its charge before DRAM is refreshed. If this time is too short, you may lose data.

DRAM Precharge Wait State

Use 0 for 60-70 ns and 1 for 70 ns DRAM.

DRAM Wait State.

Same as above.

DRAM to PCI RSLP

When enabled, the chipset allows prefetching of two lines of data from memory to the PCI bus.

FP DRAM CAS Prec. Timing

The number of CPU clock cycles for CAS to accumulate its charge before FP DRAM is allowed to recharge. The lower figure is best for performance, but if you don't allow enough time, you could lose data.

FP DRAM RAS Prec. Timing

See *FP DRAM CAS Prec. Timing*.

DRAM CAS# Hold Time

Sets the number of cycles between when RAS# is signalled and CAS# is asserted. Choices are 4, 5, 6 (default) and 7.

CAS Address Hold Time

Sets how long it will take to change the CAS address after CAS has been initiated (asserted) and aimed at a target address (location) in DRAM. Choices are 1 or 2 (default) cycles.

CAS Low Time for Write/Read

The number of clock cycles CAS is pulled low for memory operations.

Read CAS# Pulse Width

How long the CAS remains asserted for a DRAM read cycle. Choices are 2, 3 (default), 4 or 5 cycles. The same effect as wait states.

Write CAS# Pulse Width

How long the CAS remains asserted for a DRAM write cycle. Choices are 2 (default), 3, 4 or 5 cycles. The same effect as wait states.

CAS Read Pulse Width in Clks

Essentially the same as *DRAM Read Wait States*, except that the value is 1or 2 more than the number of Waits. The fewer the better.

DRAM RAS# Pulse Width

The number of CPU cycles allotted for RAS pulse refresh.

Write Pipeline

Enable when PBSRAMs are installed.

RAMW# Assertion Timing

RAMW is anoutput signal to enable local memory writes. The difference between *Normal* or *Faster* is one timer tick.

EDO CAS Pulse Width

The number of CPU cycles the CAS signal pulses during EDO DRAM reads and writes, when memory is not interleaved.

EDO CAS Precharge Time

See *FPDRAM CAS Prec. Time.*

EDO RAS Precharge Time

The number of CPU clock cycles for RAS to accumulate its charge before EDO DRAM is allowed to recharge. The lower figure is best for performance, but if you don't allow enough time, you could lose data.

EDO RAS# to CAS# Delay

Enabled, adds a delay between the assertion of RAS# and CAS# strobes (slower but more stable). Disabled gives better performance.

EDO RAS# Wait State

Inserts one additional wait state before RAS# is asserted for row misses, allowing one extra clock of MA setup time to RAS# assertion. Only applies to EDO memory.

EDO MDLE Timing

Memory Data Read Latch Enable timing when EDO is read. Sets the CPUCLK signal delay from the CAS pulse. 1 is fastest, but 2 is more stable.

EDO BRDY# Timing

When the *Burst Ready Active* signal is low, the presented data is valid during a burst cycle. 1 is fastest, 2 is more stable.

EDO RAMW# Power Setting

RAMW# is an active low output signal that enables local DRAM writes. This setting lets you enable RAMW# power-saving mode when an EDO bank is being accessed.

EDO DRAM Read Burst

The timing you set here depends on the type of DRAM you have in each row. Use slower rates (bigger numbers) for slower DRAM.

EDO DRAM Write Burst

The timing you set here depends on the type of DRAM you have in each row. Use slower rates (bigger numbers) for slower DRAM.

EDO Read Wait State

Use this only if your system has EDO (*Extended Data Out*) DRAM, to configure the exact timing of the read cycle. The timing is composed of an address cycle, for the location of the read, and three cycles where the data is actually read. The shorter each phase (or cycle) is, the faster the system is operating, but if not enough time is allowed for each cycle, data will be lost. Choices are 7-2-2-2 (default) and 6-2-2-2.

EDO read WS

See above.

EDO Back-to-Back Timing

The number of timer ticks needed for back-to-back accesses, depending on your memory specifications. (SiS).

Fast EDO Path Select

When enabled, a fast path is selected for CPU-to-DRAM read cycles for the leadoff, assuming you have EDO RAM. “It causes a 1-HCLK pull-in for all read leadoff latencies” (that is, page hits, page and row misses). *Enabled* is best for performance. Possibly the same as *Fast EDO Leadoff*. See also *Read/Write Leadoff*.

DRAM RAS# Active

Controls whether RAS# is actually activated after CAS; *Deassert* means not, which increases performance by saving a CPU cycle. The latter makes each DRAM cycle a Row miss.

Assert will be asserted after every DRAM cycle

Deassert will be deasserted after every DRAM cycle

DRAM R/W Burst Timing

Allows DRAM read and write bursts to have their timings coordinated. These are generated by the CPU in four parts, the first providing the location, and the remainder the data. The lower the timing numbers, the faster memory is addressed.

X444/X444 Read and write DRAM timings are X-4-4-4

X444/X333 Read timing = X-4-4-4, write timing = X-3-3-3

X333/X333 Read and write DRAM timings are X-3-3-3

Try the lowest figures first, until your machine is running successfully.

DRAM CAS Timing Delay

Sets *No CAS delay* (default) or *1 T state delay*. Use this only if you're using slow DRAMs. It's often ignored anyway if cache is enabled.

RAS Precharge Time

The Row Access Strobe is used to refresh or write to DRAM. The precharge time is the time taken for internal recovery of the chip before the next access, or when the system gets up enough power to do the refresh, about the same as the RAM access time, so use that as an estimate to start off with. If there is not enough time, you won't get a proper refresh, and you may lose data.

This determines the number of CPU clocks for RAS to accumulate a charge before DRAM is refreshed. If you have a 33 MHz CPU or higher, set this to 4, but try a lower number if your CPU is slower (e.g. 2 for 25 MHz, so as not to waste time), reducing idle time, unless your DRAMs can't operate with a lower figure anyway. Often ignored if cache is enabled.

RAS Precharge Period

See above.

RAS Precharge In CLKS

An Award Setting. Sets the length of time required to build up enough charge to refresh RAS memory. Choices are 3, 4, 5 or 6. Lower figures are best for performance.

RAS Precharge @Access End

When enabled, RAS# remains asserted at the end of access ownership. Otherwise, it is deasserted.

CAS Precharge In CLKS

An Award Setting. As above, but for CAS.

CAS# Precharge Time

How long (in CPU clocks) the CAS# signal is allowed to accumulate its charge before refresh. If this is too short, you may lose data.

CAS# width to PCI master write

The pulse width of CAS# when the PCI master writes to DRAM. Lower figures are best for performance.

RAS Active Time

Controls the maximum time that DRAMs are kept activated by increasing the *Row Access Strobe* (RAS) cycle, meaning that a row can be kept open for more than one access, allowing more column access in that time. The higher the figure, the better the performance.

Row Address Hold In CLKS

An Award setting, for the length of time in CPU cycles to complete a RAS refresh. A CLK is a single CPU clock tick, so the more you use here, the slower your machine will perform.

RAS Pulse Width In CLKS

The length of the RAS pulse refresh. Choices are between 4-6 CLKs, and the higher the number, the slower your machine will be.

RAS Pulse Width Refresh

The number od CPU cycles allotted.

RAS Pulse Width

See above.

CAS Pulse Width

The duration of a CAS signal pulse in timer clicks.

CAS Read Width In CLKS

An Award Setting. Sets the number of CPU cycles required to read from DRAM using Column Address Sequence (CAS) logic. Choices are 2 or 3.

CAS Write Width In CLKS

Award Setting. As above, for write cycles.

Late RAS Mode

Controls the generation of an earlier RAS signal during memory accesses, extending the length of the RAS signal for slower TAG RAM. It could also mean *RAS after CAS* (see below).

RAS Timeout Feature

For DRAMs that need a 10 microsecond maximum RAS-active time. If timeout is enabled, RAS is not allowed to remain low for longer than about 9.5 microseconds. Otherwise, it is limited to a maximum of about 15 microseconds. This affects reliability - *Disabled* is the default.

RAS Timeout

See above.

RAS to CAS delay time

The amount of time after which a CAS# will be succeeded by a RAS# signal, or the time delay between Row Address Strobe and Column Address Strobe, to allow for the transition. Performance is best with lower figures at the expense of stability.

RAS(#) To CAS(#) Delay

As for *RAS to CAS delay time*. When DRAM is refreshed, rows and columns are addressed separately. This allows you to set the time to move between RAS and CAS, or insert a timing delay between them, in CPU cycles. The shorter the better for performance.

2T	Two cycles
4T	Four cycles (Default)
6T	Six cycles

RAS to CAS Delay Timing

See above.

RAS#-to-CAS# Address Delay

Inserts a timing delay from the time RAS# is asserted to when Column Address is asserted.

DRAM write push to CAS delay

The number of cycles needed by DRAM to force the CAS to slow down (delay) to match DRAM timing specifications.

CAS Before RAS

A technique for reducing refresh cycles, to help the CPU along. Also good for power consumption. CAS is dropped first, then RAS, with one refresh cycle being performed each time RAS falls. The powersaving occurs because an internal counter is used, not an external address, and the address buffers are powered down.

Turbo Read Leadoff

Sometimes needed for faster memory, and disabled by default. When *Enabled*, the BIOS skips the first input register in the DRAM when reading data, speeding up the read timings. In other words, it shortens the leadoff cycles and optimizes performance in cacheless, 50-60 MHz, or 1-bank EDO systems, but it is known to speed up those with a 512K Level 2 Cache and 2 banks of EDO (2X16, 2X32 Mb SIMMs), especially when copying data, such as when backing up a hard drive. However, after a few hours of use, errors start in applications and when loading data from the hard drive, especially when switching between applications. Suggest enable this for games, but disable for important work. See also *Read/Write Leadoff*.

CAS Width in Read Cycle

Determines the number of wait states when the CPU reads data into the local DRAM, in T states. The lower the figure, the better the performance.

Read-Around-Write

For cache memory optimisation - allows the processor to execute read commands out of order if there is independence between them and other write commands. In other words, if a memory read is addressed to a location whose latest write is in a buffer before being written to memory, the read is satisfied from the buffer instead of memory, as the information will be more up to date. This will also be faster.

DRAM Read-Around-Write

See above.

OMC Read Around Write

Similar to the above, enabling the Memory Controller on an Orion chipset to let read operations bypass writes as long as their memory addresses don't match. In other words, priority is given to reads, except when they have the same address as a write, in which case the write is done first so the read gets the most up to date information. Found on a Pentium Pro. Enabled increases performance slightly at the expense of some stability.

DRAM Write CAS Pulse Width

See *DRAM Head Off Timing*.

DRAM Head Off Timing

7/5 or 8/6. See *DRAM Leadoff Timing*.

F000 UMB User Info

Found with MR, lets you know what's going on in the F000-FFFF range usually occupied by System ROM. The first 32K can often be used for UMBs as it is only used on startup.

```
BIOS            FC14-FFFF
UTILS           FBAA-FC13
POST            F787-FBA9
SETUP           F1C0-F786
     AVAIL      F000-FBA9
```

The above is information fed to your memory manager so it can make the best use of what's available. You can't reassign the BIOS area, and you should leave the UTILS section alone, because various hot key and cache functions are kept there. POST and SETUP only contain power up and boot code.

Interleave Mode

Controls how memory interleaving takes place, or how DRAM access is speeded up because succeeding memory accesses go to different DRAM banks, and take place while another is being refreshed (2- or 4-way interleave). Not always possible.

Fast Page Mode DRAM

Should be enabled with DRAM capable of Fast Page Mode on your motherboard (not 256K SIMMs). Page Mode speeds up memory accesses when they occur in the same area; the page address of data is noted, and if the next data is in the same area, page mode is invoked to reduce the access time to about half (that is, the row and column need not be specified again, so the RAS or CAS lines don't need to be reset). Otherwise data is retrieved normally from another page. *Fast page mode* is a quicker version of the same thing. This technique is not necessarily the best for the PC; you may be better off adjusting the RAS values and extending the signal's length so that a row can be kept open for as long as possible.

Enhanced Memory Write

Affects the *Memory Write and Invalidate* command on the PCI bus. Disable if the cache size is 512 Kb and the tag address is 8 bits.

Enhanced Page Mode

Enable or Disable, according to your memory.

Page Mode Read WS

The cycle time combination.

Pipelined CAS

When enabled, the DRAM controller will not provide time between two successive CAS cycles. Otherwise, one Host Bus clock between successive CAS cycles will be provided (default). The former is best for performance.

**00 Write Protect*

Normally, when a ROM is shadowed, the original ROM is disabled and the RAM area where its contents goes is write protected. You can disable this for special reasons, such as debugging ROM code, but very little else. Normally, leave enabled.

Parity Checking Method

You can check parity for every double word, or only the last double word during cache line fill. The Triton chipset does not support parity.

Parity Check

Enabled on a Phoenix BIOS, an NMI interrupt is produced with a parity error.

Memory Parity Check

Enable if you want to use parity, though your DRAM must support it.

Memory Parity/ECC Check

To enable memory checking when ECC or Parity-equipped RAM is installed.

F/E Segment Shadow RAM

How the E/F segments of Upper Memory are used (refers to cacheing). Choices are:

Disabled	(E segment default)
Enabled	(F segment default)
Cached	L2 cache?
Into-486	L1 cache

Disable Shadow Memory Base

Alters the location of non-shadowed memory. For example, if using a SCSI host adapter, set this to the address of the adapter and the size to 16K (see below).

Disable Shadow Memory Size

Sets a shadow memory size for *Disable Shadow Memory Base*, above. It doesn't actually disable anything.

Base Memory Size

You might want to disable on-board RAM (i.e. base memory) between 80000-9FFFF (512K-640K), so you can give 128KB of contiguous address space to cards that need it (it is not normally available in upper memory). Normally set at 640, but set 512K for such a card.

Memory Remapping (or Relocation/Rollover)

The memory between A000-FFFF (that is, the 384K of upper memory normally used for ROMs, etc) can be remapped above the 1 Mb boundary for use as extended memory—this is sometimes not available with more than 1 Mb installed. Thus, your memory will run from 0-640K and 1-1.384Mb if you have 1 Mb. You usually have the choice of moving 256K (areas A, B, D and E) or 384K (Areas A-F), if no ROMs are shadowed. Relocated memory blocks must not be used for Shadow RAM, so relocating the full 384K means no Video or System BIOS Shadow! What you get from this depends on the total memory you have, and whether you use DOS or Windows. Use mostly when memory is tight. More precise control may be obtained from a memory manager.

384 KB Memory Relocation

See *Memory Remapping*. Can solve problems if you have more than 16 Mb.

256 KB Remap Function

See *Memory Remapping*.

Global EMS Memory

Whether expanded memory is used or present. If disabled, this is ignored:

EMS I/O port access	Enable if using EMS.
EMS Page Registers	Accessed through 3 I/O ports at:
	EMS 0 (208, 209, 20Ah)—default
	EMS 1 (218, 219, 21A)

DRAM Relocate (2, 4 & 8 M)

Remaps 256K of upper memory to the top of DRAM size. Only applicable when the D and E segments are not shadowed, and with 2, 4 or 8 Mb of on-board memory.

Memory Reporting

You get the choice of *Standard* or *Windows NT*, for getting around the limitations imposed by the ISA bus on the amount of memory the CPU can address. The 16-bit ISA bus has 24 address lines, which means it can theoretically see only 16Mb.

Shared Memory Size of VGA

System memory to be allocated to VGA in a shared memory system (see *Memory*).

Extended Memory Boundary

Where extended memory ends, and expanded memory begins. Possibly for use with an expanded memory card.

Shared Memory Enable

Enable or Disable.

VGA Shared Memory Size

The size of system memory allocated to video memory, 512K-4Mb.

RAM Wait State

Allows an additional T-state (2 PROCCLK cycles) to be inserted on local memory accesses during CAS active interval, extending the width of the CAS pulse, and slowing the machine.

Cycle Check Point

This allows you to select how much time is allocated for checking memory read/write cycles. In effect, each selection sets a predetermined wait state for decoding cycle commands.

Fast	0, 1 waits (Default)
Fastest	0, 0 waits
Normal	1, 2 waits
Slow	-, 3 waits

Cycle Early Start

Allows read/write cycles to start half a clock cycle early, assuming addresses and other control signals are stable. Enabling this *may* eliminate a wait state.

MA Timing Setting

MA = Memory Access. Set disabled with EDO RAM. Also set *CAS Pulse Width* and *precharge* to 1T.

MA Additional Wait State

Enabled, inserts an extra wait state before the assertion of the first MA (*Memory Address*) and CAS#/RAS# during DRAM read or write leadoff cycles, affecting page hit, row and page miss cases. In English, inserts an additional wait state before the beginning of a memory read. Use the default unless you are getting memory addressing errors. See also *Read/Write Leadoff*.

EDO CAS# MA Wait State

Similar to above. It puts in an additonal wait state before the assertion of the first CAS# for page hit cycles, allowing it an extra clock of memory address (MA) setup time for the leadoff. This applies only to EDO memory and only needs to be changed if you get memory addressing errors.

MA Drive Capacity

Or *Memory Address Drive Strength*. Sets current draw of multiplexed DRAM chips. The smaller the number, the less power consumption, and therefore heat, but if set too low you need an extra wait state—too high and you get ringing and reflections, and errors (in PCs, the DRAM voltage can be nearly 6 volts because ringing and reflections can drive the +5 up, making the memory run hotter). If your SIMMs have a high loading, (that is, you have over 64 memory chips), select 16ma/16ma. The more chips, the higher the figure.

Memory Address Drive Strength

See above.

Mem. Dr.Str. (MA/RAS)

As above – controls the strength of the output buffers driving the MA and BA1 pins (first value) and SRASx#, SCASx#, MWEx# and CKEx# pins (second value).

DRAM Fast Leadoff

Select *Enabled* to shorten the leadoff cycles and optimize performance – the system will reduce the number of CPU clocks allowed before reads and writes to DRAM are performed. See also *Read/Write Leadoff*.

DRAM R/W Leadoff Timing

Sets the number of CPU clocks before reads and writes to DRAM are performed (Award). Similar to the cache burst timings, but reads 7-3-3-3 or similar for 50 MHz. The higher the first figure, the less the performance. EDO RAM uses one less wait state. The 430 HX chipset can use lower figures than the VX.

8/7 8 clocks leadoff for reads and 7 for writes.

7/5 7 clocks leadoff for reads and 5 for writes.

See also *Read/Write Leadoff*.

DRAM Leadoff Timing

See *DRAM R/W Leadoff Timing*. This is the AMI version and the settings are:

8-6-3 7-5-3 8-6-4 7-5-4

See also *Read/Write Leadoff*.

Reduce DRAM Leadoff Cycle

Enabling this optimises DRAM performance by shortening the time before memory operations, assuming the DRAM supports it.

DRAM Read Pipeline

Disable for stability, enable for performance. AOpen, VIA MVP3 chipset.

Read Pipeline

Pipelining improves system performance. Enable this when you have PBSRAMs installed.

DRAM Speed Selection

Set the access speed of the memory in your system.

EDO Speed Selection

See above.

Fast EDO Leadoff

Select *Enabled* only for EDO RAM in systems with either a synchronous cache or which are cacheless. It causes a 1-HCLK pull-in for all read leadoff latencies for EDO memory (that is, page hits, page and row misses). Disable for FPM or SDRAM. Possibly the same as *Fast EDO Path Select*. See also *Read/Write Leadoff*.

Speculative Leadoff

The T II chipset (430HX) can allow a DRAM read request to be generated slightly before the destination address has been fully decoded, which can reduce latencies, including the cache, DRAM and PCI. *Disabled* is the default. The "speculative" bit arises from the chipset's ability to process what might be needed in the future, or speculate on a DRAM read address, so as to keep the pipeline full. See also *Read/Write Leadoff*.

DRAM Speculative leadoff

See above.

SDRAM Speculative Read

As above.

DRAM Speculative Read

See above.

SDRAM Wait State Control

Inserts a wait state into the memory addres data cycle.

SDRAM WR Retire Rate

The timing for data transfers from the write buffer to memory.

USWC Write Posting

USWC stands for *Uncacheable Speculative Write Combination*. It *may* improve performance for some Pentium Pro systems using graphic cards with linear frame buffers (i.e. all new ones), but don't hold your breath. By combining smaller data writes (bytes and 16-bit words) into 64-bit writes, you need fewer transactions to move data. However, you might get corruption or crashes if this is not supported. The separate settings for ISA and PCI apparently affect different memory regions. The older your chipset, the more chance you have of getting extra performance. See also *PCI Burst Write Combine.*

This can cause video problems and/or intermittent crashes on many systems, including a conflict with sound cards on NT systems. Use the default NT sound driver and put the sound card on DMA channel 3, 16 bit DMA on 7; and set the BIOS *DMA Type F Buffer* to the floppy DMA channel.

USWC Write Post

See above. Enable this for wite-back cache mode when video memory cache is configured for USWC mode.

Video Memory Cache Mode

Select UC (Uncacheable) or USWC (Uncacheable Spoeculative Write Combine). The latter may give better performance.

CPU Burst Write Assembly

The (Orion) chipset maintains four posted write buffers. Posted writes are write operations held until it is convenient to execute them—under normal circumstances, the buffers hold data destined for memory, but here you can use them to collect data for the PCI bus as well. When this is enabled, the chipset can assemble long PCI bursts, or sequential writes without wasting cycles posting addresses between words, which is best for performance. The default is *Disabled*.

OPB Burst Write Assembly

Similar to the above, found on a Pentium Pro machine. It relates to USWC (see below), which affects video cards. OPB may stand for *Orion Post Buffers*. Then again, it may not.

SDRAM (CAS Lat/RAS-to-CAS)

Select a combination of CAS latency and RAS-to-CAS delay in HCLKs of 2/2 or 3/3. This sets up the SDRAM CAS latency time or *RAS to CAS Dela* - you will only see this if you have SDRAM. Usually set by the system board designer, depending on the DRAM installed. Do not change this unless you change the DRAM or the CPU, or you have instability problems.

SDRAM Leadoff Command

Allows you to adjust the time to access data in SDRAM. See also above.

SDRAM RAS to CAS Delay

You can insert a delay between the RAS (*Row Address Strobe*) and CAS (*Column Address Strobe*) signals when SDRAM is written to, read from or refreshed – in other words, this determines how quickly memnory is accessed. The lower the number, the faster the performance at the expense of stability.

SDRAM RAS Precharge Time

Controls the memory timing by setting the number of cycles the RAS needs to accumulate its charge before SDRAM refreshes. Reducing this too low affects the ability to retain data.

SDRAM Precharge Control

See also above. If disabled, all CPU cycles to SDRAM will result in an *All Banks Precharge* command on the SDRAM interface. Enabled is best for performance at the expense of stability.

SDRAM CAS Latency Time

Optimises the speed at which data is accessed in a column by defining CAS latency time in 66 or 100 MHz clocks, depending on the memory bus speed – it controls the time delay (in CLKs) before SDRAM starts a read command after receiving it. Because reading data in a row is twice as fast, reducing this number can help quite a bit at the expense of stability, but the higher it is, the faster you can run the machine, if the memory is capable.

SDRAM RAS Latency Time

See above.

SDRAM Cycle Length

The number of CPU cycles between refreshes. The shorter the faster, at the expense of stability and data.

SDRAM Bank Interleave

Supports interleaving SDRAM banks for better performance by asking how many you have. Use 2- or 4-bank interleave for 64 Mb SDRAM. Otherwise disable.

SDRAM Configuration

Either *Disabled* or *By SPD*. SPD (*Serial Presence Detect*) refers to a little EPROM on the DIMM that holds data relating to the DIMM's performance, which is checked during startup to match timings, required for the PC100 standard as things are a little tight at that speed.

SDRAM Burst X-1-1-1-1-1-1-1

Allows burst mode. Enabled is best for performance.

SDRAM WR Retire Rate

Specifies the number of clocks required to assert the SDRAM Write Retire Rate.

Special DRAM WR Mode

Enables a special inquiry filter for bus master attempts to write to DRAM; the system checks the address of the write cycle to see if it was previously detected in the preceding cycle, and if it was the transaction will pass directly to system memory without the overhead of an extra inquiry cycle. Enabling is therefore best for performance.

DRAM Clock

Allows the DRAM to work concurrently with the host bust clock. If you disable this, it will align itself to the AGP Clock.

Sustained 3T Write

Affects PBSRAM. Enables or disables direct map write back/write through the L2 cache, or enables sustained three-cycle write access for PBSRAM access at 66 or 75 MHz. Enabled is best for performance.

2 Bank PBSRAM

Sets the burst cycle for PBSRAM.

Turn-Around Insertion

When enabled, the chipset inserts one extra clock to the turn-around of back-to-back DRAM cycles. More technically, the extra clock is added to the MD signals after asserting the MWE signal before enabling the MD buffers, whatever that means. *Disabled* is the default, and best for performance. May need to be on for EDO.

Turn-Around Insertion Delay

See *Turn-Around Insertion* (above).

DRAM ECC/PARITY Select

Allows you to select between two methods of DRAM error checking, ECC and Parity (default). ECC memory can correct single-bit errors, but only detect multi-bit errors. It works by adding some redundancy to data bits to enable later duplication of the information if required, typically used in servers for extra safety.

Single Bit Error Report

When a single-bit error is detected, the offending DRAM row ID is latched, and the value held until the error status flag is explicitly cleared by software. If ECC (*Error Correcting Code*) is active, this will correct the error, but inform you that one has occurred. If ECC is used, enable.

ECC Checking/Generation

Enable with ECC SIMMs *in all rows*.

Memory Parity/ECC Check

Choose between methods of memory error checking. *Auto*, *Enabled* and *Disabled*.

Memory Parity SERR# (NMI)

The default of *Disabled* will not show memory errors. If you have parity chips, you can select *Parity* or *ECC* to correct 1 bit errors.

OMC Mem Address Permuting

Enable to allow the Orion Memory Controller to permute memory addresses to get alternate row selection bits. May hang the machine.

OMC DRAM Page Mode

Affects the Orion Memory Controller on a Pentium Pro motherboard. See *DRAM Page Mode Operation* (below).

DRAM Page Mode Operation

Page mode allows faster timing on consecutive memory accesses within a single DRAM page. Mostly, page mode is invoked automatically if the DRAM supports it.

CPU to DRAM Page Mode

Determines whether a DRAM memory page is held open after a memory access, as those to open pages can be between 30-40% faster than to closed pages, because they don't need precharging. Enabling this keeps all pages open. Disabling only opens them during burst operations, etc, when subsequent accesses will be to the same page – DRAM pages are closed after being accessed.

Fast Strings

Possibly related to 4-way memory interleaving. Enabled is best for performance.

Fast MA to RAS# Delay

Selects the DRAM Row Miss Timing, which are independent of DLT timing adjustment, whatever that is. Don't change unless you change DRAM or CPU. MA means *Memory Access*. Lower is best for performance.

Fast RAS to CAS Delay

Determines the timing of the transition from RAS to CAS. The lower the better for performance.

DRAM Quick Read Mode

For 386s only. Set to *Normal*.

Bank 0/1 DRAM Type

You can't change this, but it tells you whether you have FPM or EDO memory in the relevant banks.

386 DRAM Quick Write Mode

As above.

DRAM Page Idle Timer

The time in HCLKs that the DRAM controller waits to close a DRAM page after the CPU becomes idle. The shorter the better for performance.

DRAM Page Open Policy

When disabled, the page open register is cleared and the corresponding memory page closed. Otherwise, the page remains open, even if there are no requests to service.

DRAM Enhanced Paging

When enabled, the chipset keeps the page open until a page/row miss occurs. When disabled, the chipset uses additional information to keep the DRAM page open when the host bus is active or the PCI interface owns the bus (when the host may be “Light Back”).

DRAM Posted Write Buffer

When the chipset's internal buffer for DRAM writes is enabled, CPU write cycles to DRAM are posted to it so the CPU can start another write cycle before DRAM finishes its own cycle.

DRAM Data Integrity Mode

Select whether you want ECC or Non-ECC error checking.

Bank n DRAM Type

Indicates whether DRAM in the corresponding bank (*n*) is treated as FPM or EDO (EDO can hold the output from the last read on the output pins while the next data transfer is set up). *FPM* works with anything, but the *EDO* setting may cause a malfunction if FPM is actually used, although it will improve performance slightly.

EMS Enable

Found on some 80286 or 80386 motherboards, often using the C&T NEAT Chipset. It enables Expanded Memory through the BIOS. Best done with supplied software.

Miscellaneous

CPU Low Speed Clock

Or *Low Speed CPU Clock Select* selects whatever speed you want to use as the slow speed when you select Turbo Off on the front panel of your computer, or via your keyboard. This will be CLKIN (CPU speed) divided by 1, 2, 3 or 4.

Co-processor Ready# Delay

Enabling this with a non-compatible processor delays the ready signal by 1 T state, giving you a wider tolerance range, but less performance.

Co-processor Wait States

Number of wait states for the ready signal from NPU to CPU for similar reasons to *Co-processor Ready# Delay*, above.

C000 32K Early Shadow

Shadows the video BIOS before it initialises, assuming your VGA card agrees. As it happens before the POST you get reduced POST time and faster booting.

Video Shadow Before Video Init

See above.

Turbo VGA (0 WS at A/B)

When enabled, the VGA memory range of A0000-B0000 uses a special set of performance figures, more relevant for games.

Check ELBA# Pin

Sets when the ELBA# pin is checked, during T1 or T2. Should mostly be set to T2, that is, later in the cycle for better reliability, but this can depend on other settings. The *External Local Bus Access#* pin is active during local bus access cycles, so the CPU can communicate with devices on it without disturbing some support chips.

This can hang the machine—DO NOT CHANGE IT IF YOUR MACHINE IS WORKING!

Mouse Support Option

Used to support a PS/2 type mouse on the keyboard port. Takes up 1K of base memory for an Extended BIOS Data Area, so you only get 639K.

IRQ 12 used by ISA or PS/2 Mouse

If you're not using a PS/2 mouse, you can make its IRQ available for the ISA bus.

PS/2 Mouse Function Control

As above. *Enabled* allows the system to allocate IRQ 12 automatically.

Appian Controller

An advanced IDE controller. You also need special software to activate it.

CPU Address Pipelining

An Award Setting found on Pentiums, where the chipset signals the CPU for a new memory address before the current cycle is complete. Can be enabled if required by a multithreaded operating system.

Keyboard Reset Control

If enabled, CPU operations will be halted before the System Reset signal is actually sent. Put more technically, HALT is executed before SYSC generates CPU reset from **Ctrl-Alt-Del**.

Keyboard Clock Select

As with bus speed, this should end up as standard, in this case 7.25 MHz, so for a 40 MHz CPU, you want CPUCLK/5. You can often decouple the keyboard clock from the bus clock, so you can run one faster than the other. Some motherboards give you an option of running at 9.25 MHz, but this is not often a good idea. The keyboard controller is actually a computer in its own right; at least, it has a microprocessor, and its own BIOS inside.

Novell Keyboard Management

Normally set to *No*, but if you find the keyboard sluggish when using a Novell product, set it for the smallest number between 1-30 that gives you best performance.

Middle BIOS

Sets the System BIOS to appear at E000. It's only for old software, so disable.

Delay Internal ADSJ Feature

ADS# is a bus control signal, or an Address Status strobe driven by the CPU to indicate the start of a CPU bus cycle, showing that a valid command and address is stable on the bus. The J is a substitute for #, which stands for *signal*. See *Synch ADS* below. Enable at 50 Mhz for best compatibility for VL bus cards, but performance will be reduced.

Synch ADS

If set *Disabled*, can improve the performance on low speed machines (e.g. 25 MHz). Enable for 50 MHz 486 and 386/40 systems. Disable *Auto Setup* to use this.

Internal ADS Delay

Enabled, allows an additional span of time for the Address Data Status. Only use this if you have a fast processor.

NMI Handling

DO NOT DISABLE THIS! (sorry for shouting). It's for engineering testing only. Your machine will hang without the right equipment attached to the board and you will need to discharge the CMOS (see *Password*). NMI stands for *Non Maskable Interrupt*, which is one that can't be worked around.

Power-On Delay

Specifies a short delay when power is turned on so the PSU can stabilise.

Software I/O Delay

Can be 0-255 units. Each increment adds a fixed delay based on CPU speed. Should be set to 10, 12, 14, 18 or higher for 16, 20, 25 or 33 MHz systems, respectively.

Sampling Activity Time

Selects the delay time when the chipset monitors and samples SMI (*System Management Interrupt*). You get a choice of *No Delay* or *Delay 1T*.

GAT Mode

Also known as *Guaranteed Access Timing Mode* on Acer motherboards. This setting guarantees the 2.1us CHRDY timeout spec from EISA/ISA buses, to allow their adapters the maximum time to respond to bus signals. *Disabled* takes advantage of PCI reponse time – an ISA bus master is granted the ISA bus and the SIO chip arbitrates..

Guaranteed Access Time

See above.

SIO GAT Mode

Found on a Pentium Pro motherboard, similar to the above. Disabling appears to improve performance slightly.

NA# Enable

Allows pipelining, where the chipset signals the CPU for a new memory address before all data transfers for the current cycle are complete, resulting in faster performance.

Chipset NA# Asserted

Allows you to choose between two methods of asserting the NA# signal during CPU line fills (maybe). NA# stands for *Assertion Next Address*. Enabled helps performance, as it permits pipelining, where the chipset signals the CPU for a new memory address before the current cycle is complete.

LOCAL ready syn mode

Whether the VESA Ready signal is synchronized by the CPU clock's ready signal, or bypassed.

SYN	VESA ready synchronized by the CPU (default).
BYPASS	Synchronization bypassed.

Local Ready Delay Setting

Set the Local Ready Signal to No Delay, 1T, 2T or 3T.

LGNT# Synchronous to LCLK

When a VL bus is prepared to give a VL Bus Master access to the bus, it returns the LGNT# signal active, which acknowledges a request for control of the VL Bus; by default, the bus issues LGNT# as soon as the current bus master finishes with it. When this is enabled, the VL bus will also synchronize its response with the LCLK, the VL bus clock. Concerns reliability—normally, disable.

Cyrix A20M Pin

Cyrix chips need special BIOS handling, if only because their 386 version has a cache (Intel's doesn't), and it may have trouble keeping the cache contents up to date if any part of the PC is allowed to operate by itself, in this case, the keyboard controller toggling the A20 gate. The *A20M* signal can be raised separately by the BIOS to tell the CPU the state of the A20 gate.

This also allows the CPU's internal cache to cache the first 64K of each Mb in real mode (the gate is always open in protected mode), and is fastest.

Cyrix Pin Enabled

As above, but refers to DMA and the FLUSH pin on the CPU, which invalidates the cache after any DMA, so the contents are updated from main memory, for consistency. If you can't set the FLUSH pin, increase the refresh interval and use Hidden Refresh.

Cyrix LSSR bit

Or LSSER. LSSR stands for *Load Store Serialize Enable* (Reorder Disable). It was bit 7 of PCR0 in the 5x86 (index 0x20), but does not apply to the 6x86 or the 6x86MX, as they have no PCR0 or index 0x20.

Chipset Special Features

When disabled, the (TII or HX) chipset behaves as if it were the earlier Intel 82430FX chipset.

Polling Clock Setting

Sets the rate at which the system polls all sub-systems (buses, memory, etc.) for service requests. Choices are:

```
14.318 MHz
CLK2 (Default)
CLK2/2
CLK2/3
CLK2/4
28.636 MHz
```

Host Bus Slave Device

This allows you to use an Intel 486 Host Bus Slave (e.g. a graphics device).

Host Bus LDEV

When enabled, the chipset will monitor the LDEV (local device) signal on the host bus for attempts to access all memory and I/O ranges out of the chipset's range.

Assert LDEV0# for VL

Enabled, allows a VLB slave device to talk to the chipset on a VL/PCI-based machine when there is no VL master present.

Signal LDEV# Sample Time

Choose T2, T3, T4 or T5.

Host Bus LRDY

When this is enabled, the chipset will monitor the LRDY (local ready) signal on the host bus, returning RDY to the CPU.

Memory Hole At 512-640K

When enabled, certain space in memory is reserved for ISA cards to improve their performance – once reserved it cannot be cached as it is mapped to the AT bus. Allegedly for OS/2 only. Normally, disable.

LBD# Sample Point

Allows you to select the cycle check point, which is the point where memory decoding and cache hit/miss checking takes place. Doing it at the end of T3 rather than T2 gives you more time for checking, for greater stability.

486 Streaming

As well as burst mode, the 486 (and true compatibles) support a streaming mode where larger amounts of data are moved to/from memory during a single cycle. Enabling improves performance.

CHRDY for ISA Master

When enabled, this allows an ISA bus master device to assert CHRDY (*Channel Ready*), giving it immediate access to DRAM.

Set Mouse Lock

You can lock the PS/2 Mouse as a security precaution.

NA (NAD) Disable for External Cache

Controls whether the chipset Next Address pin will be enabled, for early posting of the next address when making back to back accesses to L2 cache. Enabled is best for performance, but worse for stability.

ATA-Disc

This only appears (in the MR BIOS) if you have an ATA device (actually up to eight). The fields are mostly filled automatically on selection, and should only be changed if you know the settings (transfer rates) are not correct.

P6 Microcode Updated

This allows you to load new microcode into the CPU (Pentium Pro/II) through the BIOS to correct minor errors, so disable for normal use.

Disconnect Selection

Turns the SCSI Disconnect function on or off. On is best for performance, as the SCSI device can disconnect and allow the CPU to get on with something else, although your operating system must be able to support this.

ChipAwayVirus

Helps the BIOS cope with a virus detector card that checks the boot sector.

OS Select For DRAM >64MB

Use with OS/2 (or NT and *maybe* Linux) when you have more than 64 Mb. The maximum reportable size of memory is 64 Mb, due to the size of the register used (AX). OS/2 and NT can get this reported as 16 Mb and convert it internally.

OS Support for more than 64 Mb

See *OS Select For DRAM >64MB* (above).

OS/2 Compatible Mode

See *OS Select For DRAM >64MB* (above).

Verifying DMI Status

To do with the Intel-Microsoft *Desktop Management Interface*, which is for remote sensing of computer configurations over a network.

POST Testing

Found on AST machines, determines whether POST testing will be *normal*, or *in-depth*. Normal just checks the memory.

MPS 1.1 Mode

The version of the multiprocessor specification.

MPS Version Control For OS

This specifies the version of the *Multiprocessor Specification* (MPS) to be used. Version 1.4 has extended bus definitions to improve support for multiple PCI bus configurations and provide future expandability – use this for NT, and possibly Linux. It is also required for a secondary PCI bus to work without the need for a bridge. Leave it as 1.1 for older server Operating Systems.

Use Multiprocessor Specification

See above.

BIOS Update

Leave disabled unless actually updating the BIOS.

In Order Queue Depth

Determines the length of the queue of instructions that must be processed in sequence, as the Pentium Pro is able to execute out-of-order for smoother processing. Can be set to 1 or 8, meaning you can track up to 8 pipelined bus transactions.

Large Disk Access Mode

Choices are *DOS*, or *Other*. This was found on a Packard Bell with A Phoenix BIOS. Select the appropriate operating system.

Assign IRQ for VGA

If enabled, the BIOS will assign an IRQ for the VGA card, as most modern cards do. It's for the 3D features of a bus mastering card, like the Matrox Mystique, but it may allow an AGP card to share an IRQ with the PCI 1 slot. Disabling releases the IRQ for another device, or reserves it for PCI 1.

Assign IRQ for USB

Enables or disables IRQ allocation for USB.

Monitor Mode

Interlaced or Non-Interlaced, according to whether the video system should output a full screen in sequence (NI) or lines in alternate passes (Interlaced). Cheap monitors won't support full interlace at higher resolutions.

Speed Model

For BIOSes that autodetect the CPU. Speedeasy does it for you. *Jumper emulation* is for the settings as taken from the manual, in terms of bus clock, multiplier, voltage and CPU speed.

S.M.A.R.T. for Hard Disks

Self-Monitoring Analysis & Reporting Technology. Allegedly allows a drive to monitor itself and report to the host (through management software) when it thinks it will fail, so network managers have time to order spares. This has nothing to do with performance, but convenience. Unfortunately, although Win 95 OSR2 and OS/2 (Merlin) are SMART aware, many failures cannot be sensed in advance. Some utilities can check the status of a drive – Micro House EZ-S.M.A.R.T. and Symantec S.M.A.R.T. Doctor.

Since this system allows the monitoring of hard drives over a network, you will get extra packets not necessarily controlled by the operating system – if you get mysterious reboots and crashes, disable this.

Spread Spectrum Modulated

There are techniques (developed by the US government, amongst others) for collecting intelligence from PC transmissions, as microprocessors (and screens) can radiate for some distance—you can expect to receive a PC's signals for up to ½ mile, and a mainframe's for anywhere between 3-4 (scan the area between 2-12 MHz).

This setting is for Electromagnetic Compatibility (EMC) purposes. It reduces EMI radiations by slightly staggering normally synchronous clocks, the idea being to lower the peak levels at multiples of the clock frequency by sending a wider, weaker pulse – in other words, the pulse spikes are reduced to flatter curves. It may also stop the sending of clock signals to unused memory sockets (see *Auto Detect DIMM/PCI Clk*, below). Some high performance peripheral devices might stop working reliably because of timing problems.

The settings could be *1.5% Down*, *0.6% Down*, *1.5% Center* or *Disabled* (the percentage is the amount of jitter, or variation performed on the clock frequency). *Center* means centered on the nominal frequency. Shuttle recommends *1.5% Down* for the HOT631, but others allow enabling or disabling. The latter may be worth trying if your PC crashes intermittently, as there may be interference with clock multiplying CPUs that phase lock the multiplied CPU clock to the bus clock—if the frequency spread exceeds the lock range, the CPU could malfunction. Do not disable if you are overclocking, which increases radiation.

You may get a *Smart Clock* option, which turns off the AGP, PCI and SDRAM clock signals when not in use instead of modulating the frequency of the pulses over time, so EMI can be reduced without compromising stability. It also helps reduce power consumption.

Clock Spread Spectrum

See above.

Auto Detect DIMM/PCI Clk

This is similar to the Smart Clock option mentioned above. If there are no cards in the slots controlled by it, the clock signals are turned off, together with those for slots with no activity. This also reduces power consumption because only components that are running will use it.

Audio DMA

Selects a DMA Channel for motherboard sound systems.

Boot Speed

Turbo is actually the normal setting. *De-Turbo* turns off the CPU cache and increases memory refresh cycles, without slowing down the CPU or altering bus clocks and clock multipliers, unlike older versions which will reduce the ISA bus speed to about 8 MHz.

Language

Sets the language on BIOS setup screens and error messages. Has no affect on the language used by the Operating System or applications.

Physical Drive

Allows logical hard drives to be interchanged, but doesn't work with operating systems such as Unix that bypass the BIOS. Dropped in 1995 in Phoenix BIOS v4.05.

NCR SCSI at AD17 Present in

Specifies the slot in which a PCI NCR 53C810 SCSI card at AD17 is inserted. The options are *Slot 1*, *Slot2*, *Slot 3*, and *Slot 4*. You won't see this if the card isn't there.

PCI Primary IDE INT# Line

Assigns an interrupt line to an add-on PCI primary IDE controller.

PCI Secondary IDE INT# Line

See *PCI Primary IDE INT# Line (above).*

Quick Frame Generation

When the PCI-VL bus bridge is acting as a PCI Master and receiving data from the CPU, a fast CPU-To-PCI buffer is enabled if this is also enabled, which allows the CPU to complete a write even though the data has not been delivered to the PCI bus, reducing the CPU cycles involved and speeding overall processing.

Power-Supply Type

AT or ATX. It seems a bit late to set this after the machine has started, but it really concerns enabling sof-off options, etc.

CPU Core Voltage

Sets the voltage of the installed CPU. Use *Auto* normally, but you can override the settings to suit different circumstances.

CPU Warning Temperature

Sets the upper and lower thresholds of the CPU warning temperature, either side of which the system will behave as specified by you.

IN0-IN6(V)

The current voltage of up to seven voltage input lines, if you have a monitoring system.

Current CPU Temperature

Indicates current CPU temperature if you have a monitoring system.

Current System Temperature

Indicates current main board temperature if you have a monitoring system.

Current CPUFAN1 Speed

The mainboard can detect the rotation speed of two fans, for the CPU cooler and the system. This indicates the CPU cooling fan's rotation speed.

Current CPUFAN1/2/3 Speed

See above, for up to three fans, if you have a monitoring system.

Vcore/Vio/+5V/+12V/-5V/-12V

Detects the output of the voltage regulators and power supply.

Auto Detect DIMM/PCI Clk

Enabling this allosw the system to auto detect and close clock signals to empty DIMM/PCI slots to reduce EMI.

DRAM Idle Timerl

Specifies the number of clocks that the DRAM controller will remain in the IDLE state before precharging all pages.

Starting Point of Paging

Specifies the number of clocks required for starting of page miss cycles. Or controls the start timing of memory paging operations.

Processor Number Feature

For Pentium IIIs – you might not even see it if you don’t have one. It allows you to control whether the Pentium III's serial number can be read by external programs.

Turbo External Clock

Disable for AMD CPUs.

Flash BIOS Protection

Protects the BIOS from accidental corruption by unauthorized users or computer viruses. To update the BIOS, you must disable this, otherwise it should be enabled.

DREQ6 PIN as

Invokes a software suspend routine by toggling the DREQ6 signal.

Drive NA before BRDY

When enabled, the NA signal is driven for one clock before the last BRDY# of every cycle for read/write hit cycles, generating ADS# in the next cycle after BRDY#, and eliminating a dead cycle.

Linear Merge

When enabled, only consecutive linear addresses can be merged.

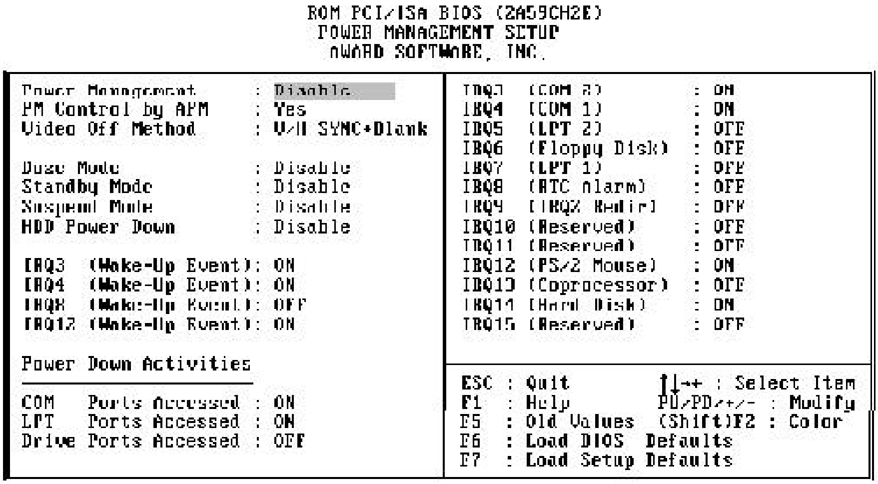
Hardware Reset Protect

When enabled, the hardware reset button will not function, preventing accidental resets (good for file servers, etc).

Notes

Power Management

This is for Green PCs, or those complying with the EPA *Energy Star* programs; the intention is to save unnecessary power usage if the system becomes inactive. Power is reduced automatically to the devices and restored as quickly as possible when activity is detected (that's the theory, anyway). This is usually done with idle timing and event monitoring techniques. A Power Management Unit (PMU) monitors interrupt signals through an interrupt events detector. If it hears nothing for a while, the system is put gradually and progressively to sleep, in that the longer the time inactive, the more parts of the system will close down. However, setting all this up in the BIOS only goes so far – you should do it in your operating system as well (not NT) – certainly, ensure that 95/98's compatibility with APM 1.0 is enabled through Control Panel.



Choices available range from simple "dozing" to complete shutdown:

- **Dozing** slows the CPU down only, to around half speed.
- **Standby** shuts down HD and video, or CPU and SCLK (depends on the chipset).
- **Suspend** shuts down all devices except the CPU.
- **Inactive** stops the CPU, slows the SCLK and powers down the L2 cache.
- **HDD Power Down** just shuts down the hard disk (not SCSI).

As with anything, there are industry standards. For energy saving, these include:

- **APM**, or Advanced Power Management, devised by Intel/Microsoft. This must be active if you want to keep the time and date when the system is suspended, with **power.exe** for DOS (try **power.drv** for Windows) that coordinates BIOS, DOS and program activity. APM is responsible for shutting the system down on quitting the operating system, typically Windows '95, and other useful tricks.
- **ATA**, or *AT Attachments Specification*, for IDE drives. Some ATA compliant devices provide Spindown facilities.
- **DPMS**, or *Display Power Management Signalling*. Monitors and cards conforming to this are meant to be matched, as signals are sent between them to put the CRT into various low power states, which need instructions from the BIOS. There are recognised power management states: *Run*, *Standby*, *Suspend* and *Off*. Suspend is slower to return to the Run state than Standby, which is regarded as being temporarily idle. Disable Standby and Suspend if you don't want PM.
- **ACPI**, or *Advanced Configuration and Power Interface*, hashed out mainly by Intel, Microsoft and Toshiba. This will allow desktop PCs to have instant on, and be better for voicemail and household device control, as peripherals can be turned off as well as the main system unit. It will work the other way, too. Only devices with an ACP BIOS later than Jan 1 1999 are guaranteed to work with Windows 2000.

Some BIOSes have their own maximum and minimum settings for the times allocated, but you may have a "User Defined" option for your own. More options may be available for SL (low power) CPUs.

SM Out, by the way, means the System Management Output control pin.

Smart Battery System

This is where circuitry is added to a battery pack to allow better power management, battery life and information for the user, such as time remaining. The battery can talk to the system, and tell it what services are required (some charging systems depend on battery heat as an indication of charge status). All this has been formalised into the SBS system, which actually stems from five documents containing the specifications for the battery itself, host system hardware, BIOS and charging. The SMBus is a separate bus allowing direct communication between the host and the battery. The Smart Charger allows a battery to control its own charge, while a Smart Battery Selector is used in multiple systems to determine which one is in use, which is charging, etc.

PM Control by APM

Or *Power Management Control by Advanced Power Management*. Switches APM on or off; choices are *Yes* or *No*. If *Yes*, combine DOS and Windows utilities for Green Mode (only with S-series CPUs). When enabled, an Advanced Power Management device will be activated to enhance the maximum Power Saving mode and stop the CPU internal clock. In other words, the BIOS will wait for a prompt from APM before going into any power management mode. If disabled, the BIOS will ignore APM. You need DOS and Windows utilities as well.

Power Management

The type or degree of power saving for Doze, Standby and Suspend modes.

Max Saving	Pre-defined settings at Maximum values, for SL CPUs only
User Define	You can set each mode individually
Min Saving	Predefined settings at Minimum values
Disabled	Global Power Management will be disabled.
Power Up By Alarm	You can set the alarm that returns the system to Full On state

ACPI Suspend Type

S1 or S3. Set the latter for *Suspend To RAM*.

PM Events

A *Power Management* (PM) *Event* awakens the system from, or resets activity timers for, Suspend Mode. You can disable monitoring of some common I/O events and interrupt requests so they don’t wake up the system – the default is keyboard activity. When On, or named, as for LPT and COM ports, activity from a listed peripheral device or IRQ wakes up the system.

IDE Standby Power Down Mode

Also known as Hard Disk Timeout, or HDD Power Down (Award), allows automatic power down of IDE drives after a specified period of inactivity, but some don't like it (notebook drives are OK). 15 minutes is a suggested minimum, to avoid undue wear and tear on the drive. Probably doesn't affect SCSI drives.

HDD Power Down

See above.

HDD Standby Timer

The hard disk powers down after a selected period of inactivity. This would appear to be separate from other power management modes.

Standby Mode Control

Sets standby clock speed to fractions of CPU speed, and enables/disables the video.

IDE Spindown

As for *Standby Mode Control*, from MR BIOS.

Doze Timer/System Doze

Certain parts of the machine are monitored, i.e. hard disk, keyboard, mouse, serial and parallel ports, interrupts and the like, and if they are inactive for a length of time determined here, the computer dozes off for a short while; that is, it reduces activity and use of power until any of the above items become active again. Gives 80% sleep, 20% work.

Power-down mode timers

From MR, sets a timeout before power saving mode is entered. *Standby* slows down the CPU and video clocks.. *Suspend* turns them off—set this for longer, to give more time to recover.

Video Off After

See also *Video Off Option*. Turns the video off after a system event:

N/A	Never turn screen off
Suspend	Off when system in Suspend Mode
Standby	Off when system in Standby Mode
Doze	Off when system in Doze Mode

Video Off Method

How the video will be switched off. Choose:

- **DPMS**, if your VGA card and monitor support it.
- **Blank Screen**. The screen will only be blanked when video is disabled. Uses more power than *V/H Sync + Blank*.
- **V/H Sync + Blank**. As well as *Blank Screen*, the Vertical and Horizontal Sync signals are turned off, but if your card is not compatible, use *Blank Screen* only.

Green monitors detect the V/H-Sync signals to turn off the electron gun – if they don't, the gun is turned off.

Standby Timer

Used when the computer is thought to be temporarily idle. Power reduction measures include the monitor partially powering down, or the CPU speed slowing to 8 MHz. Gives 92% sleep, 8% work (like me).

Global Standby Timer

After the selected period, the system enters Standby mode.

Green Timer

Either Disable, or establish between 10 secs-3 hours.

Suspend Timer

Comes into force after the system has been idle for some time, say an hour, when the computer thinks it's unattended. The CPU can be stopped, and the monitor disabled to the extent of needing to warm it up. There may be a **CRT OFF** mode, which will need the on/off switch to get the monitor working again. You may also see an **8X Mode** for factory testing and demonstrations; all it does is make everything operate 8 times faster. 99% sleep, 1% work (no, this is more like me). May support a Suspend switch on the motherboard.

Global Suspend Timer

After the selected period, the system enters Suspend mode.

Sleep Clock

Select *Stop Clock* or *Slow Clock* during Sleep Mode.

Suspend Mode Option

Select the type of Suspend Mode:

POS	Power-On Suspend (CPU and core system remain on in a very low-power mode).
Auto	After the selected period of inactivity, the system automatically enters STD mode. Otherwise it enters STR mode (see below).
STD	Save To Disk
STR	Suspend To RAM

Suspend Option

Lets you select a method of global system suspend. *Static Suspend*, sometimes called *Power-on Suspend* (POS), leaves the CPU powered on, but stops its clock. *0v Suspend*, sometimes called *Save To Disk* (STD) *Suspend*, saves the state of the entire system to disk then powers off the system.

Sleep Timer

After the selected period of inactivity, all devices except the hard disk and CPU shut off.

Suspend Mode Switch

Controls a hardware switch that puts the computer into Suspend Mode.

Auto Keyboard Lockout

If the keyboard powers down, use **Ctrl-Alt-Bksp** and wait for the keyboard lights to go on and off, then enter the CMOS password.

CPU Clock (System Slow Down)

After the specified time interval, the CPU will be slowed down to 8 MHz.

Monitor Power/Display Power Down

You must have a green power supply for this. After the specified interval, the monitor power will be turned off. Monitors with the circuitry to cope with this can be a pain if it goes wrong and keeps powering down anyway.

Event Monitoring

As *Individual IRQ Wake Up Events (System IRQ Monitor Events),* from MR (see below).

- *Local* monitoring checks only the keyboard, PS/2 mouse and two serial port interrupts.
- *Global* monitoring checks all interrupts.

Monitor Event in Full On Mode

In On Mode, the Standby Timer (see *Standby Timer Select*) starts counting if no activity is taking place and the programmable time-out period has expired. Devices checked under this category are included in the list of devices the system monitors during the PM timers countdown. Otherwise their activity doesn't affect it.

Individual IRQ Wake Up Events (System IRQ Monitor Events)

IRQs are monitored as an indirect method of watching the CPU, since it cannot be checked directly. The system can be woken up or sent to sleep if one is generated, or not, typically by a mouse (see *Expansion Cards* for a full list of IRQs).

IRQ 1(-15) Monitor

As for *Event Monitoring.*

IRQ8 Break Suspend

IRQ8 refers to the system clock. Here, you can enable or disable monitoring so it doesn't wake the system from Suspend mode.

IRQ8 Break [Event From] Suspend

See above.

IRQ8 Clock Event

See above.

DRQ 0 (-7) Monitor

As *IRQ 1(-15) Monitor*, but for DMA input monitoring. See *Expansion Cards* for a full list of DMA Channels.

System Events I/O Port Settings

Wakes the system up if one of these is accessed.

Keyboard IO Port Monitor

Allows ports 60 and 64h to be monitored for system activity (or not).

Floppy IO Port Monitor

As for *Keyboard IO Port Monitor*, but for port 3F5h.

Hard Disk IO Port Monitor

As *Keyboard IO Port Monitor*, but for ports 1F0h-3F6h.

Video Port IO Monitor

As *Keyboard IO Port Monitor*, but for video ports.

VGA Adapter Type

If you set this to *Green*, and your card supports Green features, Vertical and Horizontal scanning will also be stopped when the screen is blanked.

Video Memory Monitor

As *Keyboard IO Port Monitor*, but for A000-BFFF areas of upper memory.

Low CPU Clock Speed

What speed to use when at slow speed.

Power Management Control

Enabled, turns power management on.

Power Management RAM Select

Where the 32K required for power management is, in Upper Memory (def E000).

O.S

So you can use Non-S and AMD/Cyrix chips to shut down the monitor. Select *All O.S*. for non-DOS systems. Otherwise you can select the IRQ (e.g. DOS ONLY15).

Factory Test Mode

Do not enable this (if you see it).

APM BIOS

Turns Automatic Power Management On or Off. Use with care, as some motherboards can't maintain the time of day in some power saving modes. However, it can save 25-40 kilowatt hours a month if your PC is left on all the time. Best left off otherwise, as it can be a pain.

APM BIOS Data Area

Where to keep data relating to Power Management, F000 or DOS 1 K.

ACPI I/O Device Node

Enables or disables ACPI device node reporting from the BIOS to the Operating System.

Device Power Management

Has the following headings:

- *Display Type Support*. Set to *Green PC* if you have an EPA compatible monitor. Otherwise set *Standard*.
- *Video Off in Suspend Mode*. Permits the BIOS to power down the video display when the computer is in suspend mode.
- *IDD HDD Off in Suspend Mode*. As above, for hard drive.
- *Ser Prt Off in Suspend Mode*. As above, for serial ports.
- *Par Prt Off in Suspend Mode*. As above, for the parallel port.
- *Prog I/O Off in Suspend Mode*. As above, for Prog I/O.

Video Off In Suspend

Turns off video when entering suspend mode.

Auto Clock Control

If you don't have APM, or it isn't enabled, the BIOS will manage the CPU clock in the same way.

System Power Management

Has the following headings:

- *System Cache Off in Suspend Mode.*
- *Slow Refresh in Suspend Mode.* Refreshes DRAM every 45, not 16 ns.

Power Button Override

When this is enabled, you must press the power button for over 4 seconds before the machine will turn off. Disabled, the machine powers off immediately. It needs an ATX power supply.

System Monitor Events

The following are monitored for inactivity:

- *Video ROM Access C000h, 32K.* Allows LB access to Video ROM C000.
- *Video RAM Access A000-C7FF.* Permits local bus access to this area.
- *Video Access A000-C7FF.* Combines the previous two options.
- *Local Bus Device Access.* Enabled, permits local bus device access.
- *Local Bus Master Access.* Enabled, permits local bus master device access.
- *Local Bus Access.* Combines previous two options.

Power Down and Resume Events

You can disable monitoring of some common I/O events and interrupt requests so they do not wake the system up from Suspend Mode, or reset the activity timers. Select On if you want an IRQ, when accessed, to reload the original count of the global timer, which is the hardware timer that counts down to Doze, Standby and Suspend modes. Selected IRQs also cause the system to wake up from a global Doze, Standby and Suspend mode when accessed. If a Doze timeout is set, the system enters Doze mode when it expires. Then the timer reloads with the standby timeout, if one is set, otherwise it uses the suspend timeout, if one is set. If not, the timer turns off. The effect is similar for Standby and Suspend timeouts. If more than one global timeout is set, the timeouts run one after the other.

Reload Global Timer Events

When enabled, an event occurring on each listed device restarts the the global timer for Standby mode.

DMA Request

Enabled, permits local bus DMA requests.

NON-SMI CPU Support

Selects IRQ to replace System Management Interrupt (SMI) events when the CPU doesn't support SMI.

Video Off Option

Choices are:

Always On	Screen is never turned off
Suspend -> Off	Screen off when in Suspend mode
Susp, Stby -> Off	Screen off when in Standby or Suspend mode
All modes -> Off	As above (so why have it?)

Throttle Duty Cycle

The percentage by which CPU speed is cut back when it gets hot, or for power saving. Settings are in multiples of 12.5%.

CPU Thermal-Throttling

The duty cycle of the STPCLK# signal, so the CPU is slowed down entering Green Mode.

Soft-off by PWR-BTTN

Instant-Off allows the system to switch off immediately the power button is pressed. Otherwise, it will only do so after you press it for more than 4 seconds. Below this, the switch acts as a suspend button, leaving a small amount of power on the system so that power can be restored not only by the power switch but also by ring detection—your PC is therefore potentially subject to voltage surges on the power line 24 hours a day, whereas a conventional power switch physically disconnects the PC.

This option may also leave power on the parallel ports and prevent printers from entering their own power saving modes.

Switch Function

Select the operation of the power button, when pressed:

Deturbo	System slows – press a key to return to full power
Break	System enters Suspend Mode – press a key to return to full power
Break/Wake	System enters Suspend Mode – press the power button to return to full power

Resume By Ring

Powers the system on when the Ring Indicator signal is received in UART 1 or 2 from an external modem. Needs ATX power supply and *IRQ8 Clock Event* enabled.

Resume By LAN/Ring

Allows the system to wake up in response to a Ring Indicator signal from an external modem through UART 1 or 2, or a wake-up signal through the network card from a server. Resume By Ring needs *IRQ8 Clock Event* to be enabled. *Wake on LAN* gives you the ability to remotely boot a PC from across a network even if it has been powered down.

Ring Power Up Act

Powers the system on when the Ring Indicator signal is received in UART 1 or 2 from an external modem. Needs an ATX power supply.

Resume By Alarm

Uses an RTC alarm to generate a work event or, in other words, an alarm from the Real Time Clock can be used to wake the system up from sleeping. Needs an ATX power supply and *IRQ8 Clock Event* to be enabled.

RTC Alarm Resume

Set the date and time at which the Real Time Clock awakens the system from Suspend mode.

Keyboard Resume

When disabled, keyboard activity does not wake the system up from Suspend mode.

Thermal Duty Cycle

Slows down the CPU by the specifications listed here when it overheats.

CPU Warning Temperature

Sets an alarm when the CPU reaches a specified temperature.

Fan Failure Control

What happens if the CPU fan fails.

Automatic Power Up

For unattended or automatic power up, such as *Everyday*, or *By Date*.

Instant On Support

Enable to allow the computer to go to full power on mode when leaving a power-conserving state. O*nly available if supported by the hardware.* The AMI BIOS uses the RTC Alarm function to wake the computer at a prespecified time.

ZZ Active in Suspend

When enabled, the ZZ signal (whatever that is) is active during Suspend mode.

Version 1	Cache controller into sleep mode when system is in Suspend mode.
Version 2	When enabled, PB SRAM (cache) consumes power in PM mode.

Advanced OS Power

Allows the operating system to control power management, but may need to be turned off during some installations to stop the floppy shutting down in the middle.

BIOS PM on AC

For portables, controls whether power management is active when running on external (AC) power. *On* enables power management at all times—*Off* turns power management off except when using batteries.

BIOS PM Timers

After a specified inactivity for a particular subsystem selected here, it enters standby mode.

COM Port Activity

The PM system cannot directly monitor CPU activity, but must deduce it by monitoring external activities which require it, in this case, the serial port.

VGA Activity

Determines whether VGA activity is monitored for low power mode.

VGA Active Monitor

When enabled, video activity restarts the Global Timer for Standby Mode.

Video Timeout

Sets the timeout for automatic video blanking.

LPT Port Activity

Whether parallel port activity is monitored for initiation of low power mode.

CPU Fan Off In Suspend

When this is enabled, the CPU fan is shut down when the CPU is put into suspend mode. As with power supplies, frequent starting and stopping of the fan may cause more wear than just letting it run.

CPU Fan on Temp High

Switches the fan on at a predetermined CPU temperature.

Doze Mode

After a period of inactivity, the CPU slows down whilst everything else runs at full speed.

Doze Timer

As above.

Doze Timer Select

Selects the timeout period (i.e. of system inactivity) after which the system enters Doze Mode.

Doze Mode Control

Sets the Doze Mode clock speed to various fractions of normal CPU speed and permits the VGA Display to be enabled or disabled. The DOS time may be incorrect.

Doze Speed (div by)

Selects a divisor of full CPU speed to reduce the CPU to during Doze Mode.

Standby Speed (div by)

Selects a divisor of full speed to reduce the CPU to during Standby Mode.

Inactive Mode Control

Sets the Inactive Mode clock speed to fractions of normal CPU speed or turned off entirely – it also permits the VGA Display to be enabled or disabled. If 0 clock Speed (STOP CLK) is selected, the CPU cannot monitor external activities and therefore cannot automatically bring the computer back to normal based on actions such as keystroke entries.

Standby Mode Control

See Doze Mode Control.

Standby Timer Select

Selects the timeout period (i.e. system inactivity) after which the system enters Standby Mode.

Standby Timers

After the selected period of inactivity for each subsystem (video, hard drive, peripherals), it enters Standby Mode.

FDD/COM/LPT Port

Reloads the global timer when there is a FDD/COM/LPT event.

FDD Detection

Floppy drive activity wakes up the system or resets the inactivity timer.

HDD detection

As above, for hard disks.

Video Detection

When enabled, video activity wakes up the system or resets the inactivity timer.

IRQn Detection

As above, for IRQs.

LREQ Detection

When enabled, any activity on the LREQ signal line wakes up the system or resets the inactivity timer.

Wake on Ring

This allows a computer to be brought up from low power mode when a telephone ring is detected. Requires a special modem connection.

Wake Up Events

You can turn On or Off monitoring of commonly used interrupt requests so they do not waken the system from, or reset activity timers for, Doze and Standby modes. the default is keyboard activity.

Wake Up Event in Inactive Mode Enable

See above.

WakeUp Event In Inactive Mode

Allows you to specify which interrupts (IRQs) will wake the system up from power saving modes. It may not work properly with PnP Operating Systems that move IRQs between devices without warning.

Watch Dog Timer

A hardware timer that generates either that generates either an NMI or a reset when the software that it monitors does not respond as expected each time it is polled. See also WDT fields, below.

WDT Active Time

The watch dog timer period.

WDT Configuration Port

The I/O port for the watch dog timer.

WDT Time Out Active For

The watch dog timer response.

Boot from LAN first

Allows the BIOS to boot from a LAN boot image before attemting it from a local device. Your LAN adapter must support it.

CRT Power Down

Allows the CRT to power down when the system is in Green Mode.

CRT Sleep

The manner in which the CRT is blanked.

GPI05 Power Up Control

When enabled, a signal from General Purpose Input 05 returns the system to Full On state.

Day of Month Alarm

Select a date in the month, but use 0 if you want a weekly alarm.

Month Alarm

Select a month by number (1-12) or NA if you want the alarm for all of them.

Week Alarm

Turn the alarm on and off on specific days.

Hot Key Power Off

Enable to use the hot key for soft power off, if your system has one.

LDEV Detection

Detects activity on the LDEV signal line to wake up the system or reset the inactivity timer.

Shutdown Temperature

Selects the lower and upper limits for system shutdown temperature, if your computer has an environmental monitoring system. If the temperature extends beyond either limit, the system shuts down.

DRQ Detection

When enabled, activity on a DRQ line wakes the system up or resets the inactivity timer.

Modem Use IRQ

The IRQ line assigned to the modem, on which any activity awakens the system.

Suspend To RAM

An implementation of ACPI 1.0, which drops the power consumption to the lowest possible level and allows the quickest resumption, as the system context is retained in system memory. The current of the 5VSB line must be more than .75a, and ACPIU should be enabled, with the *ACPI Suspend Type* set to S3. You also need Win 98 or 2000.

Primary INTR

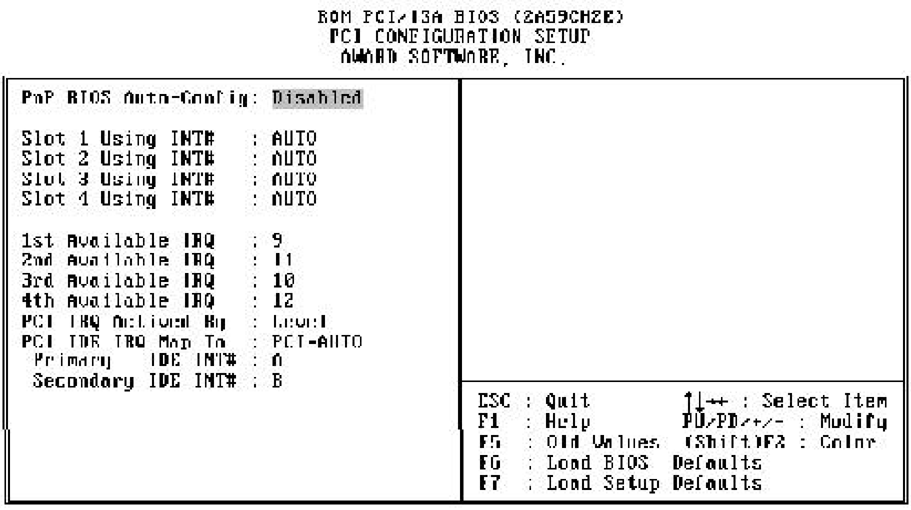
Acts like a master switch for the interrupt selections under it – when this is on, you can they can be manually configured to act as resets for the power saving timeouts. *Primary* refers to timeouts using the primary timer (i.e. power saving modes). *Secondary* refers to background maintenance tasks.

Inactive Timer Select

The period of system inactivity after which the system becomes inactive. This should be longer than for Standby.

Plug And Play/PCI

A system intended to make fitting of expansion cards easier (yes, really!). In this context, ISA cards not compatible with PnP are known as *Legacy Cards*, and are switched as normal to make them fit in ("legacy" describes something that's out of date but is tolerated in modern equipment). You will also have to reserve the IRQ or DMA settings they use in the BIOS, otherwise they might not be found later. Have as few of these as possible, as accesses to them are slow.



With *Concurrent PCI*, The T II (or 430HX/VX) chipset's *Multi Transaction Timer* allows multiple transfers in one PCI request, by reducing re-arbitration when several PCI processes can take place at once; with more than one CPU and PCI bus, both PCI buses can be accessed simultaneously. *Passive Release* allows the PCI bus to continue working when it's receiving data from ISA devices, which would normally hog the bus; in other words, it helps with latencies. *Delayed Transaction* allows PCI bus masters to work by delaying transmissions to ISA cards. *Write merging* combines byte, word and Dword cycles into a single write to memory.

The idea is that plug and play cards get interrogated by the system they are plugged into, and their requirements checked against those of the cards already in there. The BIOS will feed the data as required to the Operating System, typically Windows '95. Inside the BIOS, the POST is enhanced to include automatic resource allocation, with reference to the ESCD.

Here you can assign IRQs, etc to PCI slots and map PCI INT#s to them. Although Windows '95 or a PnP BIOS can do a lot by themselves, you really need the lot, e.g. a Plug and Play BIOS, with compatible devices and an Operating System for the best performance. Operating Systems that natively support PnP are Windows 95/98, 2000 and OS/2. Linux can also handle it, as can Windows NT with a module on the installation CD, but it’s not supported by Microsoft. Note that these systems do not *require* PnP hardware – devices won’t be configured without the right system, but you just have to do it manually, like with non-PnP stuff.

Be aware that not all PCI (2.0) cards are PnP, and that although PC (PCMCIA) cards are "Plug and Play", they are not considered here. Also, anything using PCI address ranges will not be seen by the BIOS on boot-up, which doesn’t mean that it isn’t working.

PnP itself was originally devised by Compaq, Intel and Phoenix. Your chipset settings may allow you to choose of two methods of operation (with the *Plug and Play OS* setting):

- All PnP devices are configured and activated.
- All PnP ISA cards are isolated and checked, but only those needed to boot the machine are activated. The ISA system cannot produce specific information about a card, so the BIOS has to isolate each one and give it a temporary handle so its requirements can be read. Resources can be allocated once all cards have been dealt with (recommended for Windows '95, as it can use the Registry and its own procedures to use the same information every time you boot). This leads to....

ESCD (*Extended System Configuration Data*), a system which is part of PnP (actually a superset of EISA), that can store data on PnP or non-PnP EISA, ISA or PCI cards to perform the same function as the Windows '95 Registry above, that is, provide consistency between sessions by reserving specific configurations for individual cards. Without ESCD, each boot sequence is a new adventure for the system. It occupies part of Upper Memory (E000-EDFF), which is not available to memory managers. The default length is 4K, and problems have been reported with EMS buffer addressing when this area has been used.

PCI Device Identification

Company Name	Dec ID	Hex ID
2WIRE	5483	0x156B
3A	4844	0x12EC
3COM	4279	0x10B7
3CX	5351	0x14E7
3Com	4793	0x12B9
3DFX INTERACTIVE	4634	0x121A
3PARDATA	5520	0x1590
3WARE	5057	0x13C1
A-MAX TECHNOLOGY	5534	0x159E
A-TREND	5475	0x1563
ABB AUTOMATION PRODUCTS	5317	0x14C5
ABB ROBOTICS PRODUCTS	5086	0x13DE
ABIT	5243	0x147B
ABOCOM SYSTEMS	5073	0x13D1
ACARD TECHNOLOGY	4497	0x1191
ACCTON TECHNOLOGY	4371	0x1113
ACCUSYS	5334	0x14D6
ACER LABS	4281	0x10B9
ACKSYS	5416	0x1528
ACQIRIS	5356	0x14EC
ACQIS TECHNOLOGY	5424	0x1530
ACTEL	4522	0x11AA
ADAPTEC	36868	0x9004
ADDI-DATA GMBH	5560	0x15B8
ADDONICS	5139	0x1413
ADLINK TECHNOLOGY	5194	0x144A
ADMTEK INC	4887	0x1317
ADTEK SYSTEM SCIENCE CO LTD	4972	0x136C
ADVANCED MICRO DEVICES	4130	0x1022
ADVANCED SYSTEM PRODUCTS	4301	0x10CD
ADVANCED TECHNOLOGY LABORATORIES	4487	0x1187
AETHRA S.R.L.	5023	0x139F
AG COMMUNICATIONS	5369	0x14F9
AG ELECTRONICS LTD	5579	0x15CB
AGERE INC.	5606	0x15E6
AGFA CORPORATION	4611	0x1203
AGIE SA	5185	0x1441
AGILENT TECHNOLOGIES	5564	0x15BC
AIM GMBH	5191	0x1447
AIRONET WIRELESS COMMUNICATIONS	5305	0x14B9
ALACRITECH INC	5018	0x139A

Company Name	Dec ID	Hex ID
ALACRON	4246	0x1096
ALADDIN KNOWLEDGE SYSTEMS	16748	0x416C
ALCATEL	4196	0x1064
ALFA INC	5486	0x156E
ALLEN- BRADLEY COMPANY	4768	0x12A0
ALLIED DATA TECHNOLOGIES	5515	0x158B
ALLIED TELESYN INTERNATIONAL	4697	0x1259
ALOKA CO. LTD	5128	0x1408
ALPHA PROCESSOR INC	5337	0x14D9
ALPHA-TOP CORP	5485	0x156D
ALTEON WEBSYSTEMS INC	4782	0x12AE
ALTERA CORPORATION	4466	0x1172
AMBICOM INC	5013	0x1395
AMBIENT TECHNOLOGIES INC	6163	0x1813
AMBIT MICROSYSTEMS CORP.	5224	0x1468
AMDAHL CORPORATION	4614	0x1206
AMERICAN MEGATRENDS	4126	0x101E
AMERICAN MICROSYSTEMS INC	5417	0x1529
AMERSHAM PHARMACIA BIOTECH	5550	0x15AE
AMO GMBH	4775	0x12A7
AMP	4152	0x1038
AMPLICON LIVELINE LTD	5340	0x14DC
AMTELCO	5347	0x14E3
ANALOG DEVICES	4564	0x11D4
ANCHOR CHIPS INC.	4798	0x12BE
ANDOR TECHNOLOGY LTD	5274	0x149A
ANNABOOKS	4428	0x114C
ANTAL ELECTRONIC	5436	0x153C
AOPEN INC.	41120	0xA0A0
APEX INC	5081	0x13D9
APPIAN/ETMA	4247	0x1097
APPLE COMPUTER INC.	4203	0x106B
APPLICOM INTERNATIONAL	5001	0x1389
APPLIED COMPUTING SYSTEMS INC.	5595	0x15DB
APPLIED INTEGRATION CORPORATION	5342	0x14DE
ARALION INC.	5432	0x1538
ARCHTEK TELECOM CORP.	5374	0x14FE
ARDENT TECHNOLOGIES INC	5478	0x1566
ARK RESEARCH CORP.	4939	0x134B
ARM Ltd	5045	0x13B5
ARN	5521	0x1591
ARRAY MICROSYSTEMS	4796	0x12BC
ARTESYN COMMUNICATIONS PRODUCTS INC	4643	0x1223

Company Name	Dec ID	Hex ID
ARTX INC	5120	0x1400
ASCEND COMMUNICATIONS.	4359	0x1107
ASTRODESIGN	4543	0x11BF
ASUSTEK COMPUTER.	4163	0x1043
ATELIER INFORMATIQUES et ELECTRONIQUE ETUDES S.A.	5433	0x1539
ATI TECHNOLOGIES INC	4098	0x1002
ATLANTEK MICROSYSTEMS PTY LTD	5513	0x1589
ATMEL-DREAM	5176	0x1438
AUDIOCODES INC	5368	0x14F8
AURAVISION	4561	0x11D1
AUREAL INC.	4843	0x12EB
AURORA TECHNOLOGIES.	4700	0x125C
AUSPEX SYSTEMS INC.	4290	0x10C2
AUTOMATED WAGERING INTERNATIONAL	5640	0x1608
AVAL NAGASAKI CORPORATION	4708	0x1264
AVANCE LOGIC INC	16389	0x4005
AVID TECHNOLOGY INC	4527	0x11AF
AVLAB TECHNOLOGY INC	5339	0x14DB
AVM AUDIOVISUELLES MKTG & COMPUTER SYSTEM GMBH	4676	0x1244
AVTEC SYSTEMS	5482	0x156A
AYDIN CORP	5115	0x13FB
Aculab PLC	4825	0x12D9
Adaptec/Cogent Data Technologies Inc	4361	0x1109
Advanet Inc	4879	0x130F
Aims Lab	4813	0x12CD
Analogic Corp	4822	0x12D6
B-TREE SYSTEMS INC	5616	0x15F0
B2C2	5072	0x13D0
BALDOR ELECTRIC COMPANY	5215	0x145F
BALTIMORE	5427	0x1533
BANCTEC	5623	0x15F7
BANKSOFT CANADA LTD	5377	0x1501
BARR SYSTEMS INC.	4531	0x11B3
BASIS COMMUNICATIONS CORP	5343	0x14DF
BASLER GMBH	5006	0x138E
BECKHOFF GMBH	5612	0x15EC
BEHAVIOR TECH COMPUTER CORP	5392	0x1510
BELL CORPORATION	5409	0x1521
BIOSTAR MICROTECH INT'L CORP	5477	0x1565
BITBOYS OY	5578	0x15CA
BLUE CHIP TECHNOLOGY LTD	5063	0x13C7
BLUE WAVE SYSTEMS	4465	0x1171
BLUESTEEL NETWORKS INC	5547	0x15AB

Company Name	Dec ID	Hex ID
BOEING - SUNNYVALE	4981	0x1375
BOPS INC	5523	0x1593
BRAIN BOXES LIMITED	4954	0x135A
BRAINS CO. LTD	4993	0x1381
BREA TECHNOLOGIES INC	2697	0x0A89
BROADCOM CORPORATION	5348	0x14E4
BROADLOGIC	5363	0x14F3
BROOKTREE CORPORATION	4254	0x109E
BST COMMUNICATION TECHNOLOGY LTD	5296	0x14B0
BUG.	4509	0x119D
BULL HN INFORMATION SYSTEMS	4511	0x119F
BVM LIMITED	5568	0x15C0
Billionton Systems Inc./Cadmus Micro Inc.	5323	0x14CB
Brooktrout Technology Inc	4836	0x12E4
C-CUBE MICROSYSTEMS	4671	0x123F
C-MEDIA ELECTRONICS INC	5110	0x13F6
C-PORT CORPORATION	5390	0x150E
CACHEFLOW INC	5600	0x15E0
CALCULEX INC	5092	0x13E4
CANON RESEACH CENTRE FRANCE	5360	0x14F0
CAPITAL EQUIPMENT CORP	4860	0x12FC
CARDIO CONTROL N.V.	5309	0x14BD
CARRY COMPUTER ENG. CO LTD	5359	0x14EF
CATALYST ENTERPRISES INC	5538	0x15A2
CATAPULT COMMUNICATIONS	52428	0xCCCC
CCI/TRIAD	5556	0x15B4
CEMAX-ICON INC	5468	0x155C
CENTILLIUM TECHNOLOGY CORP	5393	0x1511
CENTRAL SYSTEM RESEARCH CO LTD	5636	0x1604
CENTURY SYSTEMS.	4668	0x123C
CHAINTECH COMPUTER CO. LTD	9999	0x270F
CHAMELEON SYSTEMS INC	5382	0x1506
CHAPLET SYSTEM INC	5408	0x1520
CHICONY ELECTRONICS CO LTD	5459	0x1553
CHORI JOHO SYSTEM CO. LTD	4940	0x134C
CHRYON CORP.	5425	0x1531
CHRYSALIS-ITS	51966	0xCAFE
CIMETRICS INC	5557	0x15B5
CIPHER SYSTEMS INC	5014	0x1396
CIRTECH (UK) LTD	5331	0x14D3
CIS TECHNOLOGY INC	5174	0x1436
CISCO SYSTEMS INC	4407	0x1137
CLARION CO. LTD	5016	0x1398

Company Name	Dec ID	Hex ID
CLEVELAND MOTION CONTROLS	5225	0x1469
CLEVO/KAPOK COMPUTER	5464	0x1558
CMD TECHNOLOGY INC	4245	0x1095
COGNEX INC.	4855	0x12F7
COGNEX MODULAR VISION SYSTEMS DIV. - ACUMEN INC.	4791	0x12B7
COLOGNE CHIP DESIGNS GMBH	5015	0x1397
COMBOX LTD	5403	0x151B
COMPAL ELECTRONICS INC	5312	0x14C0
COMPAQ COMPUTER CORP.	3601	0x0E11
COMPUMASTER SRL	5536	0x15A0
COMPUTER HI-TECH CO LTD	5329	0x14D1
COMPUTEX CO LTD	5451	0x154B
COMPUTONE CORPORATION	36366	0x8E0E
COMVERSE NETWORKS SYSTEM & Ulticom.	4820	0x12D4
CONCURRENT TECHNOLOGIES	4703	0x125F
CONDOR ENGINEERING INC	5062	0x13C6
CONEXANT	5361	0x14F1
CONTEC CO. LTD	4641	0x1221
CONTEMPORARY CONTROLS	5489	0x1571
CONTROLNET INC	4995	0x1383
CORECO INC	4588	0x11EC
COROLLARY	4492	0x118C
COYOTE TECHNOLOGIES LLC	5366	0x14F6
CREAMWARE GMBH	5301	0x14B5
CREATIVE ELECTRONIC SYSTEMS SA	4342	0x10F6
CREATIVE LABS	4354	0x1102
CREATIVE LABS. MALVERN	4724	0x1274
CREST MICROSYSTEM INC.	4417	0x1141
CRYPTEK	5212	0x145C
CRYSTAL GROUP INC	5024	0x13A0
CTI PET Systems	5294	0x14AE
CYBERFIRM INC.	5594	0x15DA
CYBERNETICS TECHNOLOGY CO LTD	5592	0x15D8
CYCLONE MICROSYSTEMS.	4412	0x113C
CYTEC CORPORATION	5506	0x1582
Chase Research	4832	0x12E0
Colorgraphic Communications Corp	4875	0x130B
Computer Boards	4871	0x1307
Connect Tech Inc	4804	0x12C4
D-LINK SYSTEM INC	4486	0x1186
DAEWOO TELECOM LTD	4208	0x1070
DAINIPPON SCREEN MFG. CO. LTD	4550	0x11C6
DALLAS SEMICONDUCTOR	5098	0x13EA

Company Name	Dec ID	Hex ID
DATA RACE INC	5318	0x14C6
DATACUBE	4375	0x1117
DATAKINETICS LTD	5357	0x14ED
DATALEX COMMUNCATIONS	5431	0x1537
DCM DATA SYSTEMS	5444	0x1544
DDK ELECTRONICS INC	5480	0x1568
DECISION COMPUTER INTERNATIONAL CO. 26214	0x6666	
DELL COMPUTER CORPORATION	4136	0x1028
DELTA ELECTRONICS INC	5529	0x1599
DELTA NETWORKS INC	16435	0x4033
DFI INC.	5565	0x15BD
DIAGNOSTIC INSTRUMENTS INC	5618	0x15F2
DIATREND CORPORATION	5240	0x1478
DIGALOG SYSTEMS INC	5514	0x158A
DIGI INTERNATIONAL	4431	0x114F
DIGIGRAM	4969	0x1369
DIGITAL AUDIO LABS INC	5404	0x151C
DIGITAL RECEIVER TECHNOLOGY INC	44062	0xAC1E
DIGITMEDIA CORP.	5619	0x15F3
DISTRIBUTED PROCESSING TECHNOLOGY	4164	0x1044
DITECT COOP	5519	0x158F
DIVA SYSTEMS CORP.	5525	0x1595
DIVERSIFIED TECHNOLOGY	4200	0x1068
DLoG GMBH	5046	0x13B6
DOLPHIN INTERCONNECT SOLUTIONS AS	4552	0x11C8
DOME IMAGING SYSTEMS INC	4590	0x11EE
DOUG CARSON & ASSOCIATES	5236	0x1474
DREAMTECH CO LTD	5581	0x15CD
DRSEARCH GMBH	5611	0x15EB
DSP RESEARCH INC	5130	0x140A
DTK COMPUTER	5314	0x14C2
DUAL TECHNOLOGY CORPORATION	5497	0x1579
DY4 Systems Inc	54484	0xD4D4
DYNACHIP CORPORATION	4989	0x137D
DYNARC INC	5216	0x1460
Datum Inc. Bancomm-Timing Division	4834	0x12E2
Dialogic Corp	4807	0x12C7
E-TECH INC	5087	0x13DF
EAGLE TECHNOLOGY	59905	0xEA01
EASTMAN KODAK	4530	0x11B2
ECHELON CORPORATION	5426	0x1532
ECHOSTAR DATA NETWORKS	5022	0x139E
ECHOTEK CORPORATION	5399	0x1517

Company Name	Dec ID	Hex ID
EDEC CO LTD	5160	0x1428
EFFICIENT NETWORKS	4378	0x111A
EICON TECHNOLOGY CORPORATION	4403	0x1133
EKF ELEKTRONIK GMBH	58559	0xE4BF
ELECTRONIC EQUIPMENT PRODUUTION &DISTRIBUTION GMBH	4983	0x1377
ELECTRONICS FOR IMAGING	4462	0x116E
ELITEGROUP COMPUTER SYS	4121	0x1019
ELSA AG	4168	0x1048
ELTEC ELEKTRONIK GMBH	5171	0x1433
EMC CORPORATION	4384	0x1120
EMTEC CO. LTD	5273	0x1499
EMULEX CORPORATION	4319	0x10DF
ENE TECHNOLOGY INC	5412	0x1524
ENGINEERING DESIGN TEAM.	4669	0x123D
ENNOVATE NETWORKS INC	5298	0x14B2
ENTRIDIA CORPORATION	5590	0x15D6
EPIGRAM INC	65242	0xFEDA
ERICSSON AXE R & D	5328	0x14D0
ERMA - ELECTRONIC GMBH	5253	0x1485
ESD Electronic System Design GmbH	4862	0x12FE
ESSENTIAL COMMUNICATIONS	4623	0x120F
ETRI	4184	0x1058
EUROPOP AG	5638	0x1606
EUROSOFT (UK) LTD	5500	0x157C
EVANS & SUTHERLAND	4317	0x10DD
EVERGREEN TECHNOLOGIES INC	5429	0x1535
EVSX	5572	0x15C4
EXAR CORP.	5032	0x13A8
EXCEL SWITCHING CORP	5145	0x1419
EXTREME PACKET DEVICE INC	5622	0x15F6
Equator Technologies	4821	0x12D5
FAIRCHILD SEMICONDUCTOR	5492	0x1574
FANUC LTD	5150	0x141E
FARADAY TECHNOLOGY CORP	5531	0x159B
FAST CORPORATION	5219	0x1463
FAST MULTIMEDIA AG	4350	0x10FE
FAST SEARCH & TRANSFER ASA	64087	0xFA57
FASTPOINT TECHNOLOGIES INC.	5631	0x15FF
FCI ELECTRONICS	4376	0x1118
FEATRON TECHNOLOGIES CORPORATION	5288	0x14A8
FIC (FIRST INTERNATIONAL COMPUTER INC)	5586	0x15D2
FILANET CORPORATION	5437	0x153D
FIRST INTERNATIONAL COMPUTER INC	5385	0x1509

Company Name	Dec ID	Hex ID
FLYTECH TECHNOLOGY CO LTD	5419	0x152B
FOLSOM RESEARCH INC	5526	0x1596
FORCE COMPUTERS GMBH	4422	0x1146
FORD MICROELECTRONICS INC	5106	0x13F2
FORE SYSTEMS INC	4391	0x1127
FORVUS RESEARCH INC	5386	0x150A
FOUNTAIN TECHNOLOGIES.	4169	0x1049
FOXCONN INTERNATIONAL INC	4187	0x105B
FUJI XEROX CO LTD	4405	0x1135
FUJIFILM	4735	0x127F
FUJITSU COMPUTER PRODUCTS OF AMERICA	5405	0x151D
FUJITSU LIMITED	4303	0x10CF
FUJITSU MICROELECTRONIC	4298	0x10CA
FUJITSU MICROELECTRONICS LTD.	4510	0x119E
FUNDAMENTAL SOFTWARE INC	5124	0x1404
FUTUREPLUS SYSTEMS CORP.	4305	0x10D1
ForteMedia	4889	0x1319
Fujifilm Microdevices	4799	0x12BF
G2 NETWORKS.	4749	0x128D
GALEA NETWORK SECURITY	5535	0x159F
GALILEO TECHNOLOGY LTD.	4523	0x11AB
GARNETS SYSTEM CO LTD	5353	0x14E9
GATEWAY 2000	4219	0x107B
GE VINGMED ULTRASOUND AS	4819	0x12D3
GEMFLEX NETWORKS	5501	0x157D
GENERAL INSTRUMENT	5530	0x159A
GENRAD INC.	5582	0x15CE
GENROCO INC	21845	0x5555
GEOCAST NETWORK SYSTEMS INC	5537	0x15A1
GESPAC	4880	0x1310
GESYTEC GMBH	5461	0x1555
GET ENGINEERING CORP.	5607	0x15E7
GIGA-BYTE TECHNOLOGY	5208	0x1458
GIGAPIXEL CORP	37274	0x919A
GLOBESPAN SEMICONDUCTOR INC.	5308	0x14BC
GLOBETEK INC	5402	0x151A
GN NETTEST TELECOM DIV.	5221	0x1465
GRANITE MICROSYSTEMS	5528	0x1598
GRAPHICS MICROSYSTEMS INC	5076	0x13D4
GRAPHIN CO. LTD	5190	0x1446
GROWTH NETWORKS	18755	0x4943
GUILLEMOT CORPORATION	5295	0x14AF
GUZIK TECHNICAL ENTERPRISES	4691	0x1253

Company Name	Dec ID	Hex ID
GVC CORPORATION	5088	0x13E0
GVC/BCM ADVANCED RESEARCH	5284	0x14A4
HAMAMATSU PHOTONICS K.K.	4513	0x11A1
HERMES ELECTRONICS COMPANY	4394	0x112A
HEWLETT PACKARD	41561	0xA259
HIGH TECH COMPUTER CORP (HTC)	5567	0x15BF
HILSCHER GMBH	5583	0x15CF
HINT CORP	13192	0x3388
HIRAKAWA HEWTECH CORP	5335	0x14D7
HITACHI COMPUTER PRODUCTS	4128	0x1020
HITACHI INFORMATION TECHNOLOGY CO LTD	5000	0x1388
HITACHI SEMICONDUCTOR & DEVICES SALES CO LTD	5516	0x158C
HITACHI ULSI SYSTEMS CO LTD	4688	0x1250
HITACHI ZOSEN CORPORATION	4967	0x1367
HITACHI	4180	0x1054
HITT	5496	0x1578
HIVERTEC INC.	5289	0x14A9
HOLTEK SEMICONDUCTOR INC	4803	0x12C3
HONDA CONNECTORS/MHOTRONICS INC	5384	0x1508
HONEYWELL IAC	4268	0x10AC
HOPF ELEKTRONIK GMBH	5336	0x14D8
HOTRAIL INC.	5580	0x15CC
HTEC LTD	5383	0x1507
I-BUS	4217	0x1079
I-DATA INTERNATIONAL A-S	4959	0x135F
I-O DATA DEVICE.	4348	0x10FC
IBM	4116	0x1014
ICOMPRESION INC.	17476	0x4444
ICP-VORTEX COMPUTERSYSTEM GMBH	4377	0x1119
ICS ADVENT	5397	0x1515
IKON CORPORATION	4565	0x11D5
IMAGING TECHNOLOGY	4399	0x112F
IMC NETWORKS	5075	0x13D3
IMODL INC.	5341	0x14DD
IMPACCT TECHNOLOGY CORP	5562	0x15BA
IMPACT TECHNOLOGIES	5413	0x1525
IN WIN DEVELOPMENT INC.	5614	0x15EE
INET TECHNOLOGIES INC	5507	0x1583
INFIMED	4800	0x12C0
INFINEON TECHNOLOGIES AG	5585	0x15D1
INFINILINK CORP.	5599	0x15DF
INFOLIBRIA	5346	0x14E2
INFOTRONIC AMERICA INC	4191	0x105F

Company Name	Dec ID	Hex ID
INITIO CORPORATION	4353	0x1101
INNOMEDIA INC	5466	0x155A
INNOMEDIALOGIC INC.	5259	0x148B
INNOSYS	4521	0x11A9
INOVA COMPUTERS GMBH & CO KG	5286	0x14A6
INTEC GMBH	5391	0x150F
INTEGRATED DEVICE TECH	4381	0x111D
INTEGRATED TECHNOLOGY EXPRESS.	4739	0x1283
INTEGRATED TELECOM EXPRESS INC	5233	0x1471
INTEL CORP.	32902	0x8086
INTELLIGENT PARADIGM INC	5615	0x15EF
INTERACTIVE CIRCUITS & SYSTEMS LTD	5220	0x1464
INTERCOM INC.	4562	0x11D2
INTERCONNECT SYSTEMS SOLUTIONS	5449	0x1549
INTERNIX INC.	5306	0x14BA
INTERPHASE CORPORATION	4222	0x107E
INTERSIL CORP	4704	0x1260
INTRASERVER TECHNOLOGY INC	5097	0x13E9
INVENTEC CORPORATION	4464	0x1170
INVERTEX	5345	0x14E1
IOI TECHNOLOGY CORP.	5446	0x1546
IOMEGA CORPORATION	5066	0x13CA
ISS	5414	0x1526
ISYTEC - Integrierte Systemtechnik Gmbh	5250	0x1482
ITA INGENIEURBURO FUR TESTAUFGABEN GMBH	5381	0x1505
ITALTEL	5539	0x15A3
ITT AEROSPACE/COMMUNICATIONS DIVISION	5168	0x1430
IWASAKI INFORMATION SYSTEMS CO LTD	5316	0x14C4
IWATSU ELECTRIC CO LTD	4988	0x137C
IWILL CORPORATION	5588	0x15D4
Integrated Computing Engines	4810	0x12CA
J.P. AXZAM CORPORATION	5626	0x15FA
JANZ COMPUTER AG	5059	0x13C3
JAPAN COMPUTER INDUSTRY INC.	5373	0x14FD
JAPAN ELECRONICS IND. INC	5498	0x157A
JAYCOR NETWORKS INC.	4674	0x1242
JET PROPULSION LABORATORY	5448	0x1548
JOYTECH COMPUTER CO. LTD.	5270	0x1496
JUNGSOFT	5479	0x1567
Jaton Corp	6931	0x1B13
Juniper Networks Inc.	4868	0x1304
K.I. TECHNOLOGY CO LTD	5078	0x13D6
KAISER ELECTRONICS	5380	0x1504

Company Name	Dec ID	Hex ID
KAWASAKI HEAVY INDUSTRIES LTD	5025	0x13A1
KAWASAKI LSI USA INC	5379	0x1503
KAWASAKI STEEL CORPORATION	4971	0x136B
KINGMAX TECHNOLOGY INC	5162	0x142A
KINPO ELECTRONICS INC	5630	0x15FE
KNOWLEDGE TECHNOLOGY LAB.	4761	0x1299
KOGA ELECTRONICS CO	5624	0x15F8
KOLTER ELECTRONIC	4097	0x1001
KONICA CORPORATION	5511	0x1587
KYE SYSTEMS CORPORATION	5257	0x1489
KYOPAL CO LTD	5388	0x150C
KYUSHU ELECTRONICS SYSTEMS INC	5144	0x1418
L3 COMMUNICATIONS	5310	0x14BE
LABWAY COPORATION	5251	0x1483
LANCAST INC	5510	0x1586
LANTECH COMPUTER COMPANY	5376	0x1500
LARA TECHNOLOGY INC	5518	0x158E
LATTICE - VANTIS	5491	0x1573
LAVA COMPUTER MFG INC	5127	0x1407
LAVA SEMICONDUCTOR MANUFACTURING INC.	5639	0x1607
LECROY CORPORATION	5488	0x1570
LECTRON CO LTD	5279	0x149F
LEVEL ONE COMMUNICATIONS	5012	0x1394
LEVEL ONE COMMUNICATIONS INC	4872	0x1308
LIGHTWELL CO LTD - ZAX DIVISION	5183	0x143F
LITE-ON COMMUNICATIONS INC	4525	0x11AD
LITRONIC INC	5596	0x15DC
LOCKHEED MARTIN - Electroniss & Communications	4560	0x11D0
LOGIC PLUS PLUS INC	5205	0x1455
LOGICAL CO LTD	5189	0x1445
LOGITEC CORP.	25609	0x6409
LOGITRON	5509	0x1585
LORONIX INFORMATION SYSTEMS INC	5195	0x144B
LP ELEKTRONIK GMBH	5470	0x155E
LSI LOGIC CORPORATION	4138	0x102A
LSI SYSTEMS	4554	0x11CA
LUCENT TECHNOLOGIES	4771	0x12A3
M-SYSTEMS FLASH DISK PIONEERS LTD	5487	0x156F
MAC SYSTEM CO LTD	5469	0x155D
MACRAIGOR SYSTEMS LLC	5420	0x152C
MACROLINK INC	5613	0x15ED
MADGE NETWORKS	4278	0x10B6
MAESTRO DIGITAL COMMUNICATIONS	5561	0x15B9

Company Name	Dec ID	Hex ID
MAGMA	4553	0x11C9
MAINPINE LIMITED	5410	0x1522
MAKER COMMUNICATIONS	5267	0x1493
MALLEABLE TECHNOLOGIES INC	5598	0x15DE
MAPLETREE NETWORKS INC.	5278	0x149E
MARCONI COMMUNICATIONS LTD	4658	0x1232
MARK OF THE UNICORN INC	4986	0x137A
MASPRO KENKOH CORP	5358	0x14EE
MATRIX CORP.	5406	0x151E
MATROX GRAPHICS.	4139	0x102B
MATSUSHITA ELECTIC INDUSTRIAL CO LTD	4489	0x1189
MATSUSHITA ELECTRIC WORKS LTD	5133	0x140D
MATSUSHITA-KOTOBUKI ELECTRONICS INDUSTRIES	4705	0x1261
MAVERICK NETWORKS	5283	0x14A3
MAX TECHNOLOGIES INC.	5450	0x154A
MAZET GMBH	4742	0x1286
MEDIA 100	4374	0x1116
MEDIAQ INC.	19793	0x4D51
MEDIASTAR CO. LTD	5463	0x1557
MEDIATEK CORP.	5315	0x14C3
MEIDENSHA CORPORATION	4256	0x10A0
MEILHAUS ELECTRONIC GmbH	5122	0x1402
MEINBERG FUNKUHREN	4960	0x1360
MELCO INC	4436	0x1154
MELEC INC	5422	0x152E
MELLANOX TECHNOLOGY	5555	0x15B3
MEMEC DESIGN SERVICES	5527	0x1597
MENTOR GRAPHICS CORP.	5291	0x14AB
MERCURY COMPUTER SYSTEMS	4404	0x1134
METHEUS CORPORATION	5068	0x13CC
MICRO COMPUTER SYSTEMS INC	4271	0x10AF
MICRO INDUSTRIES CORPORATION	4325	0x10E5
MICRO SCIENCE INC	5117	0x13FD
MICRO-STAR INTERNATIONAL CO LTD	5218	0x1462
MICRON TECHNOLOGY INC	4932	0x1344
MICROTECHNICA CO LTD	19796	0x4D54
MILLENNIUM ENGINEERING INC	5282	0x14A2
MINDSHARE.	4506	0x119A
MINTON OPTIC INDUSTRY CO LTD	5164	0x142C
MIPS DENMARK	5439	0x153F
MITAC	4209	0x1071
MITEL CORP.	4402	0x1132
MITSUBISHI ELECTRIC AMERICA	4199	0x1067

Company Name	Dec ID	Hex ID
MITSUBISHI ELECTRIC CORP.	4282	0x10BA
MITSUBISHI ELECTRIC LOGISTICS SUPPORT CO LTD	5378	0x1502
MITUTOYO CORPORATION	5447	0x1547
MOBILITY ELECTRONICS	5362	0x14F2
MODULAR TECHNOLOY HOLDINGS LTD	5319	0x14C7
MOLEX INCORPORATED	4306	0x10D2
MOMENTUM DATA SYSTEMS	4406	0x1136
MORETON BAY	5546	0x15AA
MOSAID TECHNOLOGIES INC.	5554	0x15B2
MOTION ENGINEERING.	49406	0xC0FE
MOTOROLA	49374	0xC0DE
MOXA TECHNOLOGIES CO LTD	5011	0x1393
MUSIC SEMICONDUCTORS	5411	0x1523
MYCOM INC	5203	0x1453
MYLEX CORPORATION	4201	0x1069
MYRICOM INC.	5313	0x14C1
MYSON TECHNOLOGY INC	5398	0x1516
Micron Electronics.	4162	0x1042
Mitan Corporation	4806	0x12C6
Mitsubishi Electric MicroComputer	4874	0x130A
N-CUBED.NET	5629	0x15FD
NAKAYO TELECOMMUNICATIONS INC	5324	0x14CC
NATIONAL AEROSPACE LABORATORIES	5338	0x14DA
NATIONAL DATACOMM CORP.	5608	0x15E8
NATIONAL SEMICONDUCTOR CORPORATION	4107	0x100B
NATURAL MICROSYSTEMS	4790	0x12B6
NCIPHER CORP. LTD	256	0x0100
NCR	4122	0x101A
NCS COMPUTER ITALIA SRL	4753	0x1291
NDS TECHNOLOGIES ISRAEL LTD	5587	0x15D3
NEC CORPORATION	4147	0x1033
NEOMAGIC CORPORATION	4296	0x10C8
NEST INC	5091	0x13E3
NET INSIGHT	5239	0x1477
NETACCESS	4558	0x11CE
NETBOOST CORPORATION	5084	0x13DC
NETGAME LTD	5524	0x1594
NETGEAR	4997	0x1385
NETWORK APPLIANCE CORPORATION	4725	0x1275
NETWORTH TECHNOLOGIES INC	5603	0x15E3
NEW WAVE PDG	4575	0x11DF
NEWER TECHNOLOGY INC	5570	0x15C2
NEWTEK INC	5277	0x149D

Company Name	Dec ID	Hex ID
NEXTCOM K.K.	5297	0x14B1
NIHON UNISYS	5247	0x147F
NINGBO HARRISON ELECTRONICS CO LTD	5533	0x159D
NISSIN INC CO	5175	0x1437
NITSUKO CORPORATION	5333	0x14D5
NKK CORPORATION	4341	0x10F5
NOKIA TELECOMMUNICATIONS OY	5048	0x13B8
NOKIA WIRELESS BUSINESS COMMUNICATIONS	5635	0x1603
NORTEL NETWORKS	4716	0x126C
NORTEL NETWORKS - BWA DIVISION	5034	0x13AA
NORTH ATLANTIC INSTRUMENTS	5548	0x15AC
NORTHROP GRUMMAN - CANADA LTD	5632	0x1600
NOVAWEB TECHNOLOGIES INC	5292	0x14AC
NOVELL	4570	0x11DA
NTT ADVANCED TECHNOLOGY CORP.	5113	0x13F9
NUMBER 9 VISUAL TECHNOLOGY	4189	0x105D
NVIDIA CORPORATION	4318	0x10DE
O2MICRO.	4631	0x1217
OCE' - TECHNOLOGIES B.V.	5105	0x13F1
OCE' PRINTING SYSTEMS GmbH	5126	0x1406
OCEAN MANUFACTURING LTD	4195	0x1063
OCTAVE COMMUNICATIONS IND.	5200	0x1450
ODIN TELESYSTEMS INC	5321	0x14C9
OKI ELECTRIC INDUSTRY CO. LTD.	4129	0x1021
OLICOM	4237	0x108D
OLYMPUS OPTICAL CO. LTD.	4720	0x1270
OMNI MEDIA TECHNOLOGY INC.	38553	0x9699
OMRON CORPORATION	4299	0x10CB
ONO SOKKI	5434	0x153A
OPEN NETWORK CO LTD	5456	0x1550
OPTI INC.	4165	0x1045
OPTIBASE LTD	4693	0x1255
OPTO 22	5258	0x148A
OSI PLUS CORPORATION	5262	0x148E
OSITECH COMMUNICATIONS INC	5026	0x13A2
OTIS ELEVATOR COMPANY	5490	0x1572
OVISLINK CORP.	5276	0x149C
OXFORD SEMICONDUCTOR LTD	5141	0x1415
PACIFIC DIGITAL CORP.	5609	0x15E9
PACKARD BELL NEC	4250	0x109A
PAIRGAIN TECHNOLOGIES	5637	0x1605
PALIT MICROSYSTEMS INC	5481	0x1569
PAN INTERNATIONAL INDUSTRIAL CORP	5453	0x154D

Company Name	Dec ID	Hex ID
PANACOM TECHNOLOGY CORP	5332	0x14D4
PARADYNE CORP.	51	0x0033
PATAPSCO DESIGNS INC	5007	0x138F
PC-TEL INC	4941	0x134D
PE LOGIC CORP.	5322	0x14CA
PENTA MEDIA CO. LTD	5576	0x15C8
PENTEK	4848	0x12F0
PEP MODULAR COMPUTERS GMBH	5400	0x1518
PERFORMANCE TECHNOLOGIES.	4628	0x1214
PERICOM SEMICONDUCTOR	4824	0x12D8
PERLE SYSTEMS LIMITED	5471	0x155F
PFU LIMITED	4449	0x1161
PHILIPS - CRYPTO	5423	0x152F
PHILIPS BUSINESS ELECTRONICS B.V.	5300	0x14B4
PHILIPS SEMICONDUCTORS	4401	0x1131
PHOBOS CORPORATION	5080	0x13D8
PHOENIX TECHNOLOGIES LTD	4963	0x1363
PHOTRON LTD.	4444	0x115C
PIXELFUSION LTD	5349	0x14E5
PIXSTREAM INC	5165	0x142D
PLANEX COMMUNICATIONS INC	5354	0x14EA
PLANT EQUIPMENT.	5263	0x148F
PLATYPUS TECHNOLOGY PTY LTD	4491	0x118B
PLD APPLICATIONS	5462	0x1556
PLX TECHNOLOGY.	4277	0x10B5
PMC-SIERRA INC	4600	0x11F8
POINT MULTIMEDIA SYSTEMS	5517	0x158D
PORTWELL INC	5563	0x15BB
POWER MICRO RESEARCH	5621	0x15F5
PPT VISION	4987	0x137B
PRIMEX AEROSPACE CO.	5504	0x1580
PRISA NETWORKS	4925	0x133D
PROCOMP INFORMATICS LTD	5573	0x15C5
PROLINK MICROSYSTEMS CORP.	5460	0x1554
PROMAX SYSTEMS INC	4930	0x1342
PROMISE TECHNOLOGY.	4186	0x105A
PROSYS-TEC INC.	5634	0x1602
PROTAC INTERNATIONAL CORP	5467	0x155B
PROVIDEO MULTIMEDIA CO LTD	5440	0x1540
PROXIM INC	5303	0x14B7
PSION DACOM PLC	5152	0x1420
PURUP - EskoFot A/S	4630	0x1216
PX INSTRUMENTS TECHNOLOGY LTD	5503	0x157F

Company Name	Dec ID	Hex ID
Packet Engines Inc.	4888	0x1318
QLOGIC	4215	0x1077
QUADRICS SUPERCOMPUTERS WORLD	5372	0x14FC
QUANTA COMPUTER INC	5421	0x152D
QUANTEL	5569	0x15C1
QUANTUM 3D INC	5020	0x139C
QUANTUM DATA CORP.	5302	0x14B6
QUANTUM DESIGNS (H.K.) INC.	13329	0x3411
QUANTUM EFFECT DESIGN	4258	0x10A2
QUATECH INC	4956	0x135C
QUICKLOGIC CORPORATION	4579	0x11E3
QUICKNET TECHNOLOGIES INC	5602	0x15E2
QUICKTURN DESIGN SYSTEMS	5418	0x152A
RACAL AIRTECH LTD	5458	0x1552
RADIOLAN	5163	0x142B
RAMIX INC	5131	0x140B
RASCOM INC	5028	0x13A4
RATOC SYSTEMS INC	4501	0x1195
RAYCER INC	5352	0x14E8
RAYCHEM	5395	0x1513
REAL 3D	61	0x003D
REALTEK SEMICONDUCTOR CORP.	4332	0x10EC
RENDITION	4451	0x1163
RICOH CO LTD	4480	0x1180
RIOS SYSTEMS CO LTD	5017	0x1399
ROAD CORPORATION	5428	0x1534
ROCKWELL-COLLINS	5591	0x15D7
ROHM LSI SYSTEMS	4315	0x10DB
ROSUN TECHNOLOGIES INC	5394	0x1512
RUBY TECH CORP.	5228	0x146C
RadiSys Corp.	4913	0x1331
Rainbow Technologies	4830	0x12DE
Real Vision	4842	0x12EA
Reliance Computer	4454	0x1166
S S TECHNOLOGIES	20790	0x5136
S3 INC.	21299	0x5333
SALIX TECHNOLOGIES INC	4901	0x1325
SAMSUNG ELECTRONICS CO LTD	5197	0x144D
SANDISK CORP.	5559	0x15B7
SANRITZ AUTOMATION CO LTC	4992	0x1380
SANTA CRUZ OPERATION	4369	0x1111
SANYO ELECTRIC CO - Information Systems Division	4414	0x113E
SBS TECHNOLOGIES	4683	0x124B

Company Name	Dec ID	Hex ID
SBS Technologies Inc	4831	0x12DF
SCIEMETRIC INSTRUMENTS INC	5641	0x1609
SCITEX CORPORATION	4526	0x11AE
SCM MICROSYSTEMS	4927	0x133F
SEALEVEL SYSTEMS INC	4958	0x135E
SEANIX TECHNOLOGY INC	19617	0x4CA1
SEH COMPUTERTECHNIK GMBH	5505	0x1581
SEIKO EPSON CORPORATION	5355	0x14EB
SEIKO INSTRUMENTS INC	5275	0x149B
SEMTECH CORPORATION	5307	0x14BB
SEQUENT COMPUTER SYSTEMS	4205	0x106D
SEROME TECHNOLOGY INC	5577	0x15C9
SERVOTEST LTD	5454	0x154E
SHANGHAI COMMUNICATIONS TECHNOLOGIES CENTER	5544	0x15A8
SHAREWAVE INC	5055	0x13BF
SHARK MULTIMEDIA INC	5074	0x13D2
SHARP CORPORATION	5053	0x13BD
SHINING TECHNOLOGY INC	5350	0x14E6
SHUTTLE COMPUTER	4759	0x1297
SI LOGIC LTD	5465	0x1559
SICAN GMBH	4652	0x122C
SIEMENS MEDICAL SYSTEMS	5033	0x13A9
SIEMENS PC SYSTEME GMBH	4362	0x110A
SIGMA DESIGNS	4357	0x1105
SIGMATEL INC.	5597	0x15DD
SIIG Inc	4895	0x131F
SILICON GRAPHICS	4265	0x10A9
SILICON INTEGRATED SYSTEMS	4153	0x1039
SILICON LABORATORIES	5443	0x1543
SILICON MAGIC CORP.	34952	0x8888
SILICON MOTION.	4719	0x126F
SITERA	5002	0x138A
SKYWARE CORPORATION	4968	0x1368
SMA REGELSYSTEME GMBH	5271	0x1497
SMART ELECTRONIC DEVELOPMENT GMBH	5457	0x1551
SOFTING GMBH	5280	0x14A0
SOLA ELECTRONICS	5566	0x15BE
SOLECTRON	5415	0x1527
SOLIDUM SYSTEMS CORP	5512	0x1588
SOLITON SYSTEMS K.K.	4961	0x1361
SONY CORPORATION	4173	0x104D
SOPAC LTD	5365	0x14F5
SOURCE TECHNOLOGY INC	5553	0x15B1

Company Name	Dec ID	Hex ID
SP3D CHIP DESIGN GMBH	5201	0x1451
SPECIALIX INTERNATIONAL LTD	4555	0x11CB
SPIDER COMMUNICATIONS INC.	5311	0x14BF
SPLASH TECHNOLOGY.	4717	0x126D
SSE TELECOM INC	5543	0x15A7
STAR MULTIMEDIA CORP.	5499	0x157B
STELLAR SEMICONDUCTOR INC	4996	0x1384
STRATABEAM TECHNOLOGY	5455	0x154F
STRATUS COMPUTER SYSTEMS	5532	0x159C
STUDIO AUDIO & VIDEO LTD	5071	0x13CF
SUMITOMO METAL INDUSTRIES	4718	0x126E
SUNDANCE TECHNOLOGY INC	5104	0x13F0
SUNLIGHT ULTRASOUND TECHNOLOGIES LTD	5542	0x15A6
SUPER MICRO COMPUTER INC	5593	0x15D9
SYBA TECH LIMITED	5522	0x1592
SYMBIOS LOGIC INC/LSI Logic	4096	0x1000
SYMBOL TECHNOLOGIES	5474	0x1562
SYNOPSYS/LOGIC MODELING GROUP	4159	0x103F
SYSKONNECT	4424	0x1148
SYSTEMBASE CO LTD	5281	0x14A1
SYSTRAN CORP	4999	0x1387
SeaChange International	4902	0x1326
Sebring Systems	4839	0x12E7
Spectrum Signal Processing	4859	0x12FB
Standard Microsystems Corp.	4181	0x1055
T.SQWARE	5039	0x13AF
TACHYON.	5229	0x146D
TAIWAN MYCOMP CO LTD	5571	0x15C3
TAMURA CORPORATION	5041	0x13B1
TATENO DENNOU.	4751	0x128F
TATEYAMA SYSTEM LABORATORY CO LTD	5575	0x15C7
TATUNG CO.	5589	0x15D5
TC LABS PTY LTD.	5264	0x1490
TECH-SOURCE	4647	0x1227
TECHNICAL UNIVERSITY OF BUDAPEST	5574	0x15C6
TECHNOTREND SYSTEMTECHNIK GMBH	5058	0x13C2
TECHSAN ELECTRONICS CO LTD	5628	0x15FC
TECHSOFT TECHNOLOGY CO LTD	5304	0x14B8
TECHWELL INC	5438	0x153E
TEK MICROSYSTEMS INC.	5327	0x14CF
TEKNOR INDUSTRIAL COMPUTERS INC	4185	0x1059
TEKRAM TECHNOLOGY CO.LTD.	4321	0x10E1
TEKTRONIX	4712	0x1268

Company Name	Dec ID	Hex ID
TELEFON AKTIEBOLAGET LM Ericsson	5401	0x1519
TELES AG	5031	0x13A7
TELESOFT DESIGN LTD	5093	0x13E5
TELOSITY INC.	5441	0x1541
TEMPORAL RESEARCH LTD	8193	0x2001
TENTA TECHNOLOGY	5633	0x1601
TERADYNE INC.	4886	0x1316
TERALOGIC INC	21580	0x544C
TERAYON COMMUNICATIONS SYSTEMS	5472	0x1560
TERRATEC ELECTRONIC GMBH	5435	0x153B
TEXAS INSTRUMENTS	4172	0x104C
TEXAS MEMORY SYSTEMS INC	5558	0x15B6
TFL LAN INC	5396	0x1514
TIME SPACE RADIO AB	5293	0x14AD
TIMES N SYSTEMS INC	5617	0x15F1
TITAN ELECTRONICS INC	5330	0x14D2
TOKAI COMMUNICATIONS INDUSTRY CO. LTD	5269	0x1495
TOKIMEC INC	5003	0x138B
TOKYO DENSHI SEKEI K.K.	5610	0x15EA
TOKYO ELECTRONIC INDUSTRY CO LTD	5364	0x14F4
TOPIC SEMICONDUCTOR CORP	5407	0x151F
TOSHIBA AMERICA INFO SYSTEMS	4473	0x1179
TOSHIBA AMERICA	4143	0x102F
TOSHIBA ENGINEERING CORPORATION	5079	0x13D7
TOSHIBA PERSONAL COMPUTER SYSTEM CORP.	4752	0x1290
TOSHIBA TEC CORPORATION	4569	0x11D9
TOYOTA MACS INC	5541	0x15A5
TRANSAS MARINE (UK) LTD	5371	0x14FB
TRANSITION NETWORKS	5502	0x157E
TRANSMETA CORPORATION	4729	0x1279
TRANSTECH DSP LTD	4728	0x1278
TRANSWITCH CORPORATION	4747	0x128B
TRIDENT MICROSYSTEMS	4131	0x1023
TRIGEM COMPUTER INC.	4255	0x109F
TRITECH MICROELECTRONICS INC	4754	0x1292
TROIKA NETWORKS INC	5108	0x13F4
TUNDRA SEMICONDUCTOR CORP.	4323	0x10E3
TURBOCOMM TECH. INC.	5320	0x14C8
TWINHEAD INTERNATIONAL CORP.	5375	0x14FF
TYAN COMPUTER	4337	0x10F1
True Time Inc.	4826	0x12DA
UNEX TECHNOLOGY CORP.	5161	0x1429
UNISYS CORPORATION	4120	0x1018

Company Name	Dec ID	Hex ID
UNIVERSAL SCIENTIFIC IND.	5325	0x14CD
UNIWILL COMPUTER CORP.	5508	0x1584
V3 SEMICONDUCTOR INC.	4528	0x11B0
VALLEY TECHNOLOGIES INC	5605	0x15E5
VALUESOFT	5620	0x15F4
VARIAN AUSTRIALIA PTY LTD	51792	0xCA50
VELA RESEARCH LP	4733	0x127D
VIA TECHNOLOGIES.	4358	0x1106
VICTOR COMPANY OF JAPAN	4766	0x129E
VIDAC ELECTRONICS GMBH	5484	0x156C
VIDEO LOGIC LTD	4112	0x1010
VIEWCAST COM	5494	0x1576
VIEWGRAPHICS INC	5473	0x1561
VIRATA LTD	4635	0x121B
VISIONTEK	5445	0x1545
VISUAL TECHNOLOGY INC.	5452	0x154C
VIVID TECHNOLOGY INC	5442	0x1542
VLSI TECHNOLOGY INC	4100	0x1004
VMETRO.	4762	0x129A
VMWARE	5549	0x15AD
VOICE TECHNOLOGIES GROUP INC.	5601	0x15E1
VOLTAIRE ADVANCED DATA SECURITY LTD	5493	0x1575
VSN SYSTEMEN BV	5604	0x15E4
WARPSPPED INC	5389	0x150D
WAVETEK WANDEL & GOLTERMANN	5370	0x14FA
WELLBEAN CO INC	5044	0x13B4
WHISTLE COMMUNICATIONS	5326	0x14CE
WILLIAMS ELECTRONICS GAMES.	5230	0x146E
WINBOND ELECTRONICS CORP	4176	0x1050
WOLF TECHNOLOGY INC	5367	0x14F7
WORKBIT CORPORATION	4421	0x1145
X-NET OY	5540	0x15A4
XILINX.	4334	0x10EE
XIONICS DOCUMENT TECHNOLOGIES INC.	5285	0x14A5
XIOTECH CORPORATION	4777	0x12A9
XIRCOM	4445	0x115D
XPEED INC.	5299	0x14B3
XSTREAMS PLC/ EPL LIMITED	5021	0x139D
YAMAHA CORPORATION	4211	0x1073
YAMAKATSU ELECTRONICS INDUSTRY CO LTD	5476	0x1564
YAMASHITA SYSTEMS CORP	5387	0x150B
YASKAWA ELECTRIC CO. 4883	0x1313	
YOKOGAWA ELECTRIC CORPORATION	4737	0x1281

Company Name	Dec ID	Hex ID
YUAN YUAN ENTERPRISE CO. LTD.	4779	0x12AB
ZAPEX TECHNOLOGIES INC	5235	0x1473
ZENITH ELECTRONICS CORPORATION	5625	0x15F9
ZIATECH CORPORATION	4408	0x1138
ZILOG INC.	5627	0x15FB
ZOLTRIX INTERNATIONAL LIMITED	5552	0x15B0
ZOOM TELEPHONICS INC	5147	0x141B

PCI Slot Configuration

Although an unlimited number of PCI slots is allowed, in practice 4 is the maximum, due to the capabilities of the *host controller*, which connects the bus to the CPU and DRAM, so *bridge devices* are used to connect more buses downstream from the first, known as the *root*, up to 255 (this is how 6 PCI slots can be obtained). However, these extra buses don't have to be PCI; they can be EISA or ISA as well. x86 chips generate two interrupt acknowledge cycles per interrupt; both are converted to one for PCI. As the PCI interrupt system finds it difficult to cope with expansion cards requiring IRQs for each device on them, I/O devices tend to be on the motherboard.

PCI cards and slots use an internal interrupt system, with each slot being able to activate up to 4, labelled either INT#A-INT#D, or INT#1-INT#4, but they can sometimes be assigned to cards instead—if you get a problem, it often helps just to change the slot. INTs #A or #1 are always reserved for the Master function of the device concerned, and the remainder for multifunction cards. These are nothing to do with IRQs, although they can be mapped (that is, *steered*) to them if the card concerned needs it. Typically IRQs 9 and 10 are reserved for this, but any available can be used. There are various ways of implementing this, so don't expect consistency! AGP cards use only INT A and B, and it shares with PCI Slot #1 - PCI Slots 4 & 5 also share, so try not to mix them, or at least put only cards that can share IRQs in them.

Four registers control the routing of PCI Interrupts to IRQs, two or more of which can be steered into the same IRQ signal, each of which must be set to *level sensitive* (see *Edge/Level Select*) so they can be shared. The IRQs affected are IRQs 3-7, 9-12, and 14-15.

ISA cards cannot share IRQs because they are Edge triggered and rely on a single voltage, but PCI cards use Level triggering, which uses different voltage levels. Also, an ISA IRQ is available to every slot, so once the card is set up it can be used in any one. On a PCI PC, the 16 standard IRQs can be set individually for PCI or ISA, but not both—*PCI* or *IRQ Steering* is another name for sharing IRQs between PCI devices which is supported by Windows 95 OSR2 and 98, and gives them the ability to reprogram PCI IRQs when mixed with non-PnP ISA devices. However, it is not enabled in OSR2 (Error Code 29 in Device Manager, for the PCI bus under *System Devices*—just check the box for IRQ steering under *Properties*. Check also Get IRQ table from PCI BIOS 2.1 Call), which means that the BIOS does all the work, as it would for previous versions. In practice, OSR2 and 98 will accept what the BIOS has already decreed, even though it can change them if it wants to.

In a real world situation, it is common for Windows to share an IRQ between the sound and VGA cards. In the BIOS, you can manually assign IRQ5 for a sound card in whatever slot, which is where most games like to see it, and you may get better stability. In the BIOS setup (the *PCI/PnP Configuration* section), you may see each slot listed with these subheadings:

```
Slot 1
      Latency Timer
      Using IRQ
      Trigger Method
```

A PCI Master can burst as long as the target can send or receive data, and no other device requests the bus. PCI specifies two ways of disconnecting a Master during a long burst cycle so others can get a look in; *Master Latency Timer* and *Target Initiated Termination*.

Resources Controlled By

Whether you let the BIOS assign resources (Auto), or do it yourself (Manual).

If you have problems with *Auto*, *Manual* reveals the IRQ and DMA fields so you can assign them to either *Legacy ISA* or *PCI/ISA PnP* devices.

Force Updating ESCD

If enabled, the ESCD area in Upper Memory (for PnP information concerning IRQ, DMA, I/O and memory) will be updated once, then this setting will be disabled automatically for the next boot. Use if you have a new card and the subsequent reconfiguration causes a serious conflict of resources (the OS may not boot as a result). The BIOS will then reallocate everything.

430HX Global Features

Enable or disable special features. Enabled is best for performance.

Latency Timer (PCI Clocks)

Controls the length of time an agent can hold the PCI bus when another has requested it, so it guarantees a PCI card access within a specified number of clocks.

Since the PCI bus runs faster than ISA, the PCI bus must be slowed during interactions with it, so here you can define how long the PCI bus will delay for a transaction between the given PCI slot and the ISA bus. This number is dependent on the PCI master device in use and varies from 0 to 255.

AMI defaults to 66, but 40 clocks is a good place to start at 33MHz (Phoenix). The shorter the value, the more rapid access to the bus a device gets, with better response times, but the lower becomes the effective bandwidth and hence data throughput. Normally, leave this alone, but you could set it to a lower value if you have latency sensitive cards (e.g. audio cards and/or network cards with small buffers). Increase slightly if I/O sensitive applications are being run.

PCI Latency Timer

As above. The default of *32 PCI Clock* (80 sometimes) mostly gives maximum performance.

Reset Configuration Data

Normally, leave disabled, which retains PnP data in the BIOS. Selecting Yes causes the system to clear itself and automatically configure all PnP devices at boot up. Use this to reset ESCD when you exit setup after installing a new card and you cannot boot.

Using IRQ

Affected by the Trigger method. IRQs can be *Level* or *Edge* triggered (see *Expansion Cards*). Most PCI cards use the former, and ISA the latter. If you select *Edge* for the slot concerned, you may also need to set jumpers on the motherboard.

Slot PIRQ

A PIRQ (PCI IRQ) is signalled to and handled by the PCI bus. Not the same as a normal IRQ.

Host-to-PCI Bridge Retry

When enabled, the peripherals controller (PIIX4) retries, without initiating a delayed transaction, CPU-initiated non-LOCK# PCI cycles. No delayed transactions to the controller may be currently pending and *Passive Release* must be active. You must also enable *Delayed Transaction*.

PCI Delayed Transaction

The chipset has an embedded 32-bit posted write buffer to support delay transactions cycles. Enabled supports PCI 2.1.

PCI Dynamic Bursting

When enabled, every write transaction goes to the write buffer. Burstable transactions then burst on the PCI bus and non-burstable ones don’t (VP2).

PCI Slot x INTx

Assigns IRQs to PCI INT#s in slot x (or whatever). See *Slot X using INT#* (below).

Slot x INT# Map To

See *Slot X using INT#* (below).

Slot X Using INT#

Selects an INT# channel for a PCI Slot, and there are four (A, B, C & D) for each one, that is, each PCI bus slot supports interrupts A, B, C and D. #A is allocated automatically, and you would only use #B, #C, etc if the card needs to use more than one (PCI) interrupt service. For example, select up to #D if your card needs four; a typical situation would be an IDE card with two channels, each requiring an IRQ. However, using *Auto* is simplest. Most graphics cards don't need this.

Edge/Level Select

Programs PCI interrupts to single-edge or logic level. Select *Edge* for PCI IDE. IRQ 14 is used for Primary and 15 for Secondary. Some motherboards provide a particular slot for edge-triggered cards. As the interrupts are level sensitive and can be shared, two or more PCI interrupts can be steered into the same IRQ signal.

PCI Device, Slot 1/2/3

Enables I/O and memory cycle decoding.

Enable Device

Enable PCI device as a slave.

Xth Available IRQ

Selects (or maps) an IRQ for one of the available PCI INT#s above. There are ten selections (3, 4, 5, 6, 7, 9, 10, 11, 12, 14, 15). *1st available IRQ* (below) means the BIOS will assign this IRQ to the first PCI slots (order is 1, 2, 3, 4). NA means the IRQ is assigned to the ISA bus and is therefore not available to a PCI slot.

1st-6th Available IRQ

See *Xth Available IRQ*.

PCI IRQ Activated by

The method by which the PCI bus recognises an IRQ request; *Level* or *Edge* (see *Expansion Cards*). Use the default unless advised otherwise, or if you have a PCI device which only recognizes one of them. Affects reliability, not performance.

IRQ Assigned To

Specifies the type of device using the interrupt; *Legacy ISA*, which needs a specific interrupt, or *PCI/ISA PnP*, which complies with the Plug and Play standard, and will be set up automatically.

PIRQ_0 Use IRQ No. ~ PIRQ_3 Use IRQ No.

Here you can set the IRQ for a particular device on the AGP or PCI bus, particularly useful when transferring equipment from one computer to another; and you don't want to go through redetection.

Remember that the AGP and PCI slot #1 share the same IRQs, as do PCI slot #4 and #5. USB uses PIRQ_4.

	#1	#2	#3	#4
PIRQ_0	INT A	INT D	INT C	INT B
PIRQ_1	INT B	INT A	INT D	INT C
PIRQ_2	INT C	INT B	INT A	INT D
PIRQ_3	INT D	INT C	INT B	INT A

Check out the device's slot, then the table above to determine its primary PIRQ. In slot 2, for example, it is PIRQ_1. The assign the IRQ for that slot by assigning it to the appropriate PIRQ in this section.

DMA Assigned To

Similar to *IRQ Assigned To*, for DMA channels.

DMA n Assigned To

As above – you can assign DMA channels as *Legacy* or *PCI/ISA PnP*.

1st/2nd Fast DMA Channel

Select up to 2 DMA channels for Type F DMA, if supported by the peripheral.

Configuration Mode

Sets the method by which information about legacy cards is conveyed to the system:

- **Use ICU**—the BIOS depends on information provided by Plug and Play software (e.g. *Configuration Manager* or *ISA Configuration Utility*). Only set this if you have the utilities. If you select this, you will see….

  - **Boot to PnP Operating System**. When enabled, the BIOS will activate only those Plug and Play cards necessary to boot the system, and hand over to an operating system that can manage Plug and Play cards for the rest. Otherwise, the remaining Plug and Play cards will not be configured, but Legacy cards will operate fine.

- **Use Setup Utility**. The BIOS depends on information provided by you as follows. *Don't use the above utilities.*

  - **ISA Shared Memory Size**. Specifies a range of memory addresses that will be directed to the ISA bus rather than onboard memory. Enable only for a Legacy card that requires non-ROM memory space (such as a LAN card with onboard memory buffers). Normally, the BIOS will scan C8000-DFFFFh for any BIOSes, note their location and size, then autoconfigure the PCI and Plug and Play expansion cards, shadowing the area above E0000h (other than video) until it is full. Next, the BIOS will assign additional PCI and Plug and Play cards to the area between C8000h and DFFFFh. If a Legacy ISA card has non-BIOS memory requirements, Autoconfigure could write into an area needed by the card, so this setting tells Autoconfigure that the block of memory is reserved, and should not be shadowed. If you set this, you will get this:

- **ISA Shared Memory Base Address**. If you select *96 KB*, this can only be set to C8000h; If the 80 KB setting is selected, the address can only be set to C8000h or CC000h, and so on. With 64K, you can only choose D000 or below.

- **IRQ 3-IRQ 15**. The IRQs in use by ISA Legacy cards. If not used, set to *Available*. Otherwise, set *Used by ISA Card*, which means that nothing else can use it.

IDE Speed

Fast or *Slow*, but it is not known whether this concerns PIO modes or not. Pheonix says that most modern drives will run in Fast mode.

IDE Prefetch Buffers

This is disk data caching at the IDE controller level, and works with PIO and DMA, on PCI, ISA or VLB computers. Using them with early versions of the Saturn chipset may result in data corruption when two devices are accessed at the same time. There may also be problems with Partition Magic. See also......

PCI IDE Prefetch Buffers

Disables prefetch buffers in the PCI IDE controller. You may need this with an operating system (like NT) that doesn't use the BIOS to access the hard disk and doesn't disable interrupts when completing a programmed I/O operation.

Disabling also prevents errors with faulty PCI-IDE interface chips that can corrupt data on the hard disk (with true 32-bit operating systems), like a PC-Tech RZ1000 or a CMD PCIO 640, but disabling is done automatically with later boards.

PCI IDE 2nd Channel

Use if your second IDE channel is PCI based, but disable if you're not using the 2nd channel, or you will lose IRQ 15 on the ISA slots.

PCI Slot IDE 2nd Channel

Enable if your secondary IDE controller is in a slot as opposed to being on the motherboard.

PCI timeout

When disabled, the PCI cycle is disconnected if the first data access is not completed inside 16 PCI clocks. Otherwise, it remains connected.

PCI to L2 Write Buffer

The chipset maintains its own internal buffer for PCI-external cache writes. When enabled, write cycles intended for the external (L2) cache are posted to the buffer instead so devices can complete cycles without waiting for others.

PCI IDE IRQ Map to

Used for assigning IRQs 14 (Primary) and 15 (Secondary) to particular slots and INT#s, so is mostly for when you don't have IDE on the system board, but use a card in a slot. You can define the IRQ routing to make them work properly and configure your system to the type of IDE disk controller (an ISA device is assumed; the ISA setting does not assign IRQs).

Here, you specify the PCI slot and interrupt (A, B, C or D) associated with the connected hard drives (not the partitions). Since each IDE controller (primary or secondary) supports two drives, you can select the PCI INT# (not IRQ) for each. You will need to map an IRQ to each if you are using two channels.

Primary IDE INT#, Secondary IDE INT#

Each PCI peripheral can activate up to four interrupts, A, B, C and D, with A being the default. The others are used when more than one interrupt is required. This assigns 2 INT channels for primary and secondary channels, if supported. This screen is not displayed if *ISA* is selected:

- **ISA**. Assigns no IRQs to PCI slots. Use for PCI IDE cards that connect IRQs 14 and 15 directly from an ISA slot using a table from a legacy paddleboard.

Primary & Secondary IDE INT#

See above.

Primary 32 Bit Transfers Mode

Enable/Disable 32-bit transfers for the Primary IDE interface.

Secondary 32 Bit Transfers Mode

See above.

PCI-Auto

If the IDE is detected by the BIOS in a PCI slot, then the appropriate INT# channel will be assigned to IRQ 14.

PCI-Slot X

If the IDE is not detected, you can manually select the slot.

PCI Bus Parking

Sort of bus mastering; a device parking on the PCI Bus has full control of it for a short time. Improves performance when that device (maybe a PCI NIC) is being used, but excludes others.

Primary Frame Buffer

The size of the buffer selected here should not impinge on local memory.

IDE Burst Mode

When enabled, this reduces latency between each drive read/write cycle, but may cause instability if your IDE cannot support it, so disable if you are getting disk errors.

IDE Data Port Post Write

Speeds up processing of drive reads and writes, but may cause instability if your IDE cannot support it, so disable if you are getting disk errors.

IDE Buffer for DOS & Win

For IDE read ahead and posted write buffers, to increase throughput to and from IDE devices by buffering reads and writes. Slower IDE devices could end up slower, though. Award BIOS.

IDE Master (Slave) PIO Mode

Changes IDE data transfer speed; *Mode 0-4*, or *Auto*. PIO means *Programmed Input/Output*. Rather than have the BIOS issue commands to effect transfers to or from the disk drive, PIO allows the BIOS to tell the controller what it wants, and then lets the controller and the CPU perform the complete task by themselves. Modes 1-4 are available.

PCI-ISA BCLK Divider

PCI Bus CLK vs ISA Bus CLK divider; the difference between the PCI and the ISA bus: Assuming 33 MHz, you have:

AUTO	
PCICLK1/3	11 MHz
PCICLK1/2	16 and a bit
PCICLK1/4	8 ish

ISA Bus Clock

See below.

ISA Clock

See below.

ISA Bus Clock Option

See below.

ISA Bus Clock Frequency

Allows you to set the speed of the ISA bus in fractions of the PCI bus speed, so if the PCI bus is operating at its theoretical maximum, 33 MHz, PCICLK/3 would yield an ISA speed of 11 Mhz. Avoid the asynchronous speed of 7.159 because of its overheads. Remember the PCI clock runs at half the speed of the front side bus. Speeding up the ISA bus only seems to affect video cards.

7.159 MHz	(default)
PCICLK/4	A quarter speed of the PCI bus
PCICLK/3	One third speed of the PCI bus

Host Clock/PCI Clock

Determines the speed of the PCI bus relative to the CPU internal clock, which is assumed to have the value of 1.

HCLK PCICLK

Similar to above. Host CLK vs PCI CLK divider; AUTO, 1-1, 1-1.5.

PCI Write-byte-Merge

When enabled, this allows data sent from the CPU to the PCI bus to be held in a buffer. The chipset will then write the data to the PCI bus when appropriate.

PCI Write Burst

When enabled, consecutive PCI write cycles become burst cycles on the PCI bus, so the system works faster.

PCI Write Burst WS

The number of cycles allotted for a PCI master burst write.

CPU-to-PCI Read Buffer

When enabled, up to four Dwords can be read from the PCI bus without interrupting the CPU. When disabled, a write buffer is not used and the CPU read cycle will not be completed until the bus signals its readiness to receive the data. The former is best for performance.

CPU-To-PCI Write Buffer

See *CPU-to-PCI Read Buffer*.

PCI-to-CPU Write Buffer

See CPU-to-PCI Read Buffer.

PCI Write Buffer

As for *CPU-to-PCI Read Buffer*, but you can choose 2, 4 or 8 deep (Phoenix).

PCI-To-CPU Write Posting

When enabled, writes from the PCI bus to the CPU are buffered, so the bus can continue writing while the CPU gets on with something else. Otherwise, the bus must wait until the CPU is free before starting another write cycle.

CPU-to-PCI Read-Line

When On, more time will be allocated for data setup with faster CPUs. This may only be required if you add an OverDrive processor to your system.

CPU-to-PCI Read-Burst

When enabled, the PCI bus will interpret CPU read cycles as the PCI burst protocol, meaning that back-to-back sequential CPU memory read cycles addressed to the PCI will be translated into fast PCI burst memory cycles. Performance is improved, but some non-standard PCI adapters (e.g. VGA) may have problems.

Byte Merging

This exists where multiple writes to non-contiguous memory addresses are merged into one PCI-to-memory operation by the host controller, letting devices sort out the ones they want, which increases bus throughput and hence performance for devices that support it—not all PCI video cards do, so enable unless you get bad graphics (this setting is intended to improve video performance). When enabled, the controller checks the CPU Byte Enable signals (8 of them) to see if data from the PCI bus can be merged. See also *Byte Merge Support* (next) and *CPU-PCI Byte Merge*.

Byte Merge Support

In this case, enabling means that CPU-PCI writes are buffered (Award). 8- or 16-bit data moving between the CPU and PCI bus is accumulated, or merged, into 32-bit chunks and held in a buffer, being written to the PCI bus when time permits.

CPU to PCI Byte Merge

Consecutive 8- or 16-bit writes in the same double-word address en route from the CPU to the PCI bus are held in a posted write buffer, from where they are sent as a single double-word, giving faster video performance, as byte merging is performed in the compatible VGA range only (0A0000-0BFFFFh). Enabled is best.

Word Merge

Controls the word-merge feature for frame buffer cycles. When enabled, the controller checks the eight *CPU Byte Enable* signals to see if data words read from the PCI bus by the CPU can be merged.

CPU to PCI Buffer

Allows buffers to be used between the CPU and PCI bus for faster performance. Otherwise, the CPU must wait until the write is complete before starting another cycle.

Latency for CPU to PCI write

The delay time before the CPU writes data to the PCI bus.

PCI Cycle Cache Hit WS

Similar to *Latency for CPU to PCI Write*. With *Fast*, the CPU works less and performance is better.

Normal Cache refresh during normal PCI cycles.

Fast Cache refresh without PCI cycle for CAS.

PCI to DRAM Buffer

Improves PCI to DRAM performance by allowing data to be stored if a destination is busy - buffers are needed because the PCI bus is divorced from the CPU. If enabled, two buffers, capable of holding 4 Dwords each, store data written from the PCI bus to memory. Disabled, PCI writes to DRAM are limited to a single transfer.

Use Default Latency Timer Value

Whether or not the default value for the Latency Timer will be loaded, or the succeeding Latency Timer Value will be used. If *Yes* is selected (default), you don't need *Latency Timer Value* (below).

Latency Timer Value

The maximum number of PCI bus clocks that the master may burst, or the time the bus master will occupy the PCI bus. A longer latency time gives it more of a chance. See also *Latency Timer (PCI Clocks)*.

Latency from ADS# status

This allows you to configure how long the CPU waits for the *Address Data Status* (ADS) signal; it determines the CPU to PCI Post write speed.

When set to 3T, this is 5T for each double word. With 2T (default), it is 4T per double word. For a Qword PCI memory write, the rate is 7T (2T) or 8T (3T).

The default should be fine, but if you add a faster CPU to your system, you may need to increase it. The choices are:

3T	Three CPU clocks
2T	Two CPU clocks (Default)

PCI Master Latency

If your PCI Master cards control the bus for too long, there is less time for the CPU to control it. A longer latency time gives the CPU more of a chance. Don't use zero.

Max burstable range

The maximum bursting length for each FRAME# asserting. In other words, the size of the data blocks transferred to the PCI bus in burst mode. May also set the size of the maximum range of contiguous memory addressed by a burst from the PCI bus, a half or one K. Keep at a half, as larger values have been rumoured to cause some data loss.

CPU Host/PCI Clock

Default uses actual CPU and PCI bus clock values.

CPU to PCI burst memory write

If enabled, back-to-back sequential CPU memory write cycles to PCI are translated to PCI burst memory write cycles. Otherwise, each single write to PCI will have an associated FRAME# sequence. Enabled is best for performance, but some non-standard PCI cards (e.g. VGA) may have problems.

CPU-To-PCI Burst Mem. WR.

As above – it allows the chipset to assemble long PCI bursts from data held in its buffers.

CPU to PCI Bursting

Enables or disables PCI burst cycles for CPU-PCI write cycles where back-to-back sequential CPU memory writes are sent out on the PCI bus as a burst cycle, which may help improve video performance significantly.

CPU to PCI post memory write

Enabling allows up to 4 Dwords of data to be posted to PCI at oncereasing efficiency. Otherwise, not only is buffering disabled, completion of CPU writes is limited (e.g. not complete until the PCI transaction completes). Enabled is best for performance.

CPU to PCI Write Buffer

As above. Buffers are needed because the PCI bus is divorced from the CPU; they improve overall system performance by allowing the processor (or bus master) to do what it needs without writing data to its final destination; the data is temporarily stored in fast buffers.

PCI to ISA Write Buffer

When enabled, the system will temporarily write data to a buffer so the CPU is not interrupted. When disabled, the memory write cycle for the PCI bus will be direct to the slower ISA bus. The former is best for performance.

DMA Line Buffer

Allows DMA data to be stored in a buffer so PCI bus operations are not interrupted. *Disabled* means that the line buffer for DMA is in single transaction mode. *Enabled* allows it to operate in an 8-byte transaction mode for greater efficiency.

ISA Master Line Buffer

ISA master buffers are designed to isolate slower ISA I/O operations from the PCI bus for better performance. *Disabled* means the buffer for ISA master transaction is in single mode. *Enabled* means it is in 8-byte modereasing the ISA master's performance. See also *ISA Line Buffer*, below.

SIO Master Line Buffer

As above, found on Pentium Pro machines.

ISA Line Buffer

The PCI-to ISA bridge has aan 8-byte bidirectional line buffer for ISA or DMA bus master memory reads from or writes to the PCI bus. When this is enabled, an ISA or DMA bus master can prefetch two doublewords to the line buffer for a read cycle.

CPU/PCI Post Write Delay

The delay time before the CPU writes data into the PCI bus. Use the lowest possible value.

Post Write Buffer

Enables posted writing from the L1 cache, which means that, within limits, writes of altered data from cache can be held until they will not interfere with reads. When disabled, the CPU may be stalled because data required to complete the current instruction cannot be read until a write is completed.

SIO PCI Post Write Buffer

To do with buffering data between the CPU and an Orion Memory Controller.

Post Write CAS Active

Pulse width of CAS# after the PCI master writes to DRAM.

PCI master accesses shadow RAM

Enables the shadowing of a ROM on a PCI master for better performance.

Enable Master

Enables the selected device as a PCI bus master and checks whether it is capable.

AT bus clock frequency

Access speed for the AT bus in a PCI system, actually used for memory access instead of wait states. Choose whatever divisor gives you a speed of 6-8.33 MHz, for 70 ns memory, depending on the speed of the PCI bus (e.g. PCI/4 at 33 MHz).

Base I/O Address

The base of the I/O address range from which the PCI device resource requests are satisfied.

Base Memory Address

The base of the 32-bit memory address range from which the PCI device resource requests are satisfied.

Parity

Allows parity checking of PCI devices.

ISA Linear Frame Buffer

Set to the appropriate size if you use an ISA card that features a linear frame buffer (e.g. a second video card for ACAD). The address will be set automatically.

Residence of VGA Card

Whether on PCI or VL Bus.

ISA LFB Size

LFB = *Linear Frame Buffer*. This creates a hole in the system memory map when there is more than 16Mb of RAM, so accesses made to addresses within the hole are directed to the ISA Bus instead of Main Memory. Leave *Disabled*, unless you're using an ISA card with a linear frame buffer that must be accessed by the CPU, and you aren't using Plug and Play's Configuration Manager or ISA Configuration Utility. If you choose 1 Mb, the *ISA LFB Base Address* field will appear (see below).

ISA LFB Base Address

The starting address for the ISA memory hole if 1 Mb is set for the *ISA LFB Size* (above).

ISA VGA Frame Buffer Size

This is to help you use a VGA frame buffer and 16 Mb of RAM at the same time; the system will allow access to the graphics card through a hole in its own memory map; accesses to addresses within this hole will be directed to the ISA bus instead of main memory. Should be set to *Disabled*, unless you are using an ISA card with more than 64K of memory that needs to be accessed by the CPU, and you are not using the Plug and Play utilities. If you have less than 8 Mb memory, or use MS-DOS, this will be ignored.

VGA Frame Buffer

When enabled, a fixed VGA frame buffer from A000h-BFFFh and a CPU-To-PCI write buffer are implemented.

VGA Memory Clock (MHz)

The speed of the VGA memory clock.

Memory Hole

Enables a memory hole at either 512K-640K or 15M-16M to support adapters that require linear frame buffer memory space – once reserved it cannot be cached. Allegedly for OS/2 only. Disable if your extended memory appears to be limited for any reason.

Memory Map Hole; Memory Map Hole Start/End Address

See *ISA VGA Frame Buffer Size*, above. Where the hole starts depends on *ISA LFB Size*. Sometimes this is for information only. If you can change it, base address should be 16Mb, less buffer size. Only one memory hole is allowed with the Triton chipset – once reserved it cannot be cached. Allegedly for OS/2 only.

Memory Hole Size

Enables a memory hole in DRAM space. CPU cycles matching an enabled hole are passed on to PCI. Options include *1 Mb*, *2 Mb*, *4 Mb*, *8 Mb*, *Disabled*, which are amounts below 1 Mb assigned to the AT Bus, and reserved for ISA cards – once reserved it cannot be cached. Allegedly for OS/2 only. Disable if your extended memory appears to be limited for any reason.

Memory Hole Start Address

To improve performance, certain parts of system memory may be reserved for ISA cards which must be mapped into the memory space below 16 Mb for DMA reasons (check the documents). The chipset can then access any code or data directly from the ISA bus. The selections are from 1-15 with each number in Mb. This is irrelevant if the memory hole is disabled (see above). Areas reserved in this way cannot be cached. Allegedly for OS/2 only.

Memory Hole at 15M Addr.

See above.

Memory Hole at 15M-16M

See *Memory Hole Start Address*, but the area above 15 Mb (F00000 to FFFFFF) becomes unavailable to the system and allocated to the ISA bus (since ISA cards can only address 24 bits of memory, the top of the hole must be at 16mb or below, and since some operating systems, like OS/2, have problems working around the hole, it should be put as high as possible). Sometimes this is reserved for expanded PCI commands – once reserved it cannot be cached. Allegedly for OS/2. Disable if your extended memory appears to be limited.

Local Memory 15-16M

To increase performance, you can map slower device memory (e.g. on the ISA bus) into much faster local bus memory. Local memory is set aside and the start point transferred from the device memory to local memory. The default is enabled.

15-16M Memory Location

The area in the memory map allocated for ISA option ROMs. Choices are *Local* (default) or *Non-local*.

Multimedia Mode

Enables or disables palette snooping (see below) for multimedia cards.

Palette Snooping

Enable when using a Multimedia (MPEG) video card, so the address space of the PCI VGA palette can be snooped for colour information from the video processor and overlay. In other words, an ISA video card is able to synchronise its colour palette with one on the PCI bus. More in *PCI/VGA Palette Snoop*, below.

Video Palette Snoop

This allows multiple VGA cards to be used on multiple buses. VGA snooping is used by multimedia video devices (e.g. MPEG or video capture boards) to look ahead at the video controller (VGA device) and see what colour palette is currently in use when in 256-colour mode, that is, what 256 colours out of the thousands available are in the VGA memory. This setting controls how a PCI graphics card can snoop write cycles to an ISA video card's colour palette registers. Only set to *Disabled* if:

- ❑ An ISA card connects to a PCI graphics card through a VESA connector
- ❑ The ISA card connects to a colour monitor, and
- ❑ The ISA card uses the RAMDAC on the PCI card, and
- ❑ Palette Snooping (RAMDAC shadowing) not operative on PCI card.

PCI/VGA Palette Snoop

Having an MPEG board attached to the feature connector of your video card alters the VGA palette setting. Enable this if you have ISA MPEG connections through the PCI VGA feature connector, so you can adjust PCI/VGA palettes, and solve situations where the colours in Windows are wrong. For example, you may get a black and white display while booting.

In the Award BIOS, this tells the PCI VGA card to keep silent (and prevent conflict) when the palette register is updated (i.e. it accepts data without responding). Useful only when two display cards use the same palette address and are plugged into the PCI bus at the same time (such as MPEG or Video capture). In such cases, PCI VGA keeps quiet while the MPEG or capture functions normally.

However, you should only need this in exceptional circumstances, so disable for ordinary systems. (Award BIOS). See also *Video Palette Snoop* (above).

VGA Palette Snoop

See above.

PCI/VGA Snooping

Enabled, looks for a VGA card on the ISA/VLB bus. *Disabled* looks on the PCI bus.

Snoop Filter

Saves the need for multiple enquiries to the same line if it was inquired previously. When enabled, cache snoop filters ensure data integrity (cache coherency) while reducing the snoop frequency to a minimum. Bus snooping is a technique for checking if cached memory locations have been changed through DMA or another processor; it compares the address being written to by a DMA device with the cache Tag RAM. If a match occurs, the location is marked. If the CPU tries to read that location later it must get the data from main memory, which contains what has been written by DMA. In other words, bus snooping invalidates cached locations modified by anything other than the CPU, to prevent old data being read. Bus snooping must access L1 and L2 caches, using the processor bus in the case of the former. Nine bus clocks are used to perform the snoop, so it involves a loss of performance, particularly as the CPU cycle is delayed if the snoop starts just before a CPU memory access cycle. For these reasons, it is pipelined in the HX chipset.

PCI VGA Buffering

Enabled is best for performance.

E8000 32K Accessible

The 64K E area of upper memory is used for BIOS purposes on PS/2s, 32 bit operating systems and Plug and Play. This setting allows the second 32K page to be used for other purposes when not needed, in the same way that the first 32K page of the F range is useable after boot up has finished.

P5 Piped Address

Default is *Disabled*.

PCI Arbiter Mode

Devices gain access to the PCI bus through arbitration (similar to interrupts). There are two modes, 1 (the default) and 2. The idea is to minimize the time to gain control of the bus and move data. Generally, Mode 1 should be sufficient, but try mode 2 if you get problems.

PCI Arbitration Rotate Priority

Typically, access is given to the PCI bus on a first-come-first-served basis. When priority is rotated, once a device gains control of the bus it is assigned the lowest priority and all others moved up one in the queue. When enabled, PCI masters arbitrate for bus ownership using rotate priority. Otherwise, fixed priority is used.

Stop CPU When Flush Assert

See *Stop CPU when PC Flush*.

Stop CPU when PC Flush

When enabled, the CPU will be stopped when the PCI bus is being flushed of data. Disabling (default) allows the CPU to continue processing, giving greater efficiency.

Stop CPU at PCI Master

When enabled, the CPU will be stopped when the PCI bus master is operating on the bus. Disabling (default) allows the CPU to carry on, giving greater efficiency.

Preempt PCI Master Option

Enabling allows PCI bus operations to be pre-empted by certain activities, such as DRAM refresh. Otherwise, everything takes place concurrently.

I/O Cycle Recovery

When enabled, the PCI bus will be allowed a recovery period for back-to-back I/O, which is like adding wait states, so disable (default) for best performance.

I/O Recovery Period

Sets the length of time of the recovery cycle used above. The range is from 0-1.75 microseconds in 0.25 microsecond intervals.

Action When W_Buffer Full

Sets the behaviour of the system when the write buffer is full. By default, the system will immediately retry, rather than wait for it to be emptied.

Fast Back-to-Back

When enabled, the PCI bus will interpret CPU read cycles as the PCI burst protocol, meaning that back-to-back sequential CPU memory read cycles will be translated into the fast PCI burst memory cycles. Also, consecutive write cycles targeted to the same slave become fast back-to-back. Default is enabled.

CPU Pipelined Function

This allows the system controller to signal the CPU for a new memory address, before all data transfers for the current cycle are complete, resulting in increased throughput. The default is *Disabled*, that is, pipelining off.

Pipelined Function

See above.

CPU-to-PCI Fast Back to Back

As above, found on the Phoenix BIOS. *Disabled* is recommended unless your expansion cards support it.

PCI Fast Back to Back Wr

When enabled, the PCI bus interprets CPU read cycles as the PCI burst protocol, so back-to-back sequential CPU memory read cycles addressed to the PCI bus will be translated into fast PCI burst memory cycles.

Primary Frame Buffer

When enabled, this allows the system to use unreserved memory as a primary frame buffer. Unlike the VGA frame buffer, this would reduce overall available RAM for applications.

M1445RDYJ to CPURDYJ

Whether the PCI Ready signal is to be synchronized by the CPU clock's ready signal or bypassed (default).

VESA Master Cycle ADSJ

Allows you to increase the length of time the VESA Master has to decode bus commands. Choices are *Normal* (default and fastest) and *Long*. Increasing the delay increases stability. On the Phoenix BIOS, when the VESA Master Speed is less than or equal to 33 MHz, you can set *Non-Delay ADSJ*. Above that, you can use *Delay ADSJ* if you get a problem with VESA Master cards running too fast.

LDEVJ Check Point Delay

Selects the time allocated for checking bus cycle commands, which must be decoded to see whether a *Local Bus Device Access Signal* (LDEVJ) is being sent, or an ISA device is being addressed or, in other words, when the chipset checks if the current CPU cycle relates to the VL or ISA bus. Increasing the delay increases stability, especially of the VESA, while very slightly degrading the performance of ISA. Settings are in terms of the feedback clock rate (FBCLK2) used in the cache/memory control interface.

1 FBCLK2	One clock
2 FBCLK2	Two clocks (Default)
3 FBCLK2	Three clocks

Delay ISA/LDEVJ check in CLK2

See also *LDEVJ Check Point Delay*, above. For choosing when the chipset samples whether the current CPU cycle is ISA or VL Bus. Settings are in terms of *Standard* + CLK2 periods.

CPU Dynamic-Fast-Cycle

Gives you faster access to the ISA bus. When the CPU issues a bus cycle, the PCI bus examines the command to see if a PCI agent claims it. If not, an ISA bus cycle is initiated. The Dynamic-Fast-Access then allows for faster access to the ISA bus by decreasing the latency (or delay) between the original CPU command and the beginning of the ISA cycle.

Master IOCHRDY

Enabled, allows the system to monitor for a VESA master request to generate an I/O channel ready (IOCHRDY) signal.

CPU Memory sample point

This allows you to select the *cycle check point*, which is where memory decoding and cache hit/miss checking takes place. Each selection indicates the check takes place at the end of a CPU cycle, with one wait state indicating more time for checking to take place than with zero wait states. A longer check time allows for greater stability at the expense of some speed.

LDEV# Check point

The VESA local device (LDEV#) check point is where the VL-bus device decodes the bus commands and error checks, within the bus cycle itself.

0	Bus cycle point T1 (Default and fastest)
1	During the first T2
2	During second T2
3	During third T2

The slower the motherboard, the lower the number you can use here. Your VL-bus card must be fast enough to produce an LDEV# signal.

Memory Sample Point

Concerns when the chipset checks if the current CPU cycle is at the memory cycle. 0 wait states means at the first T2 rising edge, 1 wait state means at the second. The former is the best for performance.

Local memory check point

Selects between two techniques for decoding and error checking local bus writes to DRAM during a memory cycle.

Slow Extra wait state; better checking (default)

Fast No extra wait state used

FRAMEJ generation

When the PCI-VL bus bridge is acting as a PCI Master and receiving data from the CPU, this enables a fast CPU-to-PCI buffer that allows the CPU to complete a write, before the data has been delivered, reducing the CPU cycles involved and speeding overall processing. The chipset will generate two types of FRAME# signal:

Normal Buffering not employed (Default for compatibility)

Fast Buffer used for CPU-to-PCI writes

Local Memory Detect Point

Selects the cycle check point, or where memory decoding and cache hit/miss checking takes place. More wait states gives greater stability.

PCI to CPU Write Pending

Sets the behaviour of the system when the write buffer is full. By default, the system will immediately retry, but you can set it to wait for the buffer to be emptied before retrying, which is slower.

Delay for SCSI/HDD (Secs)

The length of time in seconds the BIOS will wait for the SCSI hard disk to be ready for operation. If the hard drive is not ready, the PCI SCSI BIOS might not detect the hard drive correctly. The range is from 0-60 seconds.

Busmaster IDE on PCI

Reduces CPU and PCI overhead. As the CPU-PCI bridge generates several wait states per bus command, the busmaster gives greater bandwidth by only reading 1 memory cycle (PIO=2).

VGA Type

The BIOS uses this information to determine which bus to use when the video BIOS is being shadowed. Choices are *Standard* (default), *PCI*, *ISA/VESA*.

PCI Mstr Timing Mode

This system supports two timing modes, 0 (default) and 1.

PCI Arbit. Rotate Priority

See *PCI Arbitration Rotate Priority*.

I/O Cycle Post-Write

When Enabled (default), data being written during an I/O cycle will be buffered for faster performance. Posted Write Buffers are used when write-thru cacheing is enabled, to reduce the time the CPU has to wait. Intel CPUs have 4 internal posted write buffers.

PCI Post-Write Fast

As in the above *I/O Cycle Post-Write*, enabling this will allow the system to use a fast memory buffer for writes to the PCI bus.

CPU Mstr Post-WR Buffer

When the CPU operates as a bus master for either memory access or I/O, this controls its use of a high speed posted write buffer. *NA*, *1*, *2* and *4* (default).

Graphic Posted Write Buffer

When enabled, CPU writes to graphics memory are posted to the chipset's internal buffer so the CPU can start another write cycle before the graphics memory finishes.

PCI Mstr Post-WR Buffer

As above, for PCI devices.

CPU Mstr Post-WR Burst Mode

When the CPU operates as a bus master for either memory access or I/O, this allows it to use burst mode for posted writes to a buffer.

PCI Mstr Burst Mode

As above, for PCI devices.

CPU Mstr Fast Interface

Enables or disables a fast back-to-back interface when the CPU operates as a bus master. Enabled, consecutive reads/writes are interpreted as the CPU high-performance burst mode.

PCI Mstr Fast Interface

As above, for PCI devices.

CAS Delay in Posted-WR

Select the number of CPU cycles for CAS to remain active after a posted write is complete. The fewer, the faster.

CPU Mstr DEVSEL# Time-out

When the CPU initiates a master cycle using an address (target) which has not been mapped to PCI/VESA or ISA space, the system will monitor the DEVSEL (device select) pin to see if any device claims the cycle. Here, you can determine how long the system will wait before timing-out. Choices are 3 PCICLK, 4 PCICLK, 5 PCICLK and 6 PCICLK (default).

PCI Mstr DEVSEL# Time-out

As above, for PCI devices.

IRQ Line

If you have a device requiring an IRQ service into the given PCI slot, use this to inform the PCI bus which IRQ it should initiate. Choices range from IRQ 3-15.

State Machines

The chipset uses four *state machines* to manage specific CPU and/or PCI operations, which can be thought of as highly optimized process centres for specific operations. Generally, each operation involves a master device and the bus it wishes to employ. The state machines are:

- CPU master to CPU bus (CC)
- CPU master to PCI bus (CP)
- PCI master to PCI bus (PP)
- PCI master to CPU bus (PC)

Each have the following settings:

- **Address 0 WS**. The time the system will delay while the transaction address is decoded. Enabled=no delay (fastest).
- **Data Write 0 WS**. The time the system will delay while data is being written to the target address. Enabled=no delay (fastest).
- **Data Read 0 WS**. The time the system will delay while data is being read from the target address. Enabled=no delay (fastest).

Fast Back-to-Back Cycle

When enabled, the PCI bus will interpret CPU read or write cycles as PCI burst protocol, meaning that back-to-back sequential (e.g. fast) CPU memory read/write cycles addressed to the PCI will be translated into fast PCI burst memory cycles.

On Board PCI/SCSI BIOS

You would enable this if your system motherboard had a built-in SCSI controller attached to the PCI bus, and you wanted to boot from it.

PCI I/O Start Address

Allows you to make *additional* room for older ISA devices by defining I/O start addresses for the PCI devices, thus overriding the PCI controller.

PCI Memory Start Address

For devices with their own memory which use part of the CPU's memory address space. You can determine the starting point in memory where PCI device memory will be mapped.

VGA 128k Range Attribute

This allows the chipset to apply features like *CPU-TO-PCI Byte Merge*, *CPU-TO-PCI Prefetch* to be applied to VGA memory range A0000H-BFFFFH.

Enabled	VGA receives CPU-TO-PCI functions
Disabled	Retain standard VGA interface

Posted PCI Memory Writes

When this is enabled, writes from the PCI bus to memory are posted as an intermediate step. If the CPU and PCI-To-DRAM posted write buffer is enabled, the data is interleaved with CPU write data and posted a second time before being written to memory.

CPU-To-PCI Write Posting

Posting refers to the use of buffers between the CPU and PCI bus, or maybe the PCI bus and IDE interface (depends on the manufacturer) to help match their relative speeds – they are called *Posted Write Buffers*. The idea is that the PCI bus can retrieve data in its own good time without holding up the CPU. In this particular case, they belong to the Orion chipset. When this setting is enabled, writes from the CPU to the PCI bus will be buffered without interfering with reads into the CPU cache. When disabled (default), the CPU is forced to wait until the write is completed before starting another write cycle. Sometimes this cannot be used with certain video cards at cerftain CPU speeds (just try and see). Not the same as *PCI Posted Write Enable*, which seems to buffer data between buses.

CPU To PCI Write Buffers

See *CPU-To-PCI Write Posting* (above).

OPB P6 to PCI Write Posting

As above, but found on Pentium Pro machines.

OPB PCI to P6 Write Posting

As above, but in reverse.

CPU-To-PCI IDE Posting

Enabled, IDE accesses are buffered in the CPU-PCI buffers, which is best for performance, as cycles are optimised. When disabled, *CPU to PCI IDE posting* cycles are treated as normal I/O writes.

CPU-PCI Burst Memory Write

Enabling is best for performance.

CPU-PCI Post Memory Write

Enabling is best for performance.

CPU Read Multiple Prefetch

A prefetch occurs during a process such as reading from the PCI or memory, when the chipset peeks at the next instruction and begins the next read. The Orion chipset has four read lines, and a multiple prefetch means the chipset can initiate more than one prefetch during a process. Default is *Disabled* (slowest).

CPU Line Read Multiple

A line read means the CPU is reading a full cache line, which means 32 bytes (8 DWORDS) of data. Because the line is full, the system knows exactly how much data it will be reading and doesn't need to wait for an end-of-data signal, so blocks of data can be read without pausing every 4 cycles to specify a new address. When this is enabled, the system can read more than one full cache line at a time, so is best for performance. The default is *Disabled*.

OPB P6 Line Read

As above, but on Pentium Pro machines, possibly with the Orion Chipset.

CPU Line Read Prefetch

See also *CPU Line Read Multiple* and *CPU Read Multiple Prefetch* (above). When enabled, the system is allowed to prefetch the next read instruction and initiate the next process.

Prefetching is used by 80x8x CPUs to read instructions from relatively slow DRAM and store them in fast CPU registers during the execution of previous ones, using unused cycles.

OPB Line Read Prefetch

As above, but found on Pentium Pros, possibly with the Orion chipset.

CPU Line Read

Enables or Disables full CPU line reads. See *CPU Line Read Multiple*, above.

DRAM Read Prefetch Buffer

This controls memory access latency. For every memory access request, a preprogrammed number of local bus clock signals is counted down. If the number of filled posted write buffer slots is at or above a predetermined figure when the count reaches zero, the memory request priority is raised.

Read Prefetch Memory RD

When enabled, the system can prefetch the next read instruction and initiate the next process, which is best for performance

VGA Performance Mode

If enabled, the VGA memory range of A0000-B0000 will use a special set of performance features. This has little or no effect using video modes beyond those commonly used for Windows, OS/2, UNIX, etc, but this memory range is heavily used by games.

Snoop Ahead

This is only applicable if the cache is enabled. When enabled, PCI bus masters can monitor the VGA palette registers for direct writes and translate them into PCI burst protocol for greater speed, to enhance the performance of multimedia video.

DMA Line Buffer Mode

Allows DMA data to be stored in a buffer so as not to interrupt the PCI bus. *Standard* equals single transaction mode. *Enhanced* means 8-byte transactions.

Master Arbitration Protocol

How the PCI bus determines which bus master device gains access to it.

Host—to—PCI Wait State

1, 0 or Auto.

PCI Parity Check

Enables/disables PCI Parity checking. The latter is default and slower due to extra overhead.

PCI Memory Burst Write

When enabled, CPU write cycles are interpreted as the PCI burst protocol (by the PCI bus), meaning that back-to-back sequential CPU memory write cycles addressed to PCI will be translated into (fast) PCI burst memory write cycles. This directly improves video performance when consecutive writes are initiated to a linear graphics frame buffer.

PCI Mem Line Read

When enabled, PCI Memory Line Read commands fetch full cache lines. Otherwise, partial reads are done.

PCI Mem Line Read Prefetch

When enabled, PCI Memory Line Read commands fetch a full cache line and a prefetch of up to three more. Prefetching does not cross 4K address boundaries. This setting is irrelevant if *PCI Mem Line Read* (above) is disabled.

PCI Clock Frequency

Set the clock rate for the PCI bus, which can operate between 0-33 MHz, relative to the CPU, e.g. CPUCLK/2, or half the CPU speed.

CPUCLK/1.5	CPU speed / 1.5 (Default)
CPUCLK/3	CPU speed/3
14 MHz	14 MHz
CPUCLK/2	CPU speed/2

I/O Recovery Time

As for *I/O Recovery Time Delay*, but concerns refreshing *between* cycles, so the lower the number the better. Set to *Enhanced* with Multiuser DOS on an Intel Express. If you get two numbers, the first is for 8-bit cycles, and the second 16-bit. In other words, this is a programmed delay which allows the PCI bus to exchange data with the slower ISA bus without data errors. Settings are in fractions of the PCI BCLK

2 BCLK	Two BCLKS (default)
4 BCLK	Four BCLKS
8 BCLK	Eight BCLKS
12 BCLK	Twelve BCLKS

IO Recovery (BCLK)

As for *I/O Recovery Time*.

8 Bit I/O Recovery Time

The recovery time is the length of time, measured in CPU clocks, that the system will delay after the completion of an input/output request to the ISA bus, needed because the CPU is running faster than the bus, and needs to be slowed down. Clock cycles are added to a minimum delay (usually 5) between PCI-originated I/O cycles to the ISA bus. Choices are from 1 to 7 or 8 CPU clocks. 1 is the default.

16 Bit I/O Recovery Time

As above, for 16 bit I/O. Choices between 1 to 4 CPU clocks.

PCI Concurrency

Enabled (default) means that more than one PCI device can be active at a time (Award). With Intel Chipsets, it allocates memory bus cycles to a PCI controller while an ISA operation, such as bus mastered DMA, is taking place, which normally requires constant attention. This involves turning on additional read and write buffering in the chipset. The PCI bus can also obtain access cycles for small data transfers without the delays caused by renegotiating bus access for each part of the transfer, so is meant to improve performance and consistency.

In some Award BIOSes this also controls a *Determinancy Latency Bit* that stops some CDROMs from being detected or used by Win 95 pre-OSR2. If it occurs, disable this.

PCI Streaming

Data is typically moved to and from memory and between devices in chunks of limited size, because the CPU is involved. On the PCI bus, however, data can be streamed, that is, much larger chunks can be moved without the CPU being bothered. Enable for best performance.

PCI Bursting

Consecutive writes from the CPU are regarded as a PCI Burst cycle, so this allows multiple data bytes to cross the PCI bus in one go. When enabled (default), one address cycle is combined with several data cycles before being sent across the PCI bus; the receiving agent increments the addresses itself (when disabled, data moves across the PCI bus in a single cycle/data cycle pair). All other users of the PCI bus and destination devices, such as memory, are locked out during the transfer. You may need to change this for slower PCI Video cards.

PCI (IDE) Bursting

As above, but this enables burst mode access to video memory over the PCI bus. The CPU provides the first address, and consecutive data is transferred at one word per clock. The device must support burst mode.

PCI Dynamic Bursting

Combines several PCI cycles into one.

PCI Burst Write Combine

This is meant to speed up video processing by up to about 15%, as many writes to video memory are with individual pixels, which don't ordinarily fill up a 32-byte cache line, for which the architecture is optimised – when enabled, internal processor buffers combine smaller or partial writes into burstable writes for a specific memory area, so only one transfer is used. As Pentium Pro, Celeron, Pentium II and III have a 32-byte buffer, in 8-bit color mode, 32 write operations can be sebt at once.

The chipset may also assemble large PCI bursts from data stored in burst buffers if the bus is not available. Before SP6, NT did not turn this on for the Athlon.

Burst Write Combine

See above.

PCI Preempt Timer

Sets the time before 1 PCI master preempts another when a service request has been pending.

Disabled	No preemption (default).
260 LCLKs	Preempt after 260 LCLKs
132 LCLKs	Preempt after 132 LCLKs
68 LCLKs	Preempt after 68 LCLKs
36 LCLKs	Preempt after 36 LCLKs
20 LCLKs	Preempt after 20 LCLKs
12 LCLKs	Preempt after 12 LCLKs
5 LCLKs	Preempt after 5 LCLKs

PCI-To-DRAM Pipeline

For DRAM optimisation. If enabled, full PCI-DRAM write pipelining is used, where buffers in the chipset store data written from the PCI bus to memory. Otherwise, PCI writes to DRAM are limited to one transfer per write cycle.

Burst Copy-Back Option

If a cache miss occurs with this enabled, the chipset will initiate a second, burst cache line fill from main memory to the cache, to maintain the status of the cache.

Concurrent PCI/Host

Allows other PCI devices to work concurrently with the host PCI IDE channel. If disabled, the CPU bus will be occupied during the entire PCI operation period.

Peer Concurrency

Whether or not the CPU can run DRAM/L2 cycles when non-PHLD PCI master devices are targeting the peer device. That is, whether the CPU can use cache or system memory when something else is going on, or talk to the busmaster controller and the card at the same time. This speeds things by allowing several PCI devices to operate at the same time, or as near to it as possible. Enabled is best for performance, but some cards might not like it.

IBC DEVSEL# Decoding

Sets the type of decoding used by the ISA Bridge Controller (IBC) to determine which device to select. The longer the decoding cycle, the better chance the IBC has to correctly decode the commands. Choices are *Fast*, *Medium* and *Slow* (default). *Fast* is less stable and may possibly trash a hard disk.

Arbiter timer timeout (PC CLK) 2 x 32

Working on this.

Keyboard Controller Clock

Sets the speed of the keyboard controller (PCICLKI = PCI bus speed).

7.16 MHz	Default
PCICLKI/2	1/2 PCICLKI
PCICLKI/3	1/3 PCICLKI
PCICLKI/4	1/4 PCICLKI

CPU Pipeline Function

This allows the system controller to signal the CPU for a new memory address, even before all data transfers for the current cycle are complete, resulting in increased throughput. Enabled means that address pipelining is active.

PCI Dynamic Decoding

When enabled, this setting allows the system to remember the PCI command which has just been requested. If subsequent commands fall within the same address space, the cycle will be automatically interpreted as a PCI command.

Master Retry Timer

Sets how long the CPU master will attempt a PCI cycle before the cycle is unmasked (terminated). The choices are measured in PCICLKs. Values are 10 (default), 18, 34 or 66 PCICLKs.

PCI Pre-Snoop

Pre-snooping is a technique by which a PCI master can continue to burst to the local memory until a 4K page boundary is reached rather than just a line boundary. Enabled is best for performance. If disabled, one line (four words) is transferred in a burst operation and another address must be passed at the start of the next burst.

PCI Read Burst WS

The number of cycles alloted for a PCI master burst read.

CPU/PCI Write Phase

Determines the turnaround (or number of clock signals) between the address and data phases of the CPU master to PCI slave writes. Choices are 1 LCLK (default) or 0 LCLK.

CPU to PCI POST/BURST

Data from the CPU to the PCI bus can be posted (buffered by the controller) and/or burst. This sets the methods.

POST/CON.BURST	Posting and bursting supported (default)
NONE/NONE	Neither supported
POST/NONE	Posting but not bursting supported

PCI CLK

Whether the PCI clock is tightly synchronized with the CPU clock, or is asynchronous. If your CPU, motherboard and PCI bus are running at multiple speeds of each other, e.g. Pentium 120, 60 MHz m/b and 30 MHz PCI bus, choose synchronise.

PCI Master Cycle

Where the chipset checks for the PCI Master Cycle in local memory. *Fast* means in the address phase, which is earlier, and *Slow* refers to the first data phase.

IRQ 15 Routing Selection

MISA=*Multiplexed ISA* for asynchronously interrupting the CPU. IRQ 15 is usually used for Secondary IDE channels or CD-ROMs.

Secondary CTRL Drives Present

Allows you to manually set the number of drives on your secondary channel.

CPU cycle cache hit sam point

Working on this.

PCI cycle cache hit sam point

Working on this.

Plug and Play OS

Whether you have one or not, but this only affects ISA PnP cards - PCI cards are initialised anyway. *No* means the BIOS will allocate interrupt settings. *Yes* means that they may be reassigned by the operating system, or that the BIOS will only initialise PnP PCI boot devices. Windows 2000 should have this disabled, because of ACPI, but it will work if you enable it, and you disable APM (on an ACPI-capable motherboard, disable *Power Management*).

Linux should also have this disabled, as it uses **isapnptools** to do its own thing - if you run it after the BIOS has configured your cards, it will fail, leaving any the BIOS cannot initialise (like AWE 32/64, SB16, etc) unusable.

PnP OS

See above.

PCI Passive Release

This item concerns the PIIX4 (PCI-ISA bridge), and the latency of ISA bus masters. When enabled, ISA cards are not allowed to stop the PCI bus using DMA mode. Put more officially, CPU-PCI bus accesses are allowed during passive release, otherwise the arbiter only accepts another PCI master access to local DRAM. If you have a problem with an ISA card, set it to the opposite of the current setting.

Delayed Transaction

PCI 2.1 is tight on target and master latency, and PCI cycles to and from ISA generally take longer to perform because the ISA bus is running slower. When *enabled*, the chipset provides a programmable delayed completion mechanism (i.e. 32-bit posted write buffers), where the PCI bus is freed during CPU access to 8-bit ISA cards, which normally consume about 50-60 PCI clocks without this. Disable for bus mastering PCI cards that cannot use the PCI bus, or some ISA cards that are not PCI 2.1 compliant.

PCI 2.1 Compliance

See *Delayed Transaction* (above) – this is another name for it. It lets you enable or disable the PIIX3 register Delayed Transaction and Passive Release. When enabled, the PIIX3 controls USB operation to ensure the system complies with PCI 2.1

Chipset Global Features

Applies bus masteringto all PCI slots, assuming all cards are compatible.

Multi Transaction Timer

Allows PCI cards to hold their request lines high and receive PCI bursts without rearbitration delays and without locking others out of the bus (the Multi Transaction Timer controls the minimum burst size). May improve data transfer for devices needing uninterrupted high data transfer rates (anything to do with video), but may also cause problems.

FDD IRQ Can Be Free

Allows it to be used by the PnP system.

Multi-function INTB#

Enables or disables multi-function PCI cards using INTA# and INTB#.

Shared VGA Memory Speed

The memory speed of DRAM allocated for video memory.

AGP Aperture Size (64 Mb)

The AGP memory aperture is the range of PCI memory address space used by an AGP card for 3D support, in which host cycles are forwarded to the card without translation, giving extra speed. It is the amount of memory the GART (*Graphics Address Remapping Table*) can see, which makes the processor on the video card see the card memory and is that specified here as one continuous block. This also determines the maximum amount of system RAM allocated to the graphics card for texture storage.

Double your AGP memory size, and add 12 Mb for virtual addressing. The doubled amount is for write combining. If you specify too little, you will get paging to hard disk, and you may get errors if you specify too much. The default of 64 Mb is usually OK for most drivers, and it's only used when needed, if you have such a card. *This setting is not performance related*, and neither does it affect 3DFX cards, as they do not support AGP texturing. More info on AGP at **www.apgforum.org**.

AGP 2X Mode

Allows your AGP VGA card to switch to 133 MHz transfer mode, if it supports it, where both the rising and falling edges of the signal are used to transfer data. Otherwise the card operates in 1X mode (66 MHz).

AGPCLK/CPUCLK

The relative speeds against each other of AGP and CPU clocks. 2/3 means that the AGP subsystem is running at 2/3 of the CPU speed.

AGP Master 1 WS Write

Implements a single delay when writing to the AGP Bus. Normally, two wait states are used, allowing for greater stability.

AGP Transfer Mode

Seems to override the automatic selection of 1x, 2x or 4x.

AGP Master 1 WS Read

Implements a single delay when reading from the AGP Bus. Normally, two wait states are used, allowing for greater stability.

PCI Master 0 WS Write

Increases the write cycle speed when enabled – that is, writes to the PCI bus are executed with zero wait states.

PCI Master 1 WS Write

Writes to the PCI bus are executed with an extra wait state. Normally disabled.

PCI Master 1 WS Read

Reads to the PCI bus are executed with an extra wait state. Normally disabled

PCI Delay Transaction

When enabled, the CPU can access the PCI bus during Passive Release (when Passive Release is enabled, the PCI bus can operate by itself when the ISA bus is accessed). If disabled, only PCI bus mastering devices can access the PCI bus.

PCI Master Read Prefetch

Enabled, allows the system to prefetch the next read and initiate the next process, so enabled is best for performance.

PCI#2 Access #1 Retry

Enables PCI #2 Access in #1 attempts.

PCI Arbitration Mode

Determines the order in which PCI Bus Masters get control of the PCI Bus, i.e. *First Come, First Served* (FCFS), or *Rotated*, which invokes scheduling of priorities of attached devices. Affects reliability rather than performance.

PCI Bus Clock

Determines whether the PCI bus clock is tied to the system clock or is independent, which may introduce delays because an asynchronous bus may sometimes force the CPU to wait when the PCI cycle starts late in a CPU cycle. On the other hand, performance may be slightly more consistent with *Synchronous*.

PCI IDE Bursting

This enables burst mode memory access to video memory via the PCI bus. No idea what it has to do with IDE.

PCICLK-to-ISA SYSCLK Divisor

Defines the ISA (AT) Clock speed as a fraction of the PCI bus speed. For 25MHz PCI buses, for example, use PCI/3.

Used By Legacy Device

Reserves IRQs (0-15) from the pool of those available to PnP devices. Including them means they can be assigned. Non-PnP (Legacy) devices should be excluded.

Use MultiProcessor Specification

For motherboards with lots of PCI slots, Specification 1.4 allows extended bus definition. It is needed for a secondary PCI bus to work without a bridge.

Write Allocate

Enables or disables a feature of the K6 or 6x86 that stores data lines written to a memory location not in cache into cache as well. This enhances performance by ensuring that the data is in cache if it is referenced before the cache line is reused for something else. The Write Allocate enablement bits are in different Model Specific Registers (MSRs) on the two CPUs, so the BIOS cannot set the bits if the wrong CPU is selected. You can also do this with shareware programs (**enwa.exe** or **msr.zip** for NT).

Extended CPU-PIIX4 PHLDA#

Adds one clock signal to the time the PHLDA# is active during the address phase at the beginning of a PCI read/write transaction, and following the address phase of a CPU LOCK cycle. You also need to enable *Passive Release* and *Delayed Transaction*.

Used MEM length

The memory area used by peripherals requiring high memory (could be upper memory). Choices are between 8, 16, 32 or 64K. Does not appear if no base address (below) is specified.

Used Mem Base Addr

The base address for memory specified above.

Close Empty DIMM/PCI Clk

Stops the clock in an empty DIMM or PCI slot to reduce EMI.

FWH (Firmware Hub) Protection

The BIOS is kept inside the hub so that viruses such as CIH cannot get to it. See also *Flash Write Protect*. This is set in conjunction with a jumper on the motherboard.

Flash Write Protect

This prevents interference with the BIOS by viruses such as CIH. You can still update DMI with the right setting here. Disable if you want to upgrade the BIOS.

Ultra DMA 66 IDE Controller

Enable or disable the onboard UltraDMA 66 controller.

Peripheral Setup

Mainly concerns all-in-one motherboards; the on board equipment is often not as good as other products, so you may want to disable some of them. *Onboard IDE*, for example, has been known to operate through the ISA interface rather than PCI.

Programming Option

Auto—the BIOS detects and sets up expansion cards and I/O ports automatically. On board I/O is dealt with last.

Configuration Mode

Determines whether onboard peripherals will be configured automatically or manually. Use *Auto* if you think PnP will work, but *Manual* is usually best, in which case use *Auto* first, then set them manually.

TxD, RxD Active

The setting of the TxD and RxD signals.

Use IR Pins

Concerns the setting of the TxD and RxD signals.

On Chip IDE Buffer (DOS/Windows)

See *IDE Buffer for DOS & Win*.

On Chip IDE Mode

Selects PIO Mode for your drive.

IDE 0 Master/Slave Mode, IDE 1 Master/Slave Mode

Sets independent timing modes for IDE devices on both channels, to stop the slowest interfering with the faster.

On Chip Local Bus IDE

Disable if you add another.

On-Chip Primary PCI IDE

Enables or disables onboard PCI IDE.

On-Chip Secondary PCI IDE

Enables or disables onboard PCI IDE. If you install an extra IDE interface as the second channel, see also below.

On-Chip Video Window Size

Selects the size of the window for the graphics display cache, 32 or 64 Mb.

2nd Channel IDE

If you install an extra IDE interface as the second channel, disable this to avoid a conflict with the onboard one.

IDE Second Channel Control

See above.

PCI IDE Card Present

Use if secondary IDE card installed.

Onboard Floppy Drive

Disable if you want to use a floppy controller on an expansion card.

Onboard FDC Controller

See above.

Onboard FDC Swap A: B:

For swapping drive assignments through the onboard floppy controller.

Onboard IDE

Enable/Disable. This often goes through the ISA interface.

Onboard Serial Port 1

(or 2). Sets IRQs and I/O addresses.

Onboard UART 1 / 2

See above.

Onboard UART 1 / 2 Mode

Modes selected apply to relevant serial port.

UART Mode Select

Defines what COM2 does, whether normal or IR.

Internal PCI/IDE

Enable or disable either channel on your motherboard.

UART 1 / 2 Duplex Mode

Appears in infrared port mode. Select the value required.

UART 2 Mode.

The operating mode for the second serial port, as this is the one most needing to be flexible:

Normal	RS232
Standard	RS232
IrDA 1.0	IR port to 1.0 specs
IrDA SIR	IrDA-compliant serial IR port
IrDA MIR	1 Mb/sec IR port
IrDA FIR	Fast IR standard
FIR	Fast IT standard
MIR 0.57M	0.57 Mb/sec IR port
MIR 1.15M	1.15 Mb/sec IR port
Sharp IR	4 Mb/sec data transmission
HPSIR	IrDA-compliant serial IR port, up to 115K bps
AskIR	Amplitude Shift Keyed IR port, up to 19.2K bps

UR2 Mode

See above.

Serial Port 2 Mode

See above.

First Serial Port

(or 2). Sets IRQs and I/O addresses.

Onboard Parallel Port

Enable/Disable – match the logical LPT port address and interrupt.

Onboard IDE Controller

Select the interface you want, or don't want.

Onboard PCI SCSI Chip

Enable/Disable.

Onboard Audio Chip

Enable/Disable.

Parallel Port Address

What I/O address is used.

IRQ Active State

Whether parallel/serial IRQs are active high or low.

WAVE2 DMA Select

The DMA Channel for the WAVE2 device.

WAVE2 IRQ Select

The interrupt for the WAVE2 device.

LPT Extended Mode

Parallel ports come in the following variations:

- *Standard Parallel Port (SPP)*
- *Enhanced Parallel Port (EPP)*
- *Extended Capability Port (ECP)*
- *EPP + ECP*

The SPP is unidirectional, as it was designed for printers, and only 5 of its wires are for input; bidirectional communications actually use printer status signals. SPP does not need interrupts, so they can be used elsewhere. EPP and ECP have more wires for input, so are bidirectional and do need interrupts. ECP defines register formats, allows RLL compression, is fast (over 1 Mb/sec) and buffered, and allows better communication between the device concerned and the PC – it's good for block transfers, and you can expect it to use DMA 3. EPP allows devices to be connected in a chain, so you could rig up a small network of two machines connected through their parallel ports. Printers and scanners work best with ECP. Try EPP with Zip drives.

ECP was developed by HP and Microsoft in 1997, in advance of the IEEE specification defining advanced parallel ports, so EPP is more compatible. Both have approximately the same performance, but ECP can run faster than the maximum data transfer rate. *ECP+EPP* (default) allows normal speed in two-way mode. SPP may be helpful if you have printing problems with Windows '95.

Parallel Port EPP Type

Sets one of two versions of EPP, 1.7 and 1.9. Try the latter first, but be prepared to use the former if you get problems. See also *LPT Extended Mode.*

Parallel Port Mode

Sets one of two versions of EPP, 1.7 and 1.9. Try the latter first, but be prepared to use the former if you get problems. See also *LPT Extended Mode.*

EPP Version

See above.

ECP DMA Select

Available only if you select ECP or ECP+EPP above. Channels 1 or 3 (default) are available.

ECP Mode DMA

As above.

Floppy DMA Burst Mode

Enabled is best for performance.

Serial Port 1 MIDI

Allows you to configure serial port 1 as a MIDI interface. Or not. MIDI is a specification from the music industry for controlling devices that emit music, which is probably why it stands for *Musical Instrument Digital Interface.*

USB Controller

Enabled or not. Disabled will free up an IRQ, but Windows 98 or Windows 95 B/C will require it, otherwise you will get instability (if you are using a USB device). You can share the IRQ, though.

USB Function

As above.

Assign IRQ For USB

As above.

USB Keyboard Support

Enables or disables support for a USB keyboard.

USB Keyboard Support Via

Whether the USB keyboard is supported via the operating system or the BIOS. Set the latter if you use DOS and don't have a driver.

USB Latency Time (PCI CLK)

The minimum time, in PCI clock cycles, the USB controller can retain ownership of the PCI bus.

Infrared Duplex

Whether communications are *Disabled*, *Half-Duplex* or *Full-Duplex* or *Simplex* or *Duplex*—Simplex means one-way only in either direction, Duplex means both ways at the same time.

Infra Red Duplex Type

See above.

IR Function Duplex

See above.

IR Duplex Mode

See above.

Duplex Select

See above.

UART2 Use Infrared

Allocates the onboard infrared feature to the second serial UART. The default is *Disabled*, which allows it to be used for COM2.

IRRX Mode Select

You will only see this if IrDA Mode 1.1 (Fast IR) is selected for UART2 mode. It depends on the type of transceiver module – one has a mode pin (IRMODE) and the other has a second receive data channel (IRRX3) – check your documentation.

NCR SCSI BIOS

Enables or disables the onboard NCR SCSI BIOS.

Onboard VGA Memory Size (iMb)

For allocating total VGA memory from shared memory. Choices are 1, 2 or 4 Mb.

Onboard VGA Memory Clock

Onboard Video speed. *Normal* is 50 MHz, *Fast* is 60 and *Fastest* is 66. Decrease this to match the monitor's frequency rate if your screen is unreadable.

Write Buffer Level

Select between 4 or 8 level write buffers for the PCI bridge.

Offboard PCI IDE Card

Whether an offboard PCI IDE controller is used, but you must also specify the slot, because it will not have a built-in configuration EPROM as required by PCI specification. The onboard IDE controller on the motherboard is automatically disabled. The settings are *Disabled*, *Auto, Slot1, Slot2, Slot3,* or *Slot4*. If *Auto* is selected, the AMI BIOS automatically determines the correct setting.

Audio DMA Select

Selects a DMA Channel for the audio.

Audio I/O Base Address

Selects a base I/O address for the audio.

Audio IRQ Select

Selects an IRQ for the audio.

USB Keyboard Support

Through the BIOS or Operating System.

Init Display First

Which VGA card, that is, PCI or AGP you want to be initialised first, for Windows 98 multi-monitor systems (you can use 2 of each, but you've probably got only one AGP card anyway).

Whatever combination you have, the PCI is treated as the default, which is probably the opposite of what you need, so you can change it here.

Init AGP Display First

See above - this makes the AGP display the primary one.

Onboard IR Function

Enabled or Disabled.

Joystick Function

For onboard game ports.

MPU-401 Configuration

Configures the MPU-401 interface.

MPU-401 I/O Base Address

Selects a base address for the MPU-401 interface.

Serial Port 1 / 2 Interrupt

Select between the default PC AT interrupt or none.

PWRON After PWR-Fail

When Off, the system remains on when the power supply comes back on again. Otherwise, it will either power up or go to the former status (*Former-Sts*).

COMn

Usually controls the configuration of one or two serial (COM) ports on the motherboard.

System Monitor Setup

Fan Speed

The speed of the fan connected to the headers listed here. The value assumes 2 pulses per revolution and should therefore be used as a relative figure.

Voltage Values

Shows the current values on the motherboard. +3.3v, +5v, +12v, -12v and –5v come from the ATX power supply. VTT (+1.5) is GTL Termination Voltage from the on-board regulator and VCCVID (CPU) is the CPU core voltage from the on-board switching power supply.

VCCVID(CPU) Voltage, VTT(+1.5V) Voltage

The current value of all significant voltages on the motherboard. VTT is the GT Termination voltage from the onboard regulator. VCCVID is the CPU core voltage from the power supply.

I/O Plane Voltage

When the CPU Power Plane is set to *Dual Voltage*, you can choose the I/O or external voltage. Otherwise, this setting will not be present.

Core Plane Voltage

When the CPU Power Plane is set to *Dual Voltage*, you can choose the Core voltage. Otherwise, this setting will not be present.

Plane Voltage

When the CPU Power Plane is set to *Single Voltage*, you can choose the voltage, which should be correct for your CPU. Otherwise, this setting will not be present.

LCD&CRT

Select the combinations of display you want to use, either or both.

Known Problems

Intel says that the DX/4 overdrive should not be used with BIOSes pre June '94. Microsoft say that 1987 is the cutoff date for running Windows successfully. ROM Autoscan appeared after Oct 27 1982. Award BIOS 4.5G prior to Nov 1995 can only accept dates between 1994-1999.

AMI BIOSes dated 7-25-94 and later and support drive translation, as do some versions of Award 4.0G, which implies various versions of the same BIOS! Revision 1.41a is the latest I have seen, but if yours is earlier than 12/13/1994, the address translation table is faulty, so for drives with more than 1024 cylinders, you must use *LBA* rather than *Large*. MR have supported it since early 1990.

General

ALR

- ❑ Possible Seagate hard drive problems (on early boards).

AMI

- ❑ **Pre 4-9-90** versions have compatibility problems with IDE and SCSI drives. According to AMI, this is because IDE drives don't stick to IDE standards, so they changed some of the read routines at this point (plus some other bits they won't talk about).

- ❑ **Pre 12-15-89** versions have problems with IDE and ESDI.

- ❑ **1987** version causes a reboot when accessing floppies with File Manager.

- **Pre 25/09/88** version did not fully support the 82072 floppy controller, and have trouble with MFM, RLL, ESDI and SCSI drives with OS/2.
- **1989** version causes intermittent hangs and crashes.
- **1991** version has some serial port problems.
- **Pre 09-25-88** versions have compatibility problems with SCSI/RLL/MFM drives. Keyboard BIOS must be revision F.
- **Keyboard revision** should be **K8** with AMI designed motherboards.
- **With Netware 3.1**, the user defined drive feature does not work because the parameters are kept in ROM address space and the pointers INT 41H (C:) and INT 46H (D:) are set accordingly; INT 41H points to F7FA:003D (if C: is present). INT 46H points to F7FA:004D (if D: is present). Novell doesn't work with these, but with them set as INT 41H- F000: 7FDD (basically same as F7FA:003D); INT 46H F000: 7FED (basically same as F7FA:004D). A program called **usernov.com** sets the pointers properly.
- **Versions 2.12, 2.15, 2.2 of Netware** will not accept a pointer to a drive parameter table below C800:0000. With drive type 47, data is copied into low DOS memory. If BIOS Shadow is enabled, the data will be copied back into Shadow (which is in the F000:0000 segment). To use type 47, *ROM BIOS Shadow* must be enabled.

  Not all chip sets and motherboards have this option (BIOS date should also be 4/9/90 or later). If Shadow is not available, the only other option is to have a custom drive table burned for the BIOS; *Upgrades Etc.* or *Washburn & Co.*
- **Windows 95** cannot detect an Adaptec 2940 SCSI controller with BIOS version 1.00.07.AF2. Upgrade to 1.00.09.AF2.

AST

- Premium/286 has many problems.
- Manhattan P/V may issue false thermal and voltage sensor warning after upgrading to 1.08.

Award

- Early versions have compatibility problems with IDE/SCSI drives. The 2nd decimal number refers to **OEM revisions**, so 3.12 is not necessarily better than 3.11.

- Versions **prior to 3.05** have floppy read errors.

- With **3.03**, switch to low speed occurs during floppy accesses to ensure greater reliability of data transfer, which Windows may not like. Disable speed switching (NSS) or floppy speed switching (NFS).

- BIOS Nos. **4.50, 4.50G, 4.50PG &4.51PG** when operating **Windows '95**; maybe only certain versions of the 4.50 BIOS have this bug.

- Some 486 motherboards (i.e. Pioneer) with Revisions A, B and C of OPTI memory chips and an AWARD BIOS have trouble with **himem.sys** and may return an error at bootup: Revision D should be OK.

```
Cannot enable A20 handler
```

  There is a special (OPTI) revision of Award BIOS 3.14 that corrects this problem with B and C, although Revision A may not allow A20 to work at all.

Compaq

- If an LTE 5000 is left on between 1159 and 1201 on certain dates, the date may change to the year 2019 or later. A fix for the flash BIOS can be downloaded from **www.compaq.com**, SoftPaq 2451, which upgrades the BIOS to version 5.20a.

DTK

- No IDE support prior to version 35.

- Windows Enhanced Mode might not run with version 35.

- CMOS setup utilities must be disabled with version 36.

IBM

- PS/2 35sx and 40sx, ValuePoint I, and some ValuePoint Si models—incorrectly handle more than 1024 cylinders by making drives with more appear to have relatively few cylinders.

MicroFirmware

- Early versions of BIOS upgrade P4HS00 (for the Packard Bell PB400 motherboard) do not properly handle the amounts of RAM cached by the external cache with certain configurations. Fixed in the P4HS00 upgrade.

- BIOS upgrades based on 4.03 code do not natively support drives larger than 2 Gb, because not enough bits in CMOS are used for the cylinder number.

Peak/DM

- Minimum safe version is 1.30. With 1.1, you may get UAEs or Internal Stack Overflow errors while Windows 3.0 is running in enhanced mode.

Phoenix

- Minimum safe version is 1989; 11/05/92 for OS/2. Many 4.03 and 4.04 BIOSes are limited to 3.2 Gb hard drives because of a bug in the size calculation, although this does vary between manufacturers.. In 4.03 and 4.05 versions, the date field will only allow a year value up to 2030.

3.06	No user-definable drive types, no support for 1.44 Mb floppies.
3.07	No user-definable drive types, support for 1.44 Mb floppies.
3.10	No user-definable drive types; minimum for 286 and Windows.
3.10D	User-definable drives 48-49.
1.00 ABIOS	Incorporates RLL geometries.

- Some Phoenix BIOSes report IRQ 7 differently and may cause Windows 95 not to recognize it properly, causing the startup wave file to sound continuously. Disable LPT1 or change the interrupt for the Windows Sound System.

Quadtel

- Minimum safe version is 3.05.

Tandon

- Keyboard failures with old versions.

Toshiba

- Must have version >4.2 for T3100/20.
- Must have version >1.7 T3100e.

Wyse

- You have to force 101-key keyboard selection in Setup.

Zenith

- ❑ Must have >2.4D for Turbosport 386.

Windows 95

The BIOS is normally only used for Plug and Play and Power Management, once '95 is running. If the system runs in safe mode, a BIOS problem is unlikely.

Award

These issues were introduced by OEMs and are the result of motherboard manufacturers' modifications. Problems include:

Can't turn off BIOS virus protection

Run **setup /ir**, create an emergency disk. Boot up on the emergency disk, run **sys c:**, remove the emergency disk, and reboot. You should now be booting Win95 off of the hard disk.

Motherboards affected have the following serial nos: 2A5L7F09 214X2002 2C403AB1 2A5L7F09 2C419S23

IDE Address Conflict with floppy disk controller

No news yet. Motherboards affected: 2A59CB09 2A5UNMZE

Plug and Play functionality misreported

Run **setup /P i**, which will turn off plug and play. To turn it back on after the BIOS has been upgraded, run **setup /P j**.

Motherboards affected: 2A5L7F09 2A5197000 2A51CJ3A 2A5L7F0HC 2A59CF54C

System Registry writing

Try above.

Power Management

Lockups with APM turned on, etc. Turn off power management at BIOS setup.

*System Instability with Intel Triton motherboards***.** Try setting all PIO IDE settings to Mode 2 (default is Auto).

Before ringing your motherboard manufacturer, try the following:

- ❑ Boot Dos/Windows 3.1.

- ❑ Run **scandisk /f**. *Fix any problems before proceeding*.
- ❑ Rename **config.sys** and **autoexec.bat**.
- ❑ Copy your Windows '95 CDROM to a subdirectory on the hard disk.
- ❑ Reboot with DOS only.
- ❑ Run **setup** from the hard disk. *Do not overwrite the old Windows directory*; you will have to reinstall all of your applications.
- ❑ Reboot under Windows 95.

If Windows '95 works, and all the devices under the device manager in the system icon are correct, and don't have yellow or red circles, you have finished. *Do not reload 16 bit legacy drivers unless Windows '95 did not recognize the device*. If so, the driver may not work and cause system instability.

If Windows '95 incorrectly identifies a device and is unstable or not working, you must replace the hardware. *Do not load the legacy driver*.

If you still have problems, reboot and use the F8 key to create a **bootlog.txt** file.

Neptune Chipset

There is an incompatibility problem between Intel's Neptune chipset and the Plug and Play system, which gives erratic operation and random shutdowns on early 90 MHz Pentium Micron Power Station systems.

Chipsets

BIOS Part Numbers and Chipsets

Award

Part Number	Chipset
ALIM6117	ALi M6117
2A5KBxxx	ALi 1449/61/51
2A4KCxxx	ALi 1439/45/31
2A4KDxxx	ALi 1487/89
2ARKDxxx	ALi 1489
2A5KE000	ALi 1511
2A5KFxxx	ALi 1521/23
2A4H2xxx	Contaq 82C596-9
2A498xxx	Intel Saturn II
2A499xxx	Intel Aries
2A597xxx	Intel Mercury
2A59Axxx	Intel Neptune ISA
2A59Cxxx	Intel Triton
2A59Fxxx	Intel Triton II (430 HX)
2A59Gxxx	Intel 82430VX PCI Set
2A59Ixxx	Intel 82430TX PCI Set
2A69Hxxx	Intel 82440FX PCI Set
2A69Kxxx	Intel 82440BX PCI Set
2B59Axxx	Intel Neptune EISA

Part Number	Chipset
2B69Dxxx	Intel Orion
2A5UIxxx	Opti 82C822/596/597
22A5UMxxx	Opti 82C822/546/547
2A5ULxxx	Opti 82C822/571/572
2A5UNxxx	Opti Viper 82C556/557/558
2C4UKxxx	Opti 802G
2C4I8xxx	SiS 471B/E
2A5IAxxx	SiS 501/02/03
2A4IBxxx	SiS 496/497
2A4X5xxx	UMC 8881/8886
2A5X7xxx	UMC 82C890
2A4L6xxx	VIA 496/406/505
2C4L2xxx	VIA 82C486A

Chipset Manufacturers

ACC Microelectronics

Chip	Function
82010	PC/AT 286/386 Systems
2000	Integrated peripheral controller
2100	System controller
2210	Data Bus Buffer
2220	Address Bus Buffer
82020	Hi-Speed 286/386 Chip Set
2000	Integrated peripheral controller
2120	Enhanced system controller
2210	Data Bus Buffer
2220	Address Bus Buffer
2300	Page Interleaved Memory Controller
2500	System Controller
2030	Single chip 286 System Controller
2035	Single chip 386SX System Controller
2036	486SLC/386SX/286 Single Chip AT Controller with write-back cache support
2036LV	486SLC/386SX Low Voltage Single Chip AT Controller
2046	486/386 Single Chip AT Controller
2046NT	486/386 Single Chip AT Controller with Master Mode Local Bus
2046LV	486/386 Low Voltage Single Chip AT Controller
2086	486/386 Super Chip
2168	486/386 Single Chip AT Controller
2168DT	486/386 Single Chip AT Controller with Master Mode Local Bus
3201	Floppy Disk Formatter/Controller for AT and XT

Chip	Function
3221SP	Data Processor, 100 PQFP
3221DP	Data Processor, 128 PQFP
3221EP	Data Processor, 144 PQFP
16C451	Multifunction I/O controller for AT and XT
16C452	Multifunction I/O controller for AT and XT
2020	Power Management Chip

ACER Laboratories Inc (ALI)

Acer Laboratories is a small part of Acer, usually making chipsets for Acer and AcerOpen boards. The **M1487/1489** chips are used in 486 systems, as is the **Finali**. Watch for slow cache controllers. The **Aladdin** chipsets (III, IV and V) are used in Pentium systems and are competitive with the 430VX/TX. The only real difference between the Aladdin V and the VIA MVP3 is that the V can only support 512K of cache. The **Genie** is for multiprocessing. If able to handle the Cyrix 6x86MX at 233 MHz, can run the bus at 75 MHz, keeping the peripherals at 33 MHz.

Chip	Function
M5105	Super I/O
M1207	Single Chip AT Controller with LIM 4 support
M1209	Single Chip 386sx PC/AT Controller
M1401/M1403	Dual Chip 386 Controller with cache control
M1385DX	High Performance cache controller for DX processors
M1385SX	cache controller for SX systems
A90	Notebook System Controller

Asustek

Chip	Function
A38202SX	Cache controller
A38403	Cache controller

Chips & Technologies

Chip	Function
82A235	Single Chip AT (SCAT)
82C836	Single Chip AT (SCAT SX)
84025	Data Buffer
84021	Bus/DRAM Controller
CS8221	Neat Chip Set
82C211	System Controller/Extended CMOS RAM Control Logic
82C212	I/O and memory decode
82C215	Parity Logic and Address & Data Bus Buffer
82C206	Integrated Peripheral Controller (high failure rate; no booting)

Chip	Function
CS8223	Leap Chip Set
82C421	CPU/Bus, Page/Interleave, EMS Controller and laptop support
82C242	Data/Address Buffers and Bus Conversion Logic
82C631	Data Buffer
82C636	Power Control Unit with Slow Refresh Control
82C206	Integrated Peripheral Controller
82C601	Multifunction Controller, 1 parallel and 2 serial.
82C455	VGA compatible flat panel controller
82C765	Floppy Disk Controller
CS8230	Chip Set
82C201	System Controller, Clock Generation, Reset/Ready Synchronisation, Command and Control Signal Generation, Conversion Logic, Wait State Control, DMA and Refresh Logic, Coprocessor Control, NMI and Error Logic.
82C202	RAM/ROM Decoder, I/O Controller, Parity Error Detection Logic, I/O Decode Logic
82C303	High Address Bus Buffer and Port B Chip, High Address Bus Buffer for A17-A23, Memory and I/O Read/Write Signal Buffer, Port B Status (61h)
82C404	Low Address Bus Buffer and Refresh Counter, Provides Drive and Buffering for A1-A16, Provides Drive for MA0-MA7, Provides Refresh Counter SA0-SA7
82A205	Data Bus Buffer/Parity Generator Chip, provides Data Bus Buffer and Driver for D0-D15 >SD0-SD15 >MD0-MD15, ENHLB DIRHLB-Byte Conversion Logic, Parity Gen/Check
CS8233	PEAK 386/AT Chip Set
82C311	CPU, cache, DRAM Controller
82C316	Peripheral Controller
82C315	Bus Controller
82C452	Super VGA Controller
82C601	Single Chip Peripheral Controller
82C765	Single Chip Floppy Disk Controller
CS82235	NEAT Chip Set
82C100	System Controller
82C202	Memory Controller
82C205	Data Buffer
82A203	Address Buffer
82A204	Address Buffer
82C322	Memory Controller
82C325	Data Buffer
82C223	DMA Controller
82C321	CPU Controller (MCA)
82C302	System Controller
82A305	Data Buffer
82A303	Address Buffer
82A304	Address Buffer
82C307	Cache/DRAM Controller

Contaq

The 82C599 is used in 486s with VL Buses.

Elite

Chip	Function
88C311	CPU/Cache/DRAM Controller
88C312	Data Controller

Faraday (WD)

Chip	Function
FE 3600B	Chip Set
FE 3001	System Controller
FE 3010	Peripheral Controller
FE 3021	Address Bus and Memory Control Logic
FE 3031	Parity and Data Bus Controller

G-2 Inc/Headland

Chip	Function
GC 102	Data/Address Buffer
GC 131	Peripheral Controller
GC 132	CPU/Memory Controller
GC 133	Bus Controller

Headland

Chip	Function
HT 10	Super XT Controller
HT 11/12	Super AT Controller
HT 15	Single Chip Controller
HT 216	VGA Controller
HT 21/22	Single Chip Controller
HT 101SX	Peripheral Controller
HT 102	Data Buffer
HT 113	Memory Manager
HT 131	Peripheral Controller
HT 132	CPU/Memory Controller
HT 133	Bus Controller

Intel

www.intel.com

The **Aries** chipset is for 486s, typically used where VL Bus and PCI live together (the VL Bus is attached to a PCI-CPU bridge). Watch for problems with zero wait state operation.

The **Saturn** is for the 486, up to DX/4 and maybe the P24T. With earlier versions, any problems are dealt with by turning the high performance features off! ZX identifies the Saturn II. The **Ariel** is for notebooks, similar to Triton, with advanced power management.

The **Mercury** is for 60/66 MHz Pentiums (P5s – socket 4), and the **Neptune** for 75/90/99 MHz ones (Socket 5).

The **T I/II/III** (Triton is apparently a trademark of some company in Germany) chipsets are for Pentiums. They support bus mastering IDE, with software written by Triones (check your local BBS). Parity is not checked, and neither is the cache interleaved.

The **T I** (430 FX) has only one bus, or timing register set, between two IDE channels, so only one device may be active at a time, even on separate channels. The data bus is also shared with ISA functions, so if you have your serial or parallel ports on the ISA bus (as one does), COM or LPT activity (or any on the ISA bus) will be multiplexed with the two ATA interfaces on the same set of signals. The Triton chipset also derives timing from the PCI clock, for a minimum (fastest) cycle of 5 clocks. The maximum transfer rates achievable, in terms of Mb/sec, are:

PCI Clock	Transfer Rate
25 MHz	10 Mb/s
30 MHz	12 MB/S
33 MHz	13.3 MB/S

You might get data corruption when the Triton is configured to run Mode 4 (16.7 Mb/s) drives over approximately 11 Mb/s. About 10% slower than the HX/VX. **T II** (430 HX) is apparently a redesign of the **Neptune** chipset, and **TIII** (430 VX) supports faster cache timing and SDRAM. The HX chipset has faster memory timings than the FX, and can handle non-Intel processors, but watch out for cheaper motherboards that cut corners with degraded Tag RAM chips and therefore restrict maximum memory access. The VX is between the FX and HX in terms of performance, as it has a lack of CPU-PCI buffers and is slower to access memory.

Intel's chipsets are now numbered; the Pentium/MMX uses the **430FX/VX/HX/MX** and **TX**, which is a 2-chip set building on VX/HX, adding support for ACPI and Ultra DMA, and eventually replacing them, although it appears to have timing problems with SDRAM that detract somewhat from its promised performance, though it is stable at higher speeds. Performance-wise, TX and HX chipsets are about the same, as the HX has better buffers. The TX and VX can only cache 64 Mb RAM, and the **TX** runs at 3.3 volts.

The **Mars** is for the P6, similar to T I/II, but supports parity checking. The **Natoma** (440FX/KX/GX) is also for the P6, competing with Orion (450GX), which supports more processors (4, not 2). L2 cacheing is taken care of by the CPU, helping with one bottleneck, but there is no support for SDRAM.

The **440FX** is the **Natoma** PCIset for the Pentium Pro (Socket 8 or Slot 1) and Pentium II (Slot 1), supporting single and dual processors, ECC, parity, EDO, and FPM RAM up to 1 Gb. Motherboards can have up to eight banks of RAM shared among both CPUs.

The **440 LX** (for Pentium II) supports AGP, SDRAM, PC/97 and Ultra DMA, being a combination of the best of the 430 TX and 440 FX in one chip. The **BX** allows 100 MHz memory bus speeds, and the **440EX** is for the Celeron, as is the 810. The 440GX supports the Slot 2 Xeon and up to 2 Gb SDRAM, while the 440NX handles up to four Xeons and 8 Gb EDO/DRAM.

The BX chipset uses a reference signal of 14.318MHz to generate seven others, such as Super I/O (24 MHz), USB (48 MHz), system clock, CPU (66 or 100 MHz), AGP (2/3 CPU), PCI (1/3 CPU), and SDRAM (same as CPU). Some are fixed (Super I/O, USB, and system clock), while others vary with the CPU (FSB) speed. The SDRAM and AGP clocks aren't produced directly by the CK100, but are a copy of the FSB clock sent to the 82443 BX IC. In addition, the SDRAM clock sometimes goes through a clock buffer before being split up and sent to the various DIMM banks.

The **820** is supposed to cope with RAMBUS, but propagation problems make it unable to cope with more than 2 modules, at least from mixed suppliers. The **810** has deficiencies as well, which makes the BX still a good choice. It consists of a Graphics and Memory Controller Hub (GMCH) Host Bridge and an I/O Controller Hub (ICH) Bridge – in fact, there are two versions of each, the combinations being used for cost-effectiveness (it says here). The basic is the 810L, with the 82810 GMCH0 and 82801AB ICH0, but you can also get the standard 810 with the 82801AA ICH, that supports Ultra ATA/66, and the 810 DC-100 which includes 4 Mb of 32-bit 100 MHz SDRAM display cache. In other words, the 810 and 810e have integrated AGP. The **840** is intended for high-end workstations and servers, and can handle up to 8 Gb of memory.

	430VX	430TX	430HX	430FX	Neptune	440FX	Orion
Max RAM	128Mb	256Mb	512Mb	128Mb	512Mb	1Gb	1Gb
Max cacheable RAM	64Mb	64Mb	512Mb	64Mb	512Mb	1Gb	1Gb
Max SIMM slots	4	6	8	6	8	8	8
Max CPUs	1	1	2	1	2	6	4
ECC DRAM support	No	No	Yes	No	Parity	Yes	Yes
SDRAM support	Yes	Yes	No	No	No	No	No
Disk Support	PIIX3	PIIX4	PIIX3	PIIX2	?	PIIX3	PIIX3

Chip	Function
82093AA	I/O, for 2-processor designs only.
82371SB	PCI/ISA IDE accelerator
82442FX	Data bus accelerator
82441FX	PCI and memory controller
82371SB	IDE controller (T III)
82439HX	System Controller (T II)
82371SB	IDE controller (T II)
82437FX	System controller (T I/III)
82438FX	Data Path (T I/III)
82371FB	PCI ISA IDE accelerator (T I)
83434NX	PCI/cache/memory controller (Neptune)

Chip	Function
83433NX	Local bus extension devices (Neptune)
823781B-G	System I/O bridge (Neptune)
823783B	System I/O bridge (Neptune)
82351	Local I/O EISA Controller
82352	Address Buffer
82353	Data Bus Controller
82357	Integrated System Peripheral Controller
82358	EISA Bus Controller
82359	DRAM Controller
82385	Cache Controller

Opti

www.opti.com

The **Viper** supports IDE busmastering and Type F DMA in Pentium systems, plus power management. The Viper UMA also supports BEDO and UMA. An N suffix means *Notebook*. The **OPTi Discovery** is a Pentium Pro chipset.

Chip	Function
82C822	PCI bridge
82C556	Data Buffer controller
82C206	Integrated Peripheral Controller
82C281	Memory Controller
82C283	Page Interleave Memory Controller
82C291	Memory Controller
82C381	System and Cache Memory Controller
82C382	Direct Mapped Page Interleaved Memory Controller
82C391	System Controller
82C392	Data Buffer Controller
82C491	486 System Controller with Write-Back cache controller
82C492	Data Buffer
82C493	System Controller
82C498	CPU/Cache/DRAM and System Controller.

PC Chips

Allegedly responsible for the fake cache chip eisode. Related to Hsing Tech, who make motherboards.

Samsung

Chip	Function
KS82C531	Cache and RAM controller

SIS (Silicon Integrated Systems)

The 486 chipset uses the 85C496 and 85C497. Watch for unstable caches and slow PCI performance, as the PCI bus is bridged to the VL-Bus. The **5570X/5571X** is for Pentium systems. If able to handle the Cyrix 6x86MX at 233 MHz, can run the bus at 75 MHz, keeping the peripherals at 33 MHz. Not much power saving. The **SiS 5602** is a Pentium II chipset supporting PC97. SiS chipsets are often the ones with a shared memory architecture, which allows on-board video to access main memory (up to 4 Mb of RAM can be shared, in increments of 0.5 Mb). Their 5597 chipset is PC97 compliant and sports an integrated video adapter.

Suntac

Japan

Chip	Function
ST62C203	System Controller
ST62C241	Bus/Memory Controller
ST62C251	Bus/Memory Controller
ST62303	System Controller
286	
ST62C201	System Bus Controller
ST62C202	Memory Controller
ST62C008	Integrated Peripheral Controller
ST62C010	Address Bus Controller
ST62BC001	System Controller
ST62BC002	High Address Buffer
ST62BC003	Low Address Buffer
ST62BC004	Data Buffer
ST62C005	I/O Control/DMA Page Register
ST62C006	Integrated Peripheral Controller
286/386SX	
GS62C101	System/Data Bus/Timer and Interrupt Controller
GS62C102	Memory/DMA and I/O Controller

Symphony Labs

The **Rossini** chipset is for Pentium systems, a low-cost alternative to the Triton.

Chip	Function
SL82C551	Cache/memory controller
SL82C555	System I/O controller
SL82C522	Data path controller
SL82C361	System Controller
SL82C362	Bus Controller
SL82C365	Cache Controller

Chip	Function
SL82C461	System Controller
SL82C465	Cache Controller
SL82C471	Cache/DRAM Controller
SL82C472	EISA Bus Controller
SL82C473	DRAM Controller

Texas Instruments

Chip	Function
83441	Data Path Unit
83442	Memory Control Unit
TACT83443	AT Bus Interface Unit

UMC (United Microelectronics)

8881/8886 chips are used in 486s.

VIA

www.fic.com.tw

VIA is probably the third-largest chipset maker, Taiwanese for manufacturing, with R&D and support engineers in the USA.

Early versions with the VT82C505 are not terribly stable. The **Apollo** is used in Pentium systems, and the **Apollo Pro** with the P6. If able to handle the Cyrix 6x86MX at 233 MHz, can run the bus at 75 MHz, keeping the peripherals at 33 MHz (VPX/97). The VP2/97 is a direct competitior for the 430TX and is licensed by AMD as the AMD 640, and is synchronous – arguably the best Socket 7 solution. The VP3 supports AGP with double CPU-DRAM write buffers.

The **MVP3**, for example, has the following features: 100 MHz memory bus speed (with the proper PCI bus speed), SDRAM, DDR SDRAM, ECC, parity, and EDO RAM support, up to 2048 KB external cache, up to 1 GB of system RAM (512 MB cacheable), ATA-33 support, USB, and ACPI.

The **VPX/97** has many features of the VP2/97, plus allowing an asynchronous PCI bus. The **VP3** was the first chipset to support AGP.

The **Apollo 133** and **133A** for Pentium III both support 133 FSB speeds, the latter supporting AGP 4x.

Chip	Function
VT82C685	Super I/O controller
VI82C695	System/PCI controller

Chip	Function
VT82C575M	
VT82C576M	
VT82C577M	
VT82C416	
82C486	cache/memory controller + VLB to ISA bridge
82C482	VLB to ISA bridge
82C483	DRAM controller
VT82C505	PCI to VLB bridge

VLSI

The **Wild Cat** chipset is used in Pentiums and is allegedly in between the Neptune and Triton in terms of performance.

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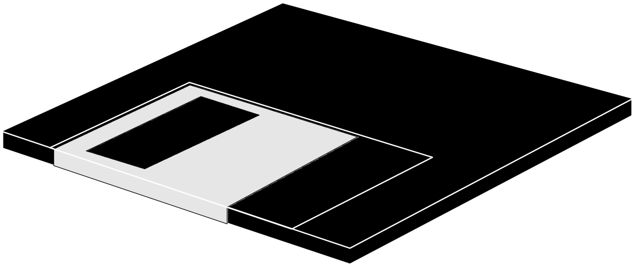
Floppy Drives

These are like a cross between a VCR and a record player, in that they record and play back information on a plastic medium covered with a magnetic substance, but the disk is flat and round, so the recording head goes straight to a particular track, which gives you speed, saving you sitting around for hours and hours while the tape winds through looking for what you want, although this is exactly what you had to do with the first IBM PC.

The first computers used 8" disks, which got smaller with new technology, through 5¼" into 3½" ones (shown below). Although they are protected by a hard plastic case, they are *not* hard disks—there's more about those shortly. Disadvantages of floppy disks are that they are literally floppy, and easily damaged, with a large *access hole* in the outer casing that the recording head needs to peek through to get to the disk surface—a prime candidate for finger marks and coffee. The 3½" variety, shown below, is now used most often, and has this hole covered with a metal flap, but you still need to be careful. *Do not*, under any circumstances, take any floppy recording surface out of its protective cover.



The heads are in constant contact with the Mylar surface, which is why they need cleaning once in a while, because they pick up bits of the magnetic coating. They are moved by a stepper motor called a *head actuator*, which is told what to do by the disk controller working under the operating system – a certain voltage is issued to move the head, which hopefully will move to the same position every time, which didn't always happen with early hard disks.

Outside of each head is a *tunnel erase head*, which erases stray magnetic bits either side of the track to make the recorded data stand out more clearly. This stems from problems that 360K disks had when being written to in 1.2 Mb drives, where the head is thinner than the track and only writes on the centre of it. When the disk is read again in a 360K drive, the machine gets the old and new data to play with.

Floppies rotate at 300 rpm, except for 1.2 Mb drives, which spin at 360 rpm. Originally, they were belt driven and had a stroboscopic thingy on the flywheel underneath that you could use in combination with an adjustment screw and the cycles-per-second from the mains to tighten up the tolerances. Nowadays, they have direct drive with automatic torque compensation to provide greater or less force when needed. Also, on earlier drives, you had to make sure terminating resistors were installed, depending on the drive's position in the chain (all buses need terminators at the end), but now they are built in.

Because they spin at constant speed, the outside tracks are longer than those on the inside. Macintosh floppies can store up to 2 Mb because they use variable spinning speeds to cater for the differences – as the head moves to the outside, the disk speeds up. they also use *Group Code Recording* (GCR) which removes excess zeros from the data stream so more can be packed into a smaller space. This system was originally used by the Victor/Sirius 9000 which, in the opinion of many people, was a way better machine than the IBM PC ever was, actually launched two weeks previously (it had 1.2 Mb floppies, more base memory, mappable keyboard, VGA-standard graphics……..if Chuck Peddle had been able to get better market penetration we might all be Victor-compatible now).

Floppies use the SA 400 interface (SA stands for *Shugart Associates*).

There is a notch on the side of 5¼" disks and a square hole in the top corner on 3½" ones for *write protection* so you don't accidentally record over what's on there already (video cassettes have a similar system). The other hole on the 3½" disk, if there is one, is for a light to shine through to identify it as *High Density* or not, just like chrome tapes use a hole in the casing to operate a switch and identify themselves to a tape recorder. On 2.8 Mb drives, this hole is in a slightly different position, so the machines don't get confused. DMF (*Distributed Media Format*, from Microsoft) disks don't need a light because they just use more sectors per track (21 rather than 18). As with audio tapes, stronger signals are needed to record information properly - DD 5.25" disks do this at 300 oersteds, and HD ones at 600, as do 720 Mb (DD) 3.5" disks. 1.4 Mb floppies use 720 oersteds, while 2.8 Mb ones use 750. DD 5.25" disks also have a reinforcing hub ring – HD ones don't. The latter also cram in 96 tracks per inch, twice the capacity of DD.

The low- and high-level formats are both done at the same time on a floppy, whereas they are separate processes on a hard drive.

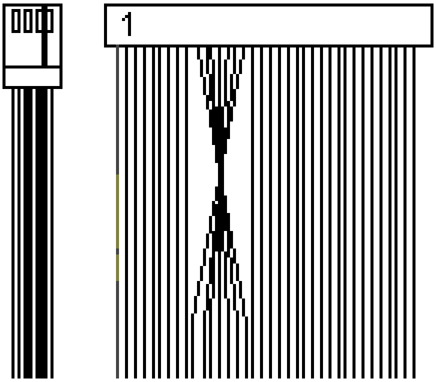
Disk Density

There are two types of floppy disk, whatever size you have. Normal ones will be labelled as DD, meaning *Double Density*, and high capacity ones as HD, or *High Density*. The very first diskettes were *Single Density*, but Double Density replaced them. HD disks are now normal, and are to DD disks what Chrome audio tape is to normal tape; they require a higher electrical current to record information, so it doesn't do to mix them up between disk drives, because the results will not be perfect.

Before disks can be recorded on, they must be *formatted* (sometimes called *initialisation*). When formatting, dummy information is placed on the disk in the right places, which is subsequently overwritten by any work you do, so when you format a disk you *completely erase what's there already*.

Data is stored on disks in separate *files;* whether it's program instructions or ordinary data; the space taken up by a particular set of computer code is still known as a file, regardless of the size, as long as it can be separately identified from other files (more about how to use files in the *DOS* chapter).

The power connector for the 3½" (1.44 Mb) floppy is smaller than the others; its "teeth" should be up as you connect it to the drive. The 5¼" floppy drive uses the same power connector as any other device.



Connect the floppy drive to the motherboard or I/O controller with the wide 34-pin data cable. Pin 1 (where the coloured stripe is) mostly goes towards the power connector (except for Panasonics). Floppies don't need to be switched as Master or Slave, as their relationship is determined by the twist at one end of the cable (they do have switches, so if you use a cable without a twist you can still set them up correctly as 0 or 1, but, by convention, floppies are all switched as the second drive (i.e. 1), and the twisted cable sorts them out). The connection that has the twist goes on to the first drive, knowsn as A:.

Pin 34 on the cable is the *disk change line*, which lets the system know when the diskette has been changed. A pulse is sent to the controller that changes once on insertion and once on ejection. If the disk doesn’t change, the computer uses the information it stored previously in memory and doesn’t have to access it again. F5 in Windows forces a refresh.

Tape Streamers

These are nothing more nor less than tape recorders that record the contents of your hard disk for backup purposes, so the tape cartridge does a similar job to a video cassette. In theory, if your hard disk becomes inoperative, you can restore the contents with the least inconvenience by just replaying the tape to the new one.

This must be done regularly to be effective, and is a considerable investment in some companies. When testing, bear in mind that only rarely do people need complete restorations; more typically, they need a single file that accidentally got deleted. Tapes are cheap, and can be stored away from the office. Having several redundant hard drives is all very well, but if someone steals the machine, or the office burns down you've still lost all your data.

Make a backup

A *full backup* means what it says – everything on your hard disk. An *incremental backup* only includes files that have been modified or created since the last time you did it (the computer knows automatically which ones they are, with the *archive bit*). This means you can add to the data already on a tape, rather than overwriting it, and reduce the amount of tapes you need.

There's no real point, aside from convenience, in backing up something that doesn't change all that much, like program files, which are only copied into memory as and when required, and not altered; if you make a note of your directory structure, you can always reinstall programs from their original disks, even if you have to buy the computer and software all over again (the need to backup doesn't always arise from system failures—your machine could get stolen).

Your data, however, is a different story, and almost impossible to replace by any other means than restoring a backed up copy or doing it all over again. If you have to allocate priorities, the data must come first, *including system configuration files*, such as the Registry in Windows '95 (don't restore an old Registry by mistake – it might refer to different devices and freeze the machine, or have a different setup entirely. Only restore a Registry if the machine loses it). Several elements have to be accounted for in a backup strategy:

- How vital your data is to your business; that is whether you can afford to lose a day's, or even a week's work.
- The relative cost of media against the value of the above (insignificant, usually).
- The time taken to back up

These are decisions that only you have control over, so the purpose of this bit is to suggest backup methods that will protect your data in a realistic manner. We *cannot be held responsible for failure of any backup device, or procedure described within these pages*. The more you backup, the more security you will get, but at the expense of the time taken, and people's non-use of files when it is taking place.

In practice, the most convenient timescale is once a day, preferably when the office is unattended, so that no files are open or otherwise being used (say, 2 in the morning). Of course, this presupposes that all the data fits on to one item of media, otherwise you'll have to be there to change it. Longer than one day risks data unnecessarily (what if the system goes down just before your weekly backup?), and a shorter period is often inconvenient to people using the system.

Don't use only one media set over and over. Aside from wear and tear, one day your data may get corrupted as you save it and you then proceed to overwrite the good backups.

Always use several sets of media (properly labelled!) in rotation and check what you've got on them after backing up, by enabling the *compare* facility, which ensures that what you've got on the tape is the same as the original copy and, more importantly, *that the tape can be read from again*. The more sets the better, as this lengthens the time available during which the need for restoration can be detected.

One suggestion is to use 10 tapes and label them Mon, Tues, Wed, Thu, Fri1, Fri2, Fri3, Month1, Month2 and Month3. Use the Mon-Fri1 tapes for the first week, and for the second week, but use Fri2 at the end instead. Similarly, for week three, use Fri3. On the fourth week, use Month1 on the Friday, and continue through the next two months using Month2 and Month3 in their respective places.

In this case, you will have a full backup for every day of the last week, full weekly backups for the last month, and a full monthly backup for the last three months, for the minimum number of tapes.

Tape drives can be connected to the floppy cable, sometimes shared as B, or attached to a SCSI bus. The QIC (*Quarter Inch Cartridge*) is still popular, but so is DAT (*Digital Audio Tape*), if a little more expensive. Be aware that manufacturers' warranties require you to clean your tape heads and that professional musicians only use DAT tapes for about three playing hours, so that should tell you something about how often you should change them.

Since different sections of the tape are used, that is, the tape head moves up and down to make extra tracks, positioning information is kept with the data, which explains why some tapes don't work in drives that may be a little misaligned, and that formatting is a complicated process.

Fixed Disk Parameters

Acer v1.00

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10.1	306	4	17	128	305
2	20.4	615	4	17	300	615
3	30.6	615	6	17	300	615
4	62.4	940	8	17	512	940
5	46.8	940	6	17	512	940
6	20.0	615	4	17	-1	615
7	30.6	462	8	17	256	511
8	30.4	733	5	17	-1	733
9	112.0	900	15	17	-1	901
10	20.4	820	3	17	-1	820
11	35.4	855	5	17	-1	855
12	49.6	855	7	17	-1	855
13	20.3	306	8	17	128	319
14	65.0	733	7	26	-1	733
16	20.3	612	4	17	0	663
17	40.5	977	5	17	300	977
18	56.7	977	7	17	-1	977
19	59.5	1024	7	17	512	1023
20	31	733	5	17	300	732
21	44	733	7	17	732	732
22	31	733	5	17	300	733
23	10	306	4	17	0	306
24	20	612	4	17	305	663
25	10	306	4	17	-1	340
26	20	612	4	17	-1	670
27	42	698	7	17	300	732
28	42	976	5	17	488	977
29	10	306	4	17	0	340
30	20	611	4	17	306	663
31	44	732	7	17	300	732
32	44	1023	5	17	-1	1023
38	42	981	5	17	-1	981
39	85	981	10	17	-1	981
40	121	761	8	39	-1	761
41	42	980	5	17	-1	980
42	112	832	8	33	-1	832
43	159	683	12	38	-1	683
44	159	512	16	38	-1	513
45	104	776	8	33	-1	776
46	212	683	16	38	-1	683
47	84.0	832	6	33	-1	832

ALR FlexCache Z 33 MHz

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10.1	306	4	17	128	305
2	20.4	615	4	17	300	615
3	30.6	615	6	17	300	615
4	62.4	940	8	17	512	940

Type	Mb	Cyls	Hds	Secs	Prec	LZ
5	46.8	940	6	17	512	940
6	20.0	615	4	17	-1	615
7	30.6	462	8	17	256	511
8	30.4	733	5	17	-1	733
9	112.0	900	15	17	-1	901
10	20.4	820	3	17	-1	820
11	35.4	855	5	17	-1	855
12	49.6	855	7	17	-1	855
13	20.3	306	8	17	128	319
14	65.0	733	7	26	-1	733
16	20.3	612	4	17	0	663
17	40.5	977	5	17	300	977
18	56.7	977	7	17	-1	977
19	59.5	1024	7	17	512	1023
20	136.6	823	10	34	-1	823
21	42.5	733	7	17	300	732
22	61.0	971	5	26	-1	971
23	40.0	820	6	17	-1	820
24	119	1024	7	34	-1	1024
25	20.4	615	4	17	0	615
26	34.0	1024	4	17	-1	1023
28	68.0	1024	8	17	-1	1023
29	31.2	615	4	26	612	615
30	103.0	1160	7	26	-1	904
31	41.0	989	5	17	128	989
32	127.0	1020	15	17	-1	1024
33	76.0	1024	9	17	-1	1024
34	144.3	966	9	34	-1	966
35	128.2	966	8	34	-1	966
36	42.5	1024	5	17	512	1024
37	65.0	1024	5	26	-1	1024
38	300.7	611	16	63	-1	612
39	20.0	615	4	17	128	664
40	40.8	615	8	17	128	664
41	114.1	917	15	17	-1	918
42	127.3	1023	15	17	-1	1024
43	68.3	823	10	17	512	823
44	40.0	820	6	17	-1	820
45	68.0	1024	8	17	-1	1024
46	91.0	1024	7	26	-1	1024
47	141.0	288	16	63	-1	1224

ALR FlexCache 25386/dt

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	20	615	4	17	300	615
3	30	615	6	17	300	615
4	62	940	8	17	512	940
5	620	1630	15	52	-1	1630
6	20	615	4	17	-1	615
7	331	1630	8	17	-1	1630
8	30	733	5	17	-1	733
9	112	900	15	17	-1	901
10	20	820	3	17	-1	820
11	35	855	5	17	-1	855
12	49	855	7	17	-1	855
13	120	953	7	34	-1	953
14	65	733	7	26	-1	733
16	80	953	5	34	-1	953
17	40.5	977	5	17	300	977
18	56	977	7	17	-1	977
19	59	1024	7	17	512	1023
20	136	823	10	34	-1	823
21	42	733	7	17	300	732
22	61	971	5	26	-1	971
23	40	820	6	17	-1	820
24	119	1024	7	34	-1	1024
25	120	1022	7	34	-1	1024
26	34	1024	4	17	-1	1023
27	42	1024	5	17	-1	1023
28	68	1024	8	17	-1	1023
29	31	615	4	26	612	615
30	103	1160	7	26	-1	904
31	41	989	5	17	128	989
32	127	1020	15	17	-1	1024
33	76	1024	9	17	-1	1024
34	144	966	9	34	-1	966
35	504	1024	16	63	-1	1630
36	42	1024	5	17	512	1024
37	65	1024	5	26	-1	1024
38	300	611	16	63	-1	612
39	330	654	16	63	-1	1630
40	330	642	16	63	-1	1778
41	114	917	15	17	-1	918
42	127	1023	15	17	-1	1024
43	1768	823	1	23	05	128
44	40	820	6	17	-1	820
45	68	1024	8	17	-1	1024
46	91	1024	7	26	-1	1024
47	141.0	288	16	63	-1	1224

AMI

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1		306	4	17	128	305
2		615	4	17	300	615
3		615	6	17	300	615
4		940	8	17	512	940
5		940	6	17	512	940
6		615	4	17		615
7		462	8	17	256	511
8		733	5	17		733
9		900	15	17		901
10		820	3	17		820
11		855	5	17		855
12		855	7	17		855
13		306	8	17	128	319
14		733	7	17		733
16		612	4	17	0	663
17		977	5	17	300	977
18		977	7	17		977
19		1024	7	17	512	1023
20		733	5	17	300	732
21		733	7	17	300	732
22		733	5	17	300	733
23		306	4	17	0	336
24		925	7	17	0	925
25		925	9	17		925
26		754	7	17		754
27		754	11	17		754
28		699	7	17	256	699
29		823	10	17		823
30		918	7	17		918
31		1024	11	17		1024
32		1024	15	17		1024
33		1024	5	17		1024
34		612	2	17	128	612
35		1024	9	17		1024
36		1024	8	17	512	1024
37		615	8	17	128	615
38		987	3	17		987
39		987	7	17		987
40		820	6	17		820
41		977	5	17		977
42		981	5	17		981
43		830	7	17	512	830
44		830	10	17		830
45		917	15	17		918
46		1224		17		1223

Amstrad 2286 v1.10/1.11*

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	21	615	4	17	300	615
3	32	615	6	17	300	615
4	65	940	8	17	512	940
5	49	940	6	17	512	940
6	21	615	4	17		615
7	32	462	8	17	256	511
8	31	733	5	17		733
9	117	900	15	17		901
10	21	820	3	17		820
11	37	855	5	17		855
12	52	855	7	17		855
13	21	306	8	17	128	319
14	44	733	7	17		733
16	21	612	4	17	0	663
17	42	977	5	17	300	977
18	59	977	7	17		977
19	62	1024	7	17	512	1023
20	31	733	5	17	300	732
21	44	733	7	17	300	732
22	31	733	5	17	300	733
23	10	306	4	17	0	336
25	21	615	4	17	0	615
26	35	1024	4	17	-1	1024
27	44	1024	5	17	-1	1024
28	71	1024	8	17	-1	1024
29	35	512	8	17	256	512
30	10	615	2	17	615	615
31	43	989	5	17	0	989
32	133	1020/4*	15	17	-1	1024
35	80	1024	9	17	1024	1024
36	44	1024	5	17	512	1024
37	72	830	10	17	-1	830
38	71	823	10	17	256	824
39	21	615	4	17	128	664
40	17	615	8	17	128	664
41	119	917	5	17	-1	918
42	133	1023	15	17	-1	1024
43	71	823	10	17	512	823
44	42	820	6	17	-1	820
45	41	589	8	17	97	619
46	72	925	9	17	-1	925
47	42	699	7	17	256	925

AST

Type	Mb	Cyls	Hds	Secs	Prec
1	615	4	17	300	615
2	615	6	17	300	615
3	940	8	17	512	940
4	940	6	17	512	940
5	615	4	17	N/A	615
6	462	8	17	256	511
7	733	5	17	N/A	733
8	900	15	17	N/A	901
9	1023	10	17	ALL	1024
10	968	14	17	ALL	969
11	1023	14	17	N/A	1024
12	968	16	17	ALL	969
13	733	7	17	N/A	733
14	0	0	0	0	0
15	612	4	17	ALL	663
16	977	5	17	300	977
17	1223	14	17	N/A	1224
18	1024	7	17	512	1024
19	733	5	17	300	733
20	733	7	17	300	733
21	782	4	27	N/A	782
22	805	4	26	N/A	805
23	1053	3	28	N/A	1053
24	1053	7	28	N/A	1053
25	968	7	34	ALL	969
26	1023	7	34	N/A	1024
27	1223	7	34	N/A	1224
28	1223	11	34	N/A	1224
29	1223	13	34	N/A	1224
30	989	5	17	ALL	989
31	969	9	34	ALL	969
32	1023	5	34	ALL	1024
33	1223	15	34	N/A	1224
34	1024	9	17	1024	1024
35	745	4	28	N/A	745
36	824	8	33	N/A	824
37	823	10	17	256	824
38	1631	15	48	N/A	1632
39	615	8	17	128	664
40	917	15	17	N/A	918
41	1023	15	17	N/A	1024
42	776	8	33	N/A	776
43	820	6	17	N/A	820
44	1024	8	17	N/A	1024
45	925	9	17	N/A	925
46	1024	5	17	N/A	1024

Award 1.10/3.0B

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	21	615	4	17	300	615
3	32	615	6	17	300	615
4	65	940	8	17	512	940
5	49	940	6	17	512	940
6	21	615	4	17		615
7	32	462	8	17	256	511
8	21	940	5	17		733
9	117	900	15	17		901
10	21	820	3	17		820
11	37	855	5	17		855
12	52	855	7	17		855
13	21	306	8	17	128	319
14	44	733	7	17		733
16	21	612	4	17	0	663
17	42	977	5	17	300	977
18	59	977	7	17		977
19	62	1024	7	17	512	1023
20	31	733	5	17	300	732
21	44	733	7	17	300	732
22	31	733	5	17	300	733
23	10	306	4	17	0	336
24	21	612	4	17	305	663
25	10	306	4	17	-1	340
26	21	612	4	17	-1	670
27	42	698	7	17	300	732
28	42	976	5	17	488	977
29	10	306	4	17	0	340
30	21	611	4	17	306	663
31	44	732	7	17	300	732
32	44	1023	5	17	-1	1023

Award 3.0*/3.03/3.04 (3.0 only to 4.1)

Type	Mb	Cyls	H	Se	Prec	LZ
1	10	306	4	17	128	305
2	20	615	4	17	300	615
3	30	615	6	17	300	615
4	65	940	8	17	512	940
5	49	940	6	17	512	940
6	21	615	4	17		615
7	32	462	8	17	256	511
8	31	733	5	17		733
9	117	900	15	17		901
10	21	820	3	17		820
11	37	855	5	17		855
12	52	855	7	17		855
13	21	306	8	17	128	319

Type	Mb	Cyls	H	Se	Prec	LZ
14	44	733	7	17		733
16	21	612	4	17	0	663
17	42	977	5	17	300	977
18	59	977	7	17		977
19	62	1024	7	17	512	1023
20	31	733	5	17	300	732
21	44	733	7	17	300	732
22	31	733	5	17	300	733
23	10	306	4	17	0	336
24	42	977	5	17		976
25	80	1024	9	17		1023
26	74	1224	7	17		1223
27	117	1224	11	17		1223
28	159	1224	15	17		1223
29	71	1024	8	17		1023
30	98	1024	11	17		1023
31	87	918	11	17		1023
32	72	925	9	17		926
33	89	1024	10	17		1023
34	106	1024	12	17		1023
35	115	1024	13	17		1023
36	124	1024	14	17		1023
37	17	1024	2	17		1023
38	142	1024	16	17		1023
39	70	918	15	17		1023
40	42	820	6	17		820
41	42	1024/615*	5/8*	17	512/-1*	1023/615*
42		809	6	26	128	852
43		809	6	17	128	852
44		776	8	26		775

Award 3.05/3.06*/3.06C**/3.10/3.12/ 3.13/3.14/3.16*/3.20/3.21/3.22/4.00***

User types started with 3.10. *OEMs.

Type	Mb	Cyls	Hds	Secs	Pre	LZ
1	10	306	4	17	128	305
2	20	615	4	17	300	615
3	30	615	6	17	300	615
4	62	940	8	17	512	940
5	46	940	6	17	512	940
6	20	615	4	17		615
7	30	462	8	17	256	511
8	30	733	5	17		733
9	112	900	15	17		901
10	20	820	3	17		820
11	35	855	5	17		855
12	49	855	7	17		855
13	20	306	8	17	128	319
14	42	733	7	17		733
16	20	612	4	17	0	663
17	40	977	5	17	300	977
18	56	977	7	17		977
19	59	1024	7	17	512	1023
20	30	733	5	17	300	732
21	42	733	7	17	300	732
22/22***	31/49	733/751	5/8	17	300/0	733/752
23/23***	10/100	306/755	4/16	17	0	336/756
24	40	977	5	17		976
25	76	1024	9	17		1023
26	71	1224	7	17		1223
27	111	1224	11	17		1223

Type	Mb	Cyls	Hds	Secs	Pre	LZ
28	152	1224	15	17		1223
29	68	1024	8	17		1023
30	93	1024	11	17		1023
31	83	918	11	17		1023
32	69	925	9	17		926
33	85	1024	10	17		1023
34/34***	106/40	1024/965	12/5	17		1023/966
35/35***	115/80	1024/965	13/10	17		1023/966
36/36***	124/114	1024/814	9	17		1023/815
37/37***	17/160	1024/968	2/10	17/34		1023/969
38/38***	142/19	1024/873	16/13	17/36		1023/874
39	114	918	15	17		1023
40	40	820	6	17		820
41	42	1024	5	17	512	1023
42	65	1024	5	26	128	1023
43	40	809	6	17	128	852
44/44***	64/61	820/809**	6	26	-1**	852**
45	100	776	8	33	-1	775
46/**/***	203	684	16	38	-1	685
47/**/***	30	615	6	17	-1	615

Award 4.5

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	20	615	4	17	300	615
3	30	615	6	17	300	615
4	62	940	8	17	512	940
5	46	940	6	17	512	940
6	20	615	4	17	None	615
7	30	462	8	17	256	511
8	30	733	5	17	None	733
9	112	900	15	17	None	901
10	20	820	3	17	None	820
11	35	855	5	17	None	855
12	49	855	7	17	None	855
13	20	306	8	17	128	319
14	42	733	7	17	None	733
16	20	612	4	17	0	663
17	40	977	5	17	300	977
18	56	977	7	17	None	977
19	59	1024	7	17	512	1023
20	30	733	5	17	300	732
21	42	733	7	17	300	732
22	30	306	5	17	300	733
23	10	977	4	17	0	336
24	40	1024	5	17	None	976
25	76	1224	9	17	None	1023
26	71	1224	7	17	None	1223
27	11	1224	11	17	None	1223
28	15	1024	15	17	None	1223
29	68	1024	8	17	None	1023
30	93	918	11	17	None	1023
31	83	925	11	17	None	1023
32	69	1024	9	17	None	926

Type	Mb	Cyls	Hds	Secs	Prec	LZ
33	85	1024	10	17	None	1023
34	102	1024	12	17	None	1023
35	110	1024	13	17	None	1023
36	119	1024	14	17	None	1023
37	17	1024	2	17	None	1023
38	136	1024	16	17	None	1023
39	114	918	15	17	None	1023
40	40	820	6	17	None	820
41	42	1024	5	17	None	1023
42	65	1024	5	26	None	1023
43	40	809	6	17	None	852
44	61	809	6	26	None	852
45	100	776	8	33	None	775
46	203	684	16	38	None	685

Commodore

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	20	615	4	17	300	615
3	30	615	6	17	300	615
4	62	940	8	17	512	940
5	46	940	6	17	512	940
6	20	615	4	17		615
7	30	462	8	17	256	511
8	30	733	5	17		733
9	112	900	15	17		901
10	20	820	3	17		820
11	35	855	5	17		855
12	49	855	7	17		855
13	20	306	8	17	128	319
14	42	733	7	17		733
16	20	612	4	17	0	663
17	40	977	5	17	300	977
18	56	977	7	17		977
19	30	1024	7	17	512	1023
20	30	733	5	17	300	732
21	42	733	7	17	300	732
22	30	733	5	17	300	733
23	10	306	4	17	0	336
24	40	805	4	26	0	820
25	100	776	8	33	0	800
26	49	751	8	17	0	800
27	100	755	17	17	0	800
28	40	965	5	17	0	1000
29	80	965	10	17	0	1000
30	41	782	4	27	0	800

Type	Mb	Cyls	Hds	Secs	Prec	LZ
31	20	782	2	27	0	782
32	202	683	16	38	0	683
42	38	925	5	17	0	926
43	46	925	6	17	0	926
44	53	925	7	17	0	926
45	61	925	8	17	0	926
46	69	925	9	17	0	926
47	202	1526	16	17	0	1600

Compaq DeskPro 386/25/33(27)/20e(37)

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	20	615	4	17	128	638
3	30	615	6	17	128	615
4	71	1024	8	17	512	1023
5	49	805	6	17	N/A	805
6	30	697	5	17	128	696
7	32	462	8	17	256	511
8	40	925	5	17	128	924
9	117	900	15	17	N/A	899
10	42	980	5	17	N/A	980
11	56	925	7	17	128	924
12	72	925	9	17	128	924
13	42	612	8	17	256	611
14	34	980	4	17	128	980
16	21	612	4	17	ALL	612
17	42	980	5	17	128	980
18	42	966	5	17	128	966
19	72	754	11	17	N/A	753
20	31	733	5	17	256	732
21	44	733	7	17	256	732
22	42	524	4	40	N/A	524
23	64	924	8	17	N/A	924
24	117	966	14	17	N/A	966
25	134	966	16	17	N/A	966
26	124	1023	14	17	N/A	1023
27	84	832	6	33	N/A	832
28	319	1222	15	34	N/A	1222
29	151	1240	7	34	N/A	1240
30	31	615	4	25	128	615
31	62	615	8	25	128	615
32	104	905	9	25	128	905
33	112	832	8	33	N/A	832
34	117	966	7	34	N/A	966
35	134	966	8	34	N/A	966

Type	Mb	Cyls	Hds	Secs	Prec	LZ
36	151	966	9	34	N/A	966
37	84	966	5	34	N/A	966
38	315	611	16	63	N/A	611
39	190	1023	11	33	N/A	1023
40	267	1023	15	34	N/A	1023
41	259	1023	15	33	0	1023
42	527	1023	16	63	0	1023
43	42	805	4	26	N/A	805
44	21	805	2	26	N/A	805
45	101	748	8	33	N/A	748
46	75	748	6	33	N/A	748
47	61	966	5	25	128	966

Compaq 386/20

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	21	615	4	17	128	638
3	31	615	6	17	128	615
4	71	1024	8	17	512	1023
5	49	940	6	17	N/A	939
6	30	697	5	17	128	696
7	32	462	8	17	256	511
8	40	925	5	17	128	924
9	117	900	15	17	N/A	899
10	42	980	5	17	N/A	980
11	56	925	7	17	128	924
12	72	925	9	17	128	924
13	42	612	8	17	256	611
14	34	980	4	17	128	980
16	21	612	4	17	ALL	612
17	42	980	5	17	128	980
18	50	966	5	17	128	966
19	72	1023	8	17	-1	1023
20	32	733	5	17	256	732
21	44	733	7	17	256	732
22	42	805	6	17	-1	805
23	64	924	8	17	N/A	924
24	117	966	14	17	N/A	966
25	134	966	16	17	N/A	966
26	125	1023	14	17	N/A	1023
27	84	966	10	17	-1	966
28	104	748	16	17	-1	748
29	64	805	6	26	-1	805
30	32	615	4	25	128	615
31	63	615	8	25	128	615
32	104	905	9	25	128	905

Type	Mb	Cyls	Hds	Secs	Prec	LZ
33	104	748	8	34	-1	748
34	117	966	7	34	N/A	966
35	134	966	8	34	N/A	966
36	151	966	9	24	N/A	966
37	84	966	5	34	N/A	966
38	315	611	16	63	N/A	611
39	190	1023	11	33	N/A	1023
40	267	1023	15	34	N/A	1023
41	260	1023	15	33	0	1023
42	528	1023	16	63	0	1023
43	43	805	4	26	N/A	805
44	21	805	2	26	N/A	805
45	101	748	8	33	N/A	748
46	76	748	6	33	N/A	748
47	62	966	5	25	128	966

Compaq Portable III

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	20	615	4	17	128	638
3	30	615	6	17	128	615
4	71	1024	8	17	512	1023
5	49	940	6	17	512	939
6	30	697	5	17	128	696
7	32	462	8	17	256	511
8	40	925	5	17	128	924
9	117	900	15	17	N/A	899
10	42	980	5	17	N/A	980
11	56	925	7	17	128	924
12	72	925	9	17	128	924
13	42	612	8	17	256	611
14	34	980	4	17	128	980
16	21	612	4	17	ALL	612
17	42	980	5	17	128	980
18	42	966	5	17	128	966
19	72	754	11	17	N/A	753
20	31	733	5	17	256	732
21	44	733	7	17	256	732
22	42	825	6	17	-1	805
23	64	924	8	17	N/A	924
24	117	966	14	17	N/A	966
25	134	966	16	17	N/A	966
26	124	1023	14	17	N/A	1023
27	84	966	10	17	-1	966
28	104	748	16	17	-1	748
29	64	805	6	26	-1	805

Type	Mb	Cyls	Hds	Secs	Prec	LZ
30	31	615	4	25	128	615
31	62	615	8	25	128	615
32	104	905	9	25	128	905
33	104	748	8	34	-1	748
34	117	966	7	34	N/A	966
35	134	966	8	34	N/A	966
36	151	966	9	34	N/A	966
37	84	966	5	34	N/A	966

Compaq SLT/286

Type	Mb	Cyls	Hd	Secs	Prec	LZ
1	10.65	306	4	17	128	305
2	21.41	615	4	17	128	638
3	32.12	615	6	17	128	615
4	71.30	1024	8	17	512	1023
5	42.04	805	6	17	-1	805
6	30.33	697	5	17	128	696
7	32.17	462	8	17	256	511
8	40.26	925	5	17	128	924
9	117.50	900	15	17	-1	899
10	42.65	980	5	17	-1	980
11	56.36	925	7	17	128	924
12	72.46	925	9	17	128	924
13	42.61	612	8	17	256	611
14	34.12	980	4	17	128	980
16	21.31	612	4	17	0	612
17	42.65	980	5	17	128	980
18	42.04	966	5	17	128	966
19	72.19	754	11	17	-1	753
20	31.90	733	5	17	256	732
21	44.66	733	7	17	256	732
22	42.93	524	4	40	-1	524
23	64.34	924	8	17	-1	924
24	117.71	966	14	17	-1	966
25	134.53	966	16	17	-1	966
26	124.66	1023	14	17	-1	1023
27	84.34	832	6	33	-1	832
28	325.03	872	14	52	-1	872
29	151.10	1240	7	34	-1	1240
30	31.49	615	4	25	128	615
31	62.98	615	8	25	128	615
32	104.26	905	9	25	128	905
33	112.46	832	8	33	-1	832
34	117.71	966	7	34	-1	966
35	134.53	966	8	34	-1	966
36	151.35	966	9	34	-1	966
37	84.08	966	5	34	-1	966
38	315.33	611	16	63	-1	611
39	190.13	1023	11	33	-1	1023
40	267.13	1023	15	34	-1	1023
41	651.36	1631	15	52	-1	1631
42	527.97	1023	16	63	-1	1023
43	42.86	805	4	26	-1	805

Type	Mb	Cyls	Hd	Secs	Prec	LZ
44	21.43	805	2	26	-1	805
45	101.1	748	8	33	-1	748
46	75.83	748	6	33	-1	748
47	61.82	966	5	25	128	966
49	651.76	816	30	52	-1	816
50	121.41	760	8	39	-1	760
51	212.62	683	16	38	-1	683
53	42.65	548	4	38	-1	548
54	21.41	615	4	17	-1	615
55	60.70	760	4	39	-1	760
56	84.34	528	8	39	-1	528
57	325.14	629	16	63	-1	629
58	121.41	624	10	38	-1	624
59	31.91	410	4	38	-1	410
60	63.82	820	4	38	-1	820
61	510.42	989	16	63	-1	989
62	510.59	1696	12	49	-1	1696
63	340.11	659	16	63	-1	659
64	170.05	659	8	63	-1	659
69	242.57	940	8	63	-1	940
70	363.85	705	16	63	-1	705
71	485.13	940	16	63	-1	940
72	679.18	658	32	63	-1	658
73	679.18	1316	16	63	-1	1316
74	2037.55	987	64	63	-1	987
75	2037.55	3948	16	63	-1	3948
76	727.70	705	32	63	-1	705
77	727.70	1410	16	63	-1	1410
78	776.21	752	32	63	-1	752
79	776.21	1504	16	63	-1	1504
80	2716.73	658	12	63	-1	658
81	2716.73	526	16	63	-1	5264
82	970.26	940	32	63	-1	940
83	970.26	1880	16	63	-1	1880
84	424.75	823	16	63	-1	823
85	636.86	617	32	63	-1	617
86	636.86	1234	16	63	-1	1234
87	849.49	823	32	63	-1	823
88	849.49	1646	16	63	-1	1646
90	1018.77	987	32	63	-1	987
91	1018.77	1974	16	63	-1	1974
92	3059.42	741	12	63	-1	741
93	3059.82	5928	16	63	-1	5928
94	1273.72	617	64	63	-1	617
95	1273.72	2468	16	63	-1	2468
96	1358.36	658	64	63	-1	658
97	1358.36	2632	16	63	-1	2632
98	4079.22	988	12	63	-1	988
99	4079.22	7904	16	63	-1	7904
100	1698.99	823	64	63	-1	823
101	1698.99	3292	16	63	-1	3292
102	1529.71	741	64	63	-1	741
103	1529.71	2964	16	63	-1	2964

DTK

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1		306	4	17	128	305
2		615	4	17	300	615
3		615	6	17	300	615
4		940	8	17	512	940
5		940	6	17	512	940
6		615	4	17	N/A	615
7		462	8	17	256	511
8		733	5	17	N/A	733
9		900	15	17	N/A	901
10		820	3	17	N/A	820
11		855	5	17	N/A	855
12		855	7	17	N/A	855
13		306	8	17	128	319
14		733	7	17	N/A	733
16		612	4	17	ALL	663
17		977	5	17	300	977
18		977	7	17	N/A	977
19		1024	7	17	512	1023
20		733	5	17	300	732
21		733	7	17	300	732
22		733	5	17	300	733
23		306	4	17	ALL	336
24		698	7	17	300	732
25		615	4	17	ALL	615
26		1024	4	17	N/A	1023
27		1024	5	17	N/A	1023
28		1024	8	17	N/A	1023
29		512	8	17	256	512
30		820	6	26	N/A	820
31		820	4	26	N/A	820
32		615	4	26	300	615
33		306	4	17	ALL	340
34		976	5	17	488	977
35		1024	9	17	1024	1024
36		1024	5	17	512	1024
37		830	10	17	N/A	830
38		823	10	17	256	824
39		615	4	17	128	664
40		615	8	17	128	664
41		917	15	17	N/A	918
42		1023	15	17	N/A	1024
43		823	10	17	512	823
44		820	6	17	N/A	820
45		1024	8	17	N/A	1024
46		925	9	17	N/A	925
47		699	7	17	256	700

Epson

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	21	615	4	17	300	615
3	32	615	6	17	300	615
4	65	940	8	17	512	940
5	49	940	6	17	512	940
6	21	615	4	17	N/A	615
7	32	462	8	17	256	511
8	31	733	5	17	N/A	733
9	117	900	15	17	N/A	901
10	21	820	3	17	N/A	820
11	37	855	5	17	N/A	855
12	52	855	7	17	N/A	855
13	21	306	8	17	128	319
14	44	733	7	17	N/A	733
16	21	612	4	17	ALL	663
17	42	977	5	17	300	977
18	59	977	7	17	N/A	977
19	62	1024	7	17	512	1023
20	31	733	5	17	300	732
21	44	733	7	17	300	732
22	31	733	5	17	300	733
23	10	306	4	17	ALL	336
24	21	612	4	17	305	663
25	10	306	4	17	-1	340
26	21	612	4	17	-1	670
27	42	698	7	17	300	732
28	42	976	5	17	488	977
29	10	306	4	17	0	340
30	21	611	4	17	306	663
31	44	732	7	17	300	732
32	44	1023	5	17	-1	1023
41	88	1022	5	34	-1	1022
42	94	1022	5	36	-1	1022
43	71	1024	8	17	512	1023
44	144	828	10	34	-1	828
45	44	1024	5	17	512	1023
46	42	615	8	17	128	618

Ferranti

Type	Cyls	Hds	SpT
1	977	5	17
2	615	4	17
3	615	6	17
4	940	8	17

Type	Cyls	Hds	SpT
5	940	6	17
6	615	4	17
7	462	8	17
8	733	5	17
9	900	15	17
10	820	3	17
11	855	7	17
12	855	7	17
13	306	8	17
14	733	7	17
15	1024	9	17

Goldstar

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	21	615	4	17	300	615
3	32	615	6	17	300	615
4	65	940	8	17	512	940
5	49	940	6	17	512	940
6	21	615	4	17		615
7	32	462	8	17	256	511
8	31	733	5	17	N/A	733
9	117	900	15	17	N/A	901
10	21	820	3	17	N/A	820
11	37	855	5	17	N/A	855
12	52	855	7	17	N/A	855
13	21	306	8	17	128	319
14	44	733	7	17	N/A	733
16	21	612	4	17		663
17	42	977	5	17	300	977
18	59	977	7	17	N/A	977
19	62	1024	7	17	512	1023
20	31	733	5	17	300	732
21	44	733	7	17	300	732
22	31	733	5	17	300	733
23	10	306	4	17		336
24	65	820	6	26	544	819
25	21	615	4	17		615
26	35	1024	4	17	N/A	1023
27	44	1024	5	17	N/A	1023
28	71	1024	8	17	N/A	1023
29	35	512	8	17	256	512
30	10	615	2	17	615	615
31	43	989	5	17	0	989
32	133	1020	15	17	-1	1024
33	44	642	8	17	128	664

Type	Mb	Cyls	Hds	Secs	Prec	LZ
34	49	615	6	26	10	614
35	80	1024	9	17	1024	1024
36	44	1024	5	17	512	1024
37	72	830	10	17	N/A	830
38	71	823	10	17	256	824
39	21	615	4	17	128	664
40	42	615	8	17	128	664
41	42	615	8	17	128	664
42	119	917	15	17	-1	918
43	133	1025	15	17	-1	1024
44	71	823	10	17	512	823
45	42	820	6	17	N/A	820
46	71	1024	8	17	N/A	1024
47	72	925	9	17	N/A	925
48	42	699	7	17	256	700

Goupil

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	10	615	4	17	300	615
3	42	977	5	17	-1	977
4	42	615	8	17	128	664
5	40	925	5	17	128	940
6	44	1024	5	17	-1	1024
7	43	898	5	17	-1	1024
8	42	820	6	17	-1	820
9	88	1022	5	34	-1	1022
10	71	823	10	17	128	823
11	72	925	9	17	128	940
12	80	1024	9	17	-1	1024
13	71	1024	8	17	-1	1024
14	151	969	9	34	-1	969
16	146	1024	8	35	-1	1024
17	32	615	4	26	300	615
18	65	615	8	26	128	664
19	65	989	5	26	128	989
20	65	820	6	26	-1	820
21	42	804	4	26	-1	805
22	42	739	4	28	-1	745
23	43	820	4	26	-1	820
24	85	636	2	33	-1	636
25	54	776	8	17	-1	776
26	41	965	5	17	-1	965
27	83	965	10	17	-1	965
28	65	948	5	27	-1	948
29	32	615	6	17	-1	615

IBM

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	21	615	4	17	300	615
3	32	615	6	17	300	615
4	65	940	8	17	512	940
5	49	940	6	17	512	940
6	21	615	4	17	N/A	615
7	32	462	8	17	256	511
8	31	733	5	17	N/A	733
9	11	900	15	17	N/A	901
10	21	820	3	17	N/A	820
11	37	855	5	17	N/A	855
12	52	855	7	17	N/A	855
13	21	306	8	17	128	319
14	44	733	7	17	N/A	733
16	21	612	4	17	ALL	663
17	42	977	5	17	300	977
18	59	977	7	17	N/A	977
19	62	1024	7	17	512	1023
20	31	733	5	17	300	732
21	44	733	7	17	300	732
22	31	733	5	17	300	733
23	10	306	4	17	ALL	336
24	21	612	4	17	305	663
25	10	306	4	17	N/A	340
26	21	612	4	17	N/A	670
27	42	698	7	17	300	732
28	42	976	5	17	488	977
29	10	306	4	17	ALL	340
30	21	611	4	17	306	663
31	44	732	7	17	300	732
32	44	1023	5	17	N/A	1023

PS/2

Type	Cap	Cyls	Hds	Secs	Prec	LZ
33		614	4	17	0	663
34		775	2	17	0	900
35		922	2	17	0	1000
36		402	4	17	0	460
37		580	6	17	0	640
38		845	2	17	0	1023
39		769	3	17	0	1023
40		531	4	17	0	532
41		577	2	17	0	1023
42		654	2	17	0	674
43		923	5	17	0	1023
44		531	8	17	0	532

MR BIOS

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10.7	306	4		128	305
2	21.4	615	4		300	615
3	32.1	615	6		300	615
4	65.5	940	8		512	940
5	49.1	940	6		512	940
6	21.4	615	4		None	615
7	32.2	462	8		256	511
8	31.9	733	5		None	733
9	117.5	900	15		None	901
10	21.4	820	3		None	820
11	37.2	855	5		None	855
12	52.1	855	7		None	855
13	21.3	306	8		128	319
14	44.7	733	7		None	733
15	0.0	0	0		None	0
16	21.3	612	4		0	663
17	42.5	977	5		300	977
18	59.5	977	7		None	977
19	62.4	1024	7		512	1023
20	31.9	733	5		300	732
21	44.7	733	7		300	732
22	21.9	733	5		300	733
23	10.7	306	4		0	336
24	42.9	805	4		None	805
25	72.5	925	9		None	925
26	104.9	776	8		None	776
27	44.6	1024	5		512	1024
28	71.3	1024	8		None	1023
29	71.6	823	10		None	823
30	159.8	1224	15		None	1223
31	98.0	1024	11		None	1024
32	133.7	1024	15		None	1024
33	44.6	1024	5		None	1024
34	10.7	612	2		128	612
35	80.2	1024	9		None	1024
36	71.3	1024	8		512	1024
37	42.8	615	128		615	17
38	71.6	823	10		256	823
39	42.2	809	6		128	809
40	42.8	820	6		None	820
41	42.5	977	5		None	977

Type	Mb	Cyls	Hds	Secs	Prec	LZ
42	42.7	981	5		None	981
43	71.6	823	10		512	823
44	72.2	830	10		None	830
45	119.7	917	15		None	917

Nimbus PC386 4.21a

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	21	615	4	17	300	615
3	32	615	6	17	300	615
4	65	940	8	17	512	940
5	49	940	6	17	512	940
6	21	615	4	17	N/A	615
7	32	462	8	17	256	511
8	31	733	5	17	N/A	733
9	11	900	15	17	N/A	901
10	21	820	3	17	N/A	820
11	37	855	5	17	N/A	855
12	52	855	7	17	N/A	855
13	21	306	8	17	128	319
14	44	733	7	17	N/A	733
16	21	612	4	17	ALL	663
17	42	977	5	17	300	977
18	59	977	7	17	N/A	977
19	62	1024	7	17	512	1023
20	31	733	5	17	300	732
21	44	733	7	17	300	732
22	31	733	5	17	300	733
23	10	306	4	17	ALL	336
24	21	612	4	17	305	663
25	10	306	4	17	N/A	340
26	21	612	4	17	N/A	670
27	42	698	7	17	300	732
28	42	976	5	17	488	977
29	10	306	4	17	ALL	340
30	21	611	4	17	306	663
31	44	732	7	17	300	732
32	44	1023	5	17	N/A	1023
33	50	830	7	17	-1	830
34	72	830	10	17	-1	830
35	44	1024	5	17	-1	1024
36	71	1024	8	17	-1	1024
37	42	615	8	17	128	615
38	42	615	8	17	-1	615
39	72	925	9	17	-1	925
40	80	1024	9	17	-1	1023

Type	Mb	Cyls	Hds	Secs	Prec	LZ
41	65	820	6	26	-1	920
42	32	615	4	26	-1	614
43	59	750	6	26	600	749
44	68	1024	5	26	768	1023
45	41	771	4	26	128	810
46	41	771	4	26	128	810
47	49	615	6	26	-1	614

Nimbus VX386 v155a

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	21	615	4	17	300	615
3	32	615	6	17	300	615
4	65	940	8	17	512	940
5	49	940	6	17	512	940
6	21	615	4	17	N/A	615
7	32	462	8	17	256	511
8	31	733	5	17	N/A	733
9	11	900	15	17	N/A	901
10	21	820	3	17	N/A	820
11	37	855	5	17	N/A	855
12	52	855	7	17	N/A	855
13	21	306	8	17	128	319
14	44	733	7	17	N/A	733
16	21	612	4	17	ALL	663
17	42	977	5	17	300	977
18	59	977	7	17	N/A	977
19	62	1024	7	17	512	1023
20	31	733	5	17	300	732
21	44	733	7	17	300	732
22	31	733	5	17	300	733
23	10	306	4	17	ALL	336
24	117	966	14	17	-1	966
25	134	966	16	17	-1	966
26	124	1023	14	17	-1	1023
27	84	966	10	17	-1	966
28	72	754	11	17	383	754
29	110	830	10	17	512	830
30	65	615	8	17	384	664
31	62	615	8	17	128	615
32	72	830	10	17	512	830
33	21	1023	16	26	-1	1023
34	117	966	7	34	-1	966
35	134	966	8	34	-1	966
36	142	1023	16	17	-1	1023
37	84	966	5	34	-1	966

Type	Mb	Cyls	Hds	Secs	Prec	LZ
38	201	1024	8	48	-1	1023
39	377	1024	15	48	-1	1023
40	133	1024	15	17	-1	1023
41	267	1024	15	34	-1	1023
42	196	1024	11	34	-1	1023
43	124	1024	7	34	-1	1023
44	142	1024	8	34	-1	1023
45	42	820	6	17	-1	820
46	65	820	6	26	-1	820
47	42	615	8	17	128	664

Olivetti v3.27

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	30	697	5	17	0	696
2	21	612	4	17	256	700
3	21	612	4	17	612	663
4	10	306	4	17	128	305
5	42	612	8	17	128	664
6	42	820	6	17	256	819
7	42	820	6	17	820	819
8	71	823	10	17	512	822
9	42	981	5	17	128	980
10	42	615	8	17	512	614
11	71	1024	8	17	1024	1023
12	80	1024	9	17	1024	1023
13	45	872	6	17	872	871
14	21	612	4	17	128	656
15	21	612	4	17	128	663
16	10	306	4	17	128	305

Olivetti M380c

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	21	615	4	17	300	615
3	40	925	5	17	128	924
4	30	697	5	17	128	696
5	80	1024	9	17	-1	1023
6	42	820	6	17	256	819
7	42	615	8	17	128	664
8	42	981	5	17	-1	980
9	42	981	5	17	128	980
10	53	1024	6	17	-1	1023
11	56	925	7	17	128	924
12	71	1024	8	17	-1	1023
13	72	925	9	17	128	924

Type	Mb	Cyls	Hds	Secs	Prec	LZ
14	44	1024	5	17	-1	1023
16	21	612	4	17	128	656
17	21	612	4	17	-1	663
18	42	820	6	17	-1	819
19	45	872	6	17	0	871
20	21	612	4	17	128	663
21	65	820	6	26	-1	819
22	65	820	6	26	128	819
23	65	615	8	26	384	664
24	142	820	10	34	-1	822
25	142	1021	8	34	-1	1023
26	71	1021	4	34	-1	1023
27	71	823	10	17	512	622
28	42	615	8	17	512	614
29	65	615	8	26	512	65
30	65	981	5	26	-1	980

Philips 2.24

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	306
2	20	615	4	17	300	615
3	30	615	6	17	300	615
4	68	1024	8	17	512	1024
5	43	874	6	17	650	872
6	25	512	6	17	256	615
7	34	512	8	17	256	512
9	20	615	4	17	128	663
10	25	1024	3	17	512	1024
11	42	1024	5	17	512	1024
12	59	1024	7	17	512	1024
13	43	754	7	17	65535	754
14	68	754	11	17	65535	754
16	20	782	2	27	65535	862
17	41	782	4	27	65535	862
18	20	745	2	28	65535	820
19	40	745	4	28	65535	820
20	43	868	3	34	65535	0
21	72	868	5	34	65535	0
22	100	868	7	34	65535	0
23	100	776	8	33	65535	776
24	40	745	4	28	65535	0
25	41	539	6	26	65535	0
26	40	979	5	17	65535	0
30	31	615	4	26	128	636

Phoenix 1.1 16.H0

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	21	615	4	17	300	615
3	32	615	6	17	300	615
4	65	940	8	17	512	940
5	49	940	6	17	512	940
6	21	615	4	17	-1	615
7	32	462	8	17	256	511
8	31	733	5	17	-1	733
9	117	900	15	17	-1	901
10	21	820	3	17	-1	820
11	37	855	5	17	-1	855
12	52	855	7	17	-1	855
13	21	306	8	17	128	319
14	44	733	7	17	-1	733
15	0	0	0	0	0	0
16	21	612	4	17	0	663
17	42	977	5	17	300	977
18	59	977	7	17	-1	977
19	62	1024	7	17	512	1023
20	31	733	5	17	300	732
21	44	733	7	17	300	732
22	31	733	5	17	300	733
23	10	306	4	17	0	336
24	110	830	10	26	-1	830
25	21	615	4	17	0	615
26	35	1024	4	17	-1	1023
27	44	1024	5	17	-1	1023
28	71	1024	8	17	-1	1023
29	35	512	8	17	256	512
30	10	615	2	17	615	615
31	43	989	5	17	0	989
32	133	1020	15	17	-1	1024
35	80	1024	9	17	1024	1024
36	44	1024	5	17	512	1024
37	72	830	10	17	-1	830
38	71	823	10	17	256	824
39	21	615	4	17	128	664
40	42	615	8	17	128	664
41	119	917	15	17	-1	918
42	133	1023	15	17	-1	1024
43	71	823	10	17	512	823
44	42	820	6	17	-1	820
45	71	1024	8	17	-1	1024
46	72	925	9	17	-1	925
47	42	699	7	17	256	700

Phoenix 1.64

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	12	306	4	17	128	305
2	25	615	4	17	300	615
3	37	615	6	17	300	615
4	75	940	8	17	512	940
5	56	940	6	17	512	940
6	25	615	4	17	65535	615
7	37	462	8	17	256	511
8	37	733	5	17	65535	733
9	136	900	15	17	65535	901
10	25	820	3	17	65535	820
11	43	855	5	17	65535	855
12	60	855	7	17	65535	855
13	24	306	8	17	128	319
14	51	733	7	17	65535	733
16	24	612	4	17	0	633
17	49	977	5	17	300	977
18	68	977	7	17	65535	977
19	72	1024	7	17	512	1023
20	37	733	5	17	300	732
21	51	733	7	17	300	732
22	37	733	5	17	0	732
22	37	733	5	17	0	732
23	10	306	4	17	0	336

Phoenix 3.00

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	21	615	4	17	300	615
3	32	615	6	17	300	615
4	65	940	8	17	512	940
5	49	940	6	17	512	940
6	21	615	4	17	-1	615
7	32	462	8	17	256	511
8	31	733	5	17	-1	733
9	117	900	15	17	-1	901
10	21	820	3	17	-1	820
11	37	855	5	17	-1	855
12	52	855	7	17	-1	855
13	20	306	8	17	128	319
14	44	733	7	17	-1	733
16	20	612	4	17	0	663
17	42	977	5	17	300	977
18	59	977	7	0	-1	977
19	62	1024	7	17	512	1023

Type	Mb	Cyls	Hds	Secs	Prec	LZ
20	31	733	5	17	300	733
21	44	733	7	17	300	733
22	31	733	5	17	300	733
23	10	306	4	17	0	336
36	41	1024	5	17	512	1024
37	72	830	10	17	-1	830
38	71	823	10	17	256	824
39	21	615	4	17	128	664
40	42	615	8	17	128	664
41	119	917	15	17	-1	918
42	133	1023	15	17	-1	1024
43	72	823	10	17	512	823

Phoenix 3.10 01

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	21	615	4	17	300	615
3	32	615	6	17	300	615
4	65	940	8	17	512	940
5	49	940	6	17	512	940
6	21	615	4	17	-1	615
7	32	462	8	17	256	511
8	31	733	5	17	-1	733
9	117	900	15	17	-1	901
10	21	820	3	17	-1	820
11	37	855	5	17	-1	855
12	52	855	7	17	-1	855
13	21	306	8	17	128	319
14	44	733	7	17	-1	733
16	21	612	4	17	0	663
17	42	977	5	17	300	977
18	59	977	7	17	-1	977
19	62	1024	7	17	512	1023
20	31	733	5	17	300	732
21	44	733	7	17	300	732
22	31	733	5	17	300	733
23	10	306	4	17	0	336
24	21	612	4	17	305	663
25	10	306	4	17	-1	340
26	21	612	4	17	-1	670
27	42	698	7	17	300	732
28	42	976	5	17	488	977
29	10	306	4	17	0	340
30	21	611	4	17	306	663
31	44	732	7	17	300	732
32	44	1023	5	17	17	1023

Type	Mb	Cyls	Hds	Secs	Prec	LZ
33	31	614	4	25	-1	663
34	44	1024	5	17	512	0
35	44	642	8	17	128	664
36	0	0	0	0	0	0
37	45	872	6	17	650	0
39	59	750	6	26	300	750
40	42	805	4	26	-1	0
41	103	776	8	33	-1	0
42	43	782	4	27	-1	0
43	49	615	6	26	-1	0
44	42	820	6	17	-1	820
45	0	0	0	0	0	0
46	43	539	6	26	-1	0

Phoenix 3.10 08A

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	305
2	20	615	4	17	300	615
3	30	615	6	17	300	615
4	62	940	8	17	512	940
5	46	940	6	17	512	940
6	20	615	4	17	-1	615
7	30	462	8	17	256	511
8	30	733	5	17	-1	733
9	112	900	15	17	-1	901
10	20	820	3	17	-1	820
11	35	855	5	17	-1	855
12	49	855	7	17	-1	855
13	20	306	8	17	128	319
14	42	733	7	17	-1	733
16	20	612	4	17	0	663
17	40	977	5	17	300	977
18	56	977	7	17	-1	977
19	59	1024	7	17	512	1023
20	30	733	5	17	300	732
21	42	733	7	17	300	732
22	30	733	5	17	300	733
23	10	36	4	17	0	336
25	20	615	4	17	0	615
26	34	1024	4	17	-1	1023
27	42	1024	5	17	-1	1023
28	68	1024	8	17	-1	1023
29	34	512	8	17	256	512
30	10	615	2	17	615	615
31	41	989	5	17	0	989
32	127	1020	15	17	-1	1024

Type	Mb	Cyls	Hds	Secs	Prec	LZ
35	76	1024	9	17	1024	1024
36	42	1024	5	17	512	1024
37	68	830	10	17	-1	830
38	68	823	10	17	256	824
39	20	615	4	17	128	664
40	40	615	8	17	128	664
41	114	917	15	17	-1	918
42	127	1023	15	17	-1	1024
43	68	823	10	17	512	823
44	40	820	6	17	-1	820
45	68	1024	8	17	-1	1024
46	69	925	9	17	-1	925
47	40	699	7	17	256	700

Phoenix 3.4

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	612	2	17	306	611
2	20	612	4	17	100	611
3	0	0	0	0	0	0
4	42	615	8	17	-1	614
5	31	615	6	26	-1	614
6	42	805	4	26	-1	805
7	42	979	5	17	-1	979
8	59	997	7	17	-1	997
9	104	776	8	33	-1	776
10	121	931	15	17	-1	931
11	20	615	4	17	-1	615
12	42	980	5	17	-1	980
13	212	683	16	38	-1	683

Phoenix 3.40

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	42	862	2	48	-1	862
2	121	931	15	17	-1	931
3	41	1024	2	40	-1	1024
4	42	695	7	17	-1	695
5	84	695	14	17	-1	695
6	45	667	4	33	-1	667
7	42	977	5	17	-1	977
8	0	0	0	0	0	0
9	42	695	7	17	-1	695
10	84	695	14	17	-1	695
11	42	980	5	17	-1	980
12	42	981	5	17	-1	981
13	85	981	10	17	-1	981

Phoenix 3.63T

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10	306	4	17	128	0
2	20	615	4	17	300	0
3	30	615	6	17	300	0
4	62	940	8	17	512	0
5	46	940	6	17	512	0
6	20	615	4	17	0	0
7	30	462	8	17	256	0
8	30	733	5	17	0	0
9	111	900	15	17	0	0
10	20	820	3	17	0	0
11	35	855	5	17	0	0
12	49	855	7	17	0	0
13	20	306	8	17	128	0
14	42	733	7	17	0	0
16	20	612	4	17	0	0
17	40	977	5	17	300	0
18	56	977	7	17	0	0
19	59	1024	7	17	512	0
20	30	733	5	17	300	0
21	42	733	7	17	300	0
22	30	733	5	17	300	0
23	10	306	4	17	0	0
24	20	612	4	17	305	0
25	10	306	4	17	0	0
26	20	612	4	17	0	0
27	40	698	7	17	300	0
28	40	976	5	17	488	0
29	10	306	4	17	0	0
30	20	611	4	17	306	0
31	42	732	7	17	300	0
32	42	1023	5	17	0	0
100	40	820	6	17	0	0
101	76	1024	9	17	0	0
102	40	615	8	17	128	0
103	42	1024	5	17	512	0
104	67	1024	8	17	512	0
105	24	987	3	17	0	0
106	41	989	5	17	0	0
107	57	987	7	17	0	0
108	67	1024	8	17	0	0
109	83	918	11	17	0	0
110	114	918	15	17	0	0
111	42	1024	5	17	0	0
112	50	1024	5	17	0	0
113	59	1024	7	17	0	0
114	38	925	5	17	0	0

Type	Mb	Cyls	Hds	Secs	Prec	LZ
115	53	925	7	17	0	0
116	69	925	9	17	0	0
117	10	615	2	17	0	0
118	25	754	4	17	0	0
119	43	754	7	17	0	0
120	68	754	11	17	0	0
121	28	699	5	17	0	0
122	40	699	7	17	0	0
123	68	823	10	17	0	0
124	20	830	3	17	0	0
125	34	830	5	17	0	0
126	41	830	6	17	0	0
127	48	830	7	17	0	0
128	68	830	10	17	0	0
129	40	981	5	17	0	0
130	56	981	7	17	0	0
131	127	1024	15	17	0	0
132	40	987	5	17	0	0
133	18	731	3	17	0	0
134	30	731	5	17	0	0
135	42	731	7	17	0	0
136	36	872	5	17	650	0
137	43	872	6	17	650	0
138	50	872	7	17	650	0
139	127	1024	15	17	0	0
140	41	989	5	17	128	0
150	80	969	5	34	0	0
151	112	969	7	34	0	0
152	144	969	9	34	0	0
153	68	823	5	34	0	0
154	81	823	6	34	0	0
155	95	823	7	34	0	0
156	136	823	10	34	0	0
157	67	1024	4	34	0	0
158	84	1024	5	34	0	0
159	101	1024	6	34	0	0
160	118	1024	7	34	0	0
161	135	1024	8	34	0	0
162	254	1024	15	34	0	0
163	68	830	5	34	0	0
164	96	830	7	34	0	0
165	137	830	10	34	0	0
166	209	903	14	34	0	0
167	80	1216	4	34	0	0
168	161	1216	8	34	0	0
169	242	1216	12	34	0	0
170	142	1224	7	34	0	0
171	162	1224	8	34	0	0

Type	Mb	Cyls	Hds	Secs	Prec	LZ
172	223	1224	11	34	0	0
173	243	1224	12	34	0	0
174	142	1225	7	34	0	0
175	223	1225	11	34	0	0
176	144	1243	7	34	0	0
177	226	1243	11	34	0	0
178	79	1600	3	34	0	0
179	106	1600	4	34	0	0
180	132	1600	5	34	0	0
181	159	1600	6	34	0	0
182	216	1632	8	34	0	0
183	263	1224	13	34	0	0
184	284	1224	14	34	0	0
185	304	1224	15	34	0	0
186	304	1225	15	34	0	0
187	309	1243	15	34	0	0
188	404	1624	15	34	0	0
189	406	1632	15	34	0	0
190	145	1249	7	34	0	0
191	145	1250	7	34	0	0
192	633	1632	15	53	0	0
193	644	1661	15	53	0	0
216	29	615	4	25	128	0
217	59	615	8	25	128	0
218	35	966	3	25	0	0
219	38	756	4	26	0	0
220	19	756	2	26	0	0
221	38	768	4	26	0	0
222	19	768	2	26	0	0
223	58	966	5	25	128	0
224	61	805	6	26	0	0
225	99	905	9	25	128	0
226	30	611	4	26	0	0
227	15	611	2	26	0	0
228	31	615	4	26	128	0
229	31	615	4	26	0	0
230	46	615	6	26	0	0
231	41	820	4	26	0	0
232	62	820	6	26	0	0
233	37	987	3	26	0	0
234	62	987	5	26	0	0
235	87	987	7	26	0	0
236	64	1024	5	26	0	0
237	116	1024	9	26	0	0
238	103	1166	7	26	0	0
239	40	745	4	28	0	0
240	99	776	8	33	0	0
241	41	782	4	27	0	0

Type	Mb	Cyls	Hds	Secs	Prec	LZ
242	40	805	4	26	0	0
243	34	834	3	28	0	0
244	199	1348	8	38	0	0
245	191	816	15	32	0	0
246	107	832	8	33	0	0
247	225	1747	5	53	0	0
248	105	906	7	34	0	0
249	316	1747	7	53	0	0

Type	Mb	Cyls	Hds	Secs	Prec	LZ
40		615	8	17	128	664
41		917	15	17		918
42		1023	15	17		1024
43		823	10	17	512	823
44		820	6	17		820
45		1024	8	17		1024
46		925	9	17		925
47		699	7	17	256	700

Phoenix 3.06/3.07

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1		306	4	17	128	305
2		615	4	17	300	615
3		615	6	17	300	615
4		940	8	17	512	940
5		940	6	17	512	940
6		615	4	17		615
7		462	8	17	256	511
8		733	5	17		733
9		900	15	17		901
10		820	3	17		820
11		855	5	17		855
12		855	7	17		855
13		306	8	17	128	319
14		733	7	17		733
16		612	4	17	0	663
17		977	5	17	300	977
18		977	7	17		977
19		1024	7	17	512	1023
20		733	5	17	300	732
21		733	7	17	300	732
22		733	5	17	300	733
23		306	4	17	0	336
25		615	4	17	0	615
26		1024	4	17		1023
27		1024	5	17		1023
28		1024	8	17		1023
29		512	8	17	256	512
30		615	2	17	615	615
31		989	5	17	0	989
32		1020	15	17		1024
35		1024	9	17		1024
36		1024	5	17	512	1024
37		830	10	17		830
38		823	10	17	256	824
39		615	4	17	128	664

Phoenix 3.10

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1		306	4	17	128	305
2		615	4	17	300	615
3		615	6	17	300	615
4		940	8	17	512	940
5		940	6	17	512	940
6		615	4	17		615
7		462	8	17	256	511
8		733	5	17		733
9		900	15	17		901
10		820	3	17		820
11		855	5	17		855
12		855	7	17		855
13		306	8	17	128	319
14		733	7	17		733
16		612	4	17	0	663
17		977	5	17	300	977
18		977	7	17		977
19		1024	7	17	512	1023
20		733	5	17	300	732
21		733	7	17	300	732
22		733	5	17	300	733
23		306	4	17	0	336
25		615	4	17	0	615
26		1024	4	17		1023
27		1024	5	17		1023
28		1024	8	17		1023
29		512	8	17	256	512
30		615	2	17	615	615
31		989	5	17	0	989
32		1020	15	17		1024
35		1024	9	17		1024
36		1024	5	17	512	1024
37		830	10	17		830
38		823	10	17	256	824
39		615	4	17	128	664

Type	Mb	Cyls	Hds	Secs	Prec	LZ
40		615	8	17	128	664
41		917	15	17		918
42		1023	15	17		1024
43		823	10	17	512	823
44		820	6	17		820
45		1024	8	17		1024
46		925	9	17		925
47		699	7	17	256	700

Phoenix 1.00 ABIOS

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1		306	4	17	128	305
2		615	4	17	300	615
3		615	6	17	300	615
4		940	8	17	512	940
5		940	6	17	512	940
6		615	4	17		615
7		462	8	17	256	511
8		733	5	17		733
9		900	15	17		901
10		820	3	17		820
11		855	5	17		855
12		855	7	17		855
13		306	8	17	128	319
14		733	7	17		733
16		612	4	17	0	663
17		977	5	17	300	977
18		977	7	17		977
19		1024	7	17	512	1023
20		733	5	17	300	732
21		733	7	17	300	732
22		733	5	17	300	733
23		306	4	17	0	336
25		615	4	17	0	615
26		1024	4	17		1023
27		1024	5	17		1023
28		1024	8	17		1023
29		512	8	17	256	512
30		615	2	17	615	615
31		989	5	17	0	989
32		1020	15	17		1024
33		615	4	26		615
34		820	6	26		820
35		1024	9	17		1024
36		1024	5	17	512	1024
37		1024	5	26	512	1024

Type	Mb	Cyls	Hds	Secs	Prec	LZ
38		823	10	17	256	824
39		615	4	17	128	664
40		615	8	17	128	664
41		917	15	17		918
42		1023	15	17		1024
43		823	10	17	512	823
44		820	6	17		820
45		1024	5	17		1024
46		925	9	17		925
47		699	7	17	256	700

Samsung

Type	Mb	Cyls	Hds	Secs	WPC	LZ
1	10	306	4	17	128	305
2	21	615	4	17	300	615
3	32	615	6	17	300	615
4	65	940	8	17	512	940
5	49	940	6	17	512	940
6	21	615	4	17	-1	615
7	32	462	8	17	256	511
8	31	733	5	17	-1	733
9	117	900	15	17	-1	901
10	21	820	3	17	-1	820
11	37	855	5	17	-1	855
12	52	855	7	17	-1	855
13	21	306	8	17	128	319
14	44	733	7	17	-1	733
16	21	612	4	17	0	663
17	42	977	5	17	300	977
18	59	977	7	17	-1	977
19	62	1024	7	17	512	1023
20	31	733	5	17	300	732
21	44	733	7	17	300	732
22	31	733	5	17	300	733
23	10	306	4	17	0	336

Sperry PC/IT

Type	Mb	Cyls	Heads	Sectors
1	20	610	4	17
2	20	615	4	17
3	30	615	6	17
4	42	960	5	17
5	72	920	9	17
6	70	1000	8	17
7	118	900	15	17

Type	Mb	Cyls	Heads	Sectors
8	42	960	5	17
9	26	604	5	17
10	42	960	5	17
11	21	614	4	17
12	44	1000	5	17
13	21	600	4	17
14	40	924	5	17

Tandon 001-2.24 000-10

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	10.65	306	4	17	128	305
2	21.41	615	4	17	300	615
3	32.12	615	6	17	300	615
4	65.45	940	8	17	512	940
5	49.09	940	6	17	512	940
6	21.41	615	4	17		615
7	32.17	462	8	17	256	511
8	31.90	733	5	17		733
9	117.50	900	15	17		901
10	21.41	820	3	17		820
11	37.21	855	5	17		855
12	52.09	855	7	17		855
13	21.31	306	8	17	128	319
14	44.66	733	7	17		733
16	21.31	612	4	17	0	663
17	42.52	977	5	17	300	977
18	59.53	977	7	17		977
19	62.39	1024	7	17	512	1023
20	31.90	733	5	17	300	732
21	44.66	733	7	17	300	732
22	31.90	733	5	17	300	733
23	10.65	306	4	17	0	336
28	124.78	1024	14	17		1024
29	31.96	612	6	17		612
30	42.82	615	8	17		615
31	71.30	1024	8	17		1024
32	32.12	615	6	17		615
33	98.04	1024	11	17		1024
34	72.46	925	9	17		925
35	42.25	809	6	17		852
36	71.37	820	10	17		820
37	27.19	781	4	17		805
38	57.10	820	8	17		820
39	28.03	805	4	17		805
40	44.56	1024	5	17		1024
41	71.30	1024	8	17		1024

Type	Mb	Cyls	Hds	Secs	Prec	LZ
42	80.22	1024	9	17		1024
43	42.82	820	6	17		820
44	75.20	960	9	17		960
45	72.24	830	10	17		830
46	133.69	1024	15	17		1024
47	42.69	981	5	17		981

Tandon 3.61

Type	Mb	Cyls	Hds	Secs	WPC	LZ
1	10	306	4	17	128	305
2	20	615	4	17	128	615
3	30	615	6	17	300	615
4	62	940	8	17	512	940
5	46	940	6	17	512	940
6	20	615	4	17	615	615
7	30	462	8	17	256	511
8	30	733	5	17	733	733
9	112	900	15	17	900	901
10	20	820	3	17	820	820
11	35	855	5	17	855	855
12	49	855	7	17	855	855
13	20	306	8	17	128	319
14	42	733	7	17	733	733
15	0	0	0	0	0	0
16	20	612	4	17	0	663
17	40	977	5	17	300	977
18	56	977	7	17	977	977
19	59	1024	7	17	512	1023
20	30	733	5	17	300	732
22	30	733	5	17	300	733
23	10	306	4	17	0	336
24	0	0	0	0	0	0
25	0	0	0	0	0	0
26	105	904	14	17	904	904
27	107	861	15	17	861	861
28	119	1024	14	17	1024	1024
29	30	612	6	17	612	612
30	40	615	8	17	615	615
31	68	1024	8	17	512	1024
32	30	615	6	17	615	615
33	93	1024	11	17	1024	1024
34	69	925	9	17	925	925
35	40	809	6	17	809	852
36	68	820	10	17	128	820
37	25	781	4	17	781	805
38	54	820	8	17	820	820

Type	Mb	Cyls	Hds	Secs	WPC	LZ
39	26	805	4	17	805	805
40	42	1024	5	17	1024	1024
41	68	1024	8	17	1024	1024
42	76	1024	9	17	1024	1024
43	40	820	6	17	820	820
44	71	960	9	17	960	960
45	68	830	10	17	830	830
46	127	1024	15	17	1024	1024
47	40	981	5	17	981	981

Toshiba 1.0

Type	Mb	Cyls	Hds	Secs	WPC	LZ
1	21	615	4	17	-1	615
2	21	581	2	36	-1	581
3	42	980	5	17	-1	980
4	42	791	3	35	-1	791
5	31	411	4	38	-1	411
6	64	823	4	38	-1	823
12	21	615	4	17	-1	615
13	21	581	2	36	-1	581
14	21	653	2	32	-1	653

Victor AT 3.01

Type	Mb	Cyls	Hds	Secs	WPC	LZ
1	10	306	4	17	128	305
2	21	615	4	17	300	615
3	31	615	6	17	300	615
4	65	940	8	17	512	940
5	49	940	6	17	512	940
6	21	615	4	17	-1	615
7	32	462	8	17	256	511
8	31	733	5	17	-1	733
9	117	900	15	17	-1	901
10	21	820	3	17	-1	820
11	37	855	5	17	-1	855
12	52	855	7	17	-1	855
13	21	306	8	17	128	319
14	44	733	7	17	-1	733
15	0	0	0	0	0	0
16	21	612	4	17	0	663
17	42	977	5	17	17	300
18	59	977	7	17	-1	977
19	62	1024	7	17	512	1023
20	31	733	5	17	300	732
21	44	733	7	17	300	732

Type	Mb	Cyls	Hds	Secs	WPC	LZ
22	31	733	5	17	300	733
23	22	306	4	17	0	336
24	23	440	6	17	256	440
25	30	615	4	24	0	616
26	71	1024	8	17	-1	1024
27	41	1024	5	17	-1	1024
28	44	640	8	17	250	641
29	80	1023	9	17	-1	1023
30	42	820	6	17	-1	820
31	119	918	15	17	-1	918
32	44	642	8	17	128	664
33	42	980	5	17	-1	980
34	40	965	5	17	0	965
35	84	965	10	17	0	965
36	41	1024	5	17	512	1024
37	120	814	9	32	0	814
38	168	968	10	34	0	968
39	209	873	13	36	0	873
40	49	750	5	26	600	750
41	59	750	6	26	600	750
42	69	750	7	26	600	750
43	41	1023	2	40	-1	1023
44	42	820	6	17	-1	820
45	0	0	0	0	0	0
46	32	616	4	26	0	615
47	42	699	7	17	256	700

Wang

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1		306	4	17	128	305
2		615	4	17	300	615
3		615	6	17	300	615
4		940	8	17	512	940
5		940	6	17	512	940
6		615	4	17	N/A	615
7		462	8	17	256	511
8		733	5	17	N/A	733
9		900	15	17	N/A	901
10		820	3	17	N/A	820
11		855	5	17	N/A	855
12		855	7	17	N/A	855
13		306	8	17	128	319
14		733	7	17	N/A	733
16		612	4	17	ALL	663
17		977	5	17	300	977
18		977	7	17	N/A	977

Type	Mb	Cyls	Hds	Secs	Prec	LZ
19		1024	7	17	512	1023
20		733	5	17	300	732
21		733	7	17	300	732
22		733	5	17	300	733
23		306	4	17	ALL	336
24		0	0	0	0	0
25		615	4	17	ALL	615
26		1024	4	17	N/A	1023
27		1024	5	17	N/A	1023
28		1024	8	17	N/A	1023
29		512	8	17	256	512
30		612	2	17	128	612
31		0	0	0	0	0
32		0	0	0	0	0
33		0	0	0	0	0
34		0	0	0	0	0
35		1024	9	17	1024	1024
36		1024	5	17	512	1024
37		830	10	17	N/A	830
38		823	10	17	256	824
39		615	4	17	128	664
40		615	8	17	128	664
41		917	15	17	N/A	918
42		1023	15	17	N/A	1024
43		823	10	17	512	823
44		820	6	17	N/A	820
45		1024	8	17	N/A	1024
46		925	9	17	N/A	925
47		699	7	17	256	700

Type	Mb	Cyls	Hds	Secs	Prec	LZ
16	21	612	4	17	ALL	663
17	43	977	5	17	300	977
18	60	977	7	17	N/A	977
19	63	1024	7	17	512	1023
20	32	733	5	17	300	732
21	45	733	7	17	300	732
22	32	733	5	17	300	733
23	10	306	4	17	ALL	336
24	10	612	2	17		611
25	32	615	4	17	ALL	615
26	32	462	8	17	256	511
27	21	820	3	17		820
28	60	981	7	17		986
29	72	754	11	17		754
30	120	918	15	17		918
31	43	987	5	17		987
32	43	830	6	17	400	830
33	24	697	4	17		696
34	21	615	4	17		615
35	21	615	4	17	128	663
36	80	1024	9	17		1024
37	45	1024	5	17	512	1024
38	43	820	6	17		910
39	21	615	4	17	306	684
40	73	925	9	17		924
41	71	1024	8	17	512	1023
42	45	1024	5	17	1024	1023
43	43	615	8	17	300	615
44	43	989	5	17		988

Zenith

Type	Mb	Cyls	Hds	Secs	Prec	LZ
1	11	306	4	17	128	305
2	21	615	4	17	300	615
3	30	699	5	17	256	710
4	65	940	8	17	512	940
5	49	940	6	17	512	940
6	21	615	4	17	N/A	615
7	43	699	7	17	256	710
8	32	733	5	17	N/A	733
9	117	900	15	17	N/A	901
10	40	925	5	17	N/A	926
11	37	855	5	17	N/A	855
12	52	855	7	17	N/A	855
13	21	306	8	17	128	319
14	45	733	7	17	N/A	733

Hard Disks

A hard disk works the same way as a floppy, but has several platters on top of each other inside a hard case, each with its own read/write head, which are all used at the same time for speed. The platters were originally made of metal, but latterly of glass, which is why they are called hard disks (because they are not removeable, they are also called fixed disks). However, they were originally called *Winchester Drives*, after one that IBM made for mainframes, which had 30 Mb fixed and 30 removeable, after the Winchester 30-30 calibre rifle. In fact, their first one, in 1954, stored 5 Mb across fifty 24 inch platters – now, you're more likely to get 20 Mb across three 3.5 inch ones.

The first PC to support them properly was the PC/XT (e**X**tended **T**echnology) in 1983. Previously, hard drives came as external devices with their own adapter card and power supply, as the BIOS and the power supply on the PC could not cope with them, and only then after DOS could handle subdirectories (in version 2). The hard disk controller in the XT was created by Xebec, which contained the extra code that wasn't already in the System BIOS, which is why you had to use a debug script at C800 to access it.

The IBM AT (Advanced Technology) had hard disk support in the BIOS, together with more IRQs, etc to play with, and a CMOS chip backed up with a battery to remember it all. The "support", however was a few standard hard drive types, and you had to go back to a ROM on the controller if you wanted something else. The original types are still in there somewhere, although there are now well over 40 to choose from, plus those you can add yourself. Since a ROM cannot be changed, the additional types are kept in a small amount of memory set aside for the purpose.

DOS, meanwhile, was still unable to support partitions greater than 32 Mb, because of the way sectors were numbered; there could not be more than 65,536, as they were 16-bit values.

Neither did it know anything about extended partitions before v3.3, so you couldn't even split a large drive up!

As talking to the controller can be quite tedious, the BIOS contains a subroutine at INT 13 that can be accessed to do the job. DOS itself has routines for file management, as well (INT 25/26, etc), so applications call the DOS INTs, which in turn rope in the BIOS to help.

Inside a hard disk, each solid platter is mounted on a spindle and covered in a magnetic substance, with its own read/write head. All of them move at once when data is requested, giving the quickest possible response. The most common speed is 3600 RPM, but many high performance drives increase this up to 4500, 5400, 6300 , 7200 or 10000. Speed is not the whole story, however – some 5400 RPM drives perform better than many at 7200. The surface of each platter is marked out in concentric *tracks*, which are split into *sectors* which hold 512 bytes of data each. Track 0 on the first platter, which holds the boot sector, is often referred to as Head 0, as each platter has its own heads. A collection of sectors is called a *cluster*, but more of that later. All the tracks on all sides of the platters on top of each other are collectively known as a *cylinder*, a term which comes from the time when hard drives were round drums, like old phonograph records.

Read/write heads are not in contact with the drive surface, as they are with floppy drives. On a hard disk, they actually float a couple of thousandths of an inch above it. As the gap between the recording head and the surface is so small, you can imagine the problems if dust or other contaminants were to get in. This is why hard disks are sealed—a good reason for not undoing them, although they still work with the top off (great for demos). When the power is off on older drives, the head will rest on the surface, with obvious dangers when the computer is moved. Unfortunately, similar dangers arise when the computer is switched on, since the flow of power moves the head slightly to the right, scraping the recording medium as it does so.

To protect your data, and prolong hard disk life, it's a good idea to *park* the heads in a neutral area whenever the computer is switched off, so the above problems are not so apparent. This won't stop the head from scraping the surface, but at least it will do so in a safe place! However, modern hard disk designs have the head mounted on a solenoid which is designed to spring upwards when power is turned off, so parking the heads is not so important, and may even confuse the issue. In fact, some manufacturers recommend that you *don't* park the heads on such drives, as the movement towards the safe area causes damage to the physical stops that prevent the head moving too far.

Size matters

The maximum capacity of your hard disk may be determined by your operating system; early versions of DOS (2.0-3.2) only supported up to 32 Mb in one volume on a physical drive. With v 3.3, you could have a 32 Mb *primary partition* and an *extended partition*, inside which you could put several volumes, up to 32 Mb in size (you can have a maximum of 23, because that's how many letters of the alphabet are left once A, B and C are used up). Although present versions are better, until recently, DOS and/or the BIOS and the IDE interface could still only cope with 1024 cylinders and 528 Mb, although you can have more than two drives (post DOS 5), but see *Enhanced IDE*, or *Logical Block Addressing*.

Many BIOSes had trouble handling drives over 2.1 Gb because not enough space was allocated in the CMOS to store a value for cylinders over a certain size (actually 4096), and some Phoenix BIOSes have a problem calculating over 32 Gb, but you can't access more than 2.1 Gb with FAT 16 anyway, unless you're using NT, which can format FAT 16 drives up to 4 Gb because it uses 64K clusters.

Back to operating systems, DOS (and hence Windows) cannot handle a translated drive geometry with 256 heads.. DOS 6.22 is limited to 8.4 Gb, and although Windows can handle more than this, your BIOS may not, due to LBA translation methods - very few written before 1998 can do so. Drives over 8.4 Gb are supposed to report in with a geometry of 16282 x 16 x 63. There is a workaround for this that uses system memory to keep drive information as well as the normal registers, but this will still limit you to 137.4 Gb.

The cylinder problem is catered for by clever programming, or translation of parameters, fooling the PC into thinking it has the right apparent size of drive, when it hasn't. A controller will have a *Translator ROM* on board to do this.

Common Interfaces

The interface is the connection between the hard disk and the expansion bus. Those relevant to PCs are:

ST-412

An early version of……

ST-506

A standard established by Shugart Technologies in 1980, typically using MFM (see later) to transfer data serially at a rate of rather less than 1 Mb per second. An identical number of sectors is used per track, so they are shorter near the centre.

ESDI

The *Enhanced Small Device Interface*, developed by Maxtor, offers up to four times the throughput of ST-506, of which it is a direct descendant - it uses the same cabling, albeit with different signals. It still needs a separate controller, but the interpretation of various control bits is left to the drive, hence the transfer rate of up to 2.5 Mb per second (a higher density of sectors per track helps). Controller speed should match drive speed, meaning that a 10 MHz drive needs a 10 MHz controller.

Drives can be soft or hard sectored (switchable), but some controller cards can only cope with one or the other. The ESDI controller uses a data buffer to hold data during transfers, enabling data to be recovered that could be lost with an ST-506 controller. Many ESDI drives were quite well regarded.

ATA/IDE (embedded AT)

The term IDE, or *Integrated Drive Electronics* is popularly used to describe an intelligent drive that communicates directly with the AT expansion bus through an adapter on the motherboard. The interface name, by the way, is officially ATA, or *AT Attachment*, after the AT and was for ISA. Anything that's not a hard disk should not be referred to as IDE.

It was designed to use PIO (that is, *Programmed Input/Output*), where the CPU controls the transfer of every bit between the data bus and memory (although this sounds performance-draining, it was still faster than the original implementation of DMA).

Because the controller is on the drive, the path between components is very short, as it is with ESDI, and therefore more reliable, so the track density can be increased. Having said that, with the former interfaces, verification was done by the controller, which would, after a write, read back the data and compare ECCs (not data). If the ECCs were OK, the transfer was presumed to be OK. In the ATA/IDE interface, the controller is on the same end of the cable as the hard drive, so the above system does not work.

The original ATA interface is based on TTL bus interface technology, which in turn uses the old asynchronous ISA bus protocol, where data and command signals are sent along a signal strobe, but are not interconnected, so that only one can be sent at a time, and a data request must be completed before a command or other signal can be sent along the same strobe.

ATA-2 was synchronous, giving faster PIO and DMA modes, where the drive controls the strobe and synchronizes the data and command signals with the rising edge of each pulse, which is regarded as a signal separator. Each pulse can carry a data or command signal, so they can be combined. Increasing the strobe rate increases performance, but also increases EMI, which can cause data corruption and transfer errors. ATA-2 also introduced ATAPI (*ATA Packet Interface*), for devices like CD-ROMs that use the ordinary ATA (IDE) port. EIDE (*Enhanced IDE*) is WD's version based on them both, and *Fast ATA* is Seagate and Quantum's answer, based on ATA-2 only. They both provide flow control through an unused pin (IORDY) on the IDE interface to control data transfer, which is much more efficient. Both systems can produce data transfer rates in excess of 10 Mbps, which is well over what the ISA bus can cope with, hence the need for flow control.

Originally, only two devices per interface were allowed, one being master and the other slave, and there is often considerable effort involved in getting drives from the same manufacturer working together, let alone with others. Four channels are allowed with EIDE, though, so you can have up to eight with two devices on each, but beware of mixing devices with different performance specifications on the same one. Not only will the slower one be taken as a yardstick, but data loss may also result (check out Western Digital's documentation).

ATA-4 includes *Ultra ATA* which, in trying to avoid EMI, uses both rising and falling edges of the strobe as signal separators, so twice as much data is transferred at the same strobe rate in the same period. It was designed by Quantum, in association with Intel, to better match the Pentium processor, and to take over from PIO Mode 5, which was abandoned because of electrical noise. While ATA-2 and -3 can burst up to 16.6 Mbytes/sec, Ultra ATA gives up to

33.3 Mbytes/sec. ATA-4 also adds Ultra DMA mode 2 (33.3 Mbytes/sec) to the previous PIO modes 0-4 and traditional DMA modes 0-2.

ATA-5 includes *Ultra ATA/66* which doubles the Ultra ATA burst transfer rate by reducing setup times and increasing the strobe rate, which again increases EMI to a point where a special cable is needed, adding 40 ground lines between each of the original 40 ground and signal lines, so the connector stays the same, except that pin 34 is knocked out to allow for cable section of Master and Slave (it's colour coded, too – the blue connector goes to the motherboard, the grey to the slave and the black to the master device on whichever channel it is used on). ATA-5 adds Ultra DMA modes 3 (44.4 Mbytes/sec) and 4 (66.6 Mbytes/sec) to the mix, but in a single-drive environment, there is a negligible performance increase over UDMA/33 – you're better off with two 10 Mb drives, for example, than one of 20 Mb, because of the better use of the bandwidth available, and you will actually find your machine better at multitasking than running faster. *UDMA/100* is the next one to come.

Having said all that, Bus Master DMA is available for IDE, which helps with multimedia under a multithreaded operating system. Traditional DMA still uses the CPU, even if only for setting up data transfers in the first place. A Bus Master DMA device can do its own setup and transfer, even between devices on the same bus, leaving the CPU (and the motherboard DMA controller) out of it (it doesn't improve IDE throughput, however).

In theory, IDE data transfer speeds can be three times higher than ESDI (IDE transmits in parallel), up to 5 Mb per second, in fact, but this depends on several factors, such as bus clock speeds and other hardware in the computer.

Capacity can be limited on a PC (around 528 Mb), due to the BIOS and IDE specifications. The BIOS Disk Interface (Int 13) is limited to 63 (512 byte) sectors per track and 1024 cylinders, while IDE drives themselves can only have 16 heads, together with up to 255 secs/track and 65536 cylinders. The BIOS only allows 255 heads and 128 bits for a CHS address. *Logical Block Addressing* converts CHS (*Cylinders, Heads, Sectors*) addresses to 28-bit Logical Blocks, numbered sequentially from 1-16, 450, 60, giving over 8 Gb capacity. The blocks may not necessarily be in the same place on different machines.

The maximum cable length is 18 inches, which depends on the machine, or its chipset. Some manufacturers use one buffer for two channels and the signals on the cable are therefore shared, which means your maximum cable length may be halved. Assuming your motherboard is like most others, and has already used up a couple of inches as a trace, something like 7" looks much safer, especially as the cable is not terminated or otherwise protected from noise. Many GPFs in Windows have been traced to IDE cables being too long.

Although 40-way cabling is standard, some proprietary interfaces (i.e. early Toshiba) use 72. ATA is a good cheap solution for desktop machines where multitasking is not required; that is, *serious* multitasking as opposed to just printing in the background. The average IDE drive in such a situation performs about 10-30% better than SCSI, but performance is not the whole story; SCSI handles more devices over longer cables with less interrupts.

SCSI

The *Small Computer Systems Interface*, originally designed by Shugart and NCR, has a high data transfer rate, up to 5 Mb/sec for **SCSI-1**, over an 8-bit bus (asynchronously, this was more like 3 Mb/sec). Asynchronous timing is faster on short cable runs, up to around 6 ft, but it needs an acknowledgement of every byte sent. Synchronous, on the other hand, can send multiple requests before receiving an acknowledgement, and is about 3 times faster.

As a SCSI hard drive is intelligent, its vital statistics can be hidden from applications—for example, the storage space provided will appear as sequentially numbered blocks rather than cylinders and heads. SCSI devices are daisy-chained along a parallel bus which, in theory, can cater for 8 or more, including the adapter, but many features are optional, so watch out for discrepancies. For example, there is no standard for how data is translated on to a hard drive, so be careful when moving drives between adapters. Although the adapter takes up an IRQ, the devices attached to it do not, which makes for easy expandability (EIDE requires an interrupt per channel).

SCSI-2 (Fast SCSI) is more standardised, offering more immunity to line noise, and longer cabling (Fast=10 MHz). It also paved the way for devices that weren't hard disks, and is the standard, whatever that means. It performs at rates up to 10 Mb/sec, for an 8-bit data path.

SCSI 3, known otherwise as *Ultra SCSI*, but really a subset of it (actually SCSI Fast 20), doubles the bus frequency with a 20 MHz bus clock, giving 20 Mb/sec on an 8-bit bus, and at less cost than Fast Wide SCSI. The bus is not the whole story, though; you can only get these speeds with multiple drives, as single drives tend to top out well below that, so you will only really notice the different with multitasking or multiple users. Just to confuse matters, *Ultra 2 SCSI* can reach 40 Mb/sec over an 8-bit bus, the Wide version (i.e. 16-bit) getting 80 Mb/sec. This is commonly known as *U2W*. Ultra2 also uses LVD (*Low Voltage Differential*) and needs active (not passive) termination.

Wide SCSI is not really a standard, but a 16-bit variation to the normal Narrow (8-bit) standards mentioned above, having double the capacity (it uses two cables), and double the devices allowed (16). It can be combined with either of the above, so Fast Wide could give you 20 Mb/sec. Use Ultra Wide when you have more than one device simultaneously using the channel, to reduce bottlenecks.

SCSI Type	Bus	Txfer Rate
Standard	8-bit	4.5 Mb/sec
Fast	8-bit	10 Mb/sec
Fast Wide	16-bit	20 Mb/sec
Ultra SCSI	8-bit	20 Mb/sec
SCSI 3 (Ultra Wide)	16-bit	40 Mb/sec
Ultra 2	8-bit	40 Mb/sec
Wide Ultra 2 (U2W)	16-bit	80 Mb/s

SCSI devices rely less on the processor than IDE ones. The SCSI card and cable operate independently from the rest of the computer, so data exchange amongst the devices does not use CPU cycles or the system bus, allowing you to do a lot more in the background, like tape backups.

Each device needs a unique ID, including the adapter itself. The ID both identifies devices and allocates prorities between them, being from 0-7, with the card using ID 7 and the first boot device using 0 (usually). ID 7 has the highest priority, the remaining ones being 6 to 0 for 8-bit SCSI, 15 to 8, 23-16 and 31-24 otherwise. Gaps between numbers don't matter, that is, they don't need to be sequential along the cable or even used at all. The SCAM protocol (*SCSI Configured AutoMatically*) assigns IDs automatically if your devices support it, but it's always best to do it in hardware if you can.

The ID jumpers on each device are in binary, and run from right to left:

```
4 2 1
```

To allocate an ID of 5, therefore, place a jumper on 4 and 1. Removing all will give ID 0, and adding all gives ID 7 (1+2+4).

The ends of each SCSI channel, as with any bus, must be properly terminated. Usually, this means flicking a switch on the last device attached to it, but sometimes you have to use a terminating resistor (the adapter card looks after itself). Internal Ultra2 devices come with termination disabled and you must use a special cable with a terminator at the end of it. For those with relatively poor termination (such as external Zip drives) an Active Terminator can be installed at the end of the cable. These keep the bus voltage constant at 3.6 volts, whereas with Passive Terminators, it can vary between 1-2-3.5.

Wide controllers have Low and High terminating wires. Low controls the 8-bit bus, and Low and High together control both. Desktop situations should have Terminator Power *from* the bus, whereas RAID, etc. should have it *to* the bus (that is from the device). *Set Start Unit* settings allow devices to start in sequence to avoid excessive power drain.

The command overhead for SCSI is high (10 times that of ESDI), which can detract from performance in a single drive system; EIDE will perform about 10-30% better here, but EIDE can also take up a significant percentage of processor time. SCSI's strong point is connectivity over long distance (6m+), so is best for multi-user systems with heavy multitasking requirements, or when short of slots. You could also have external equipment, and there's nothing to stop you having one drive between two machines. Disadvantages include the fact that software drivers are required for *everything* and can be specific to the equipment, so you may need more than one card! This is reduced somewhat if all your equipment is compatible with ASPI or SCAM.

SCSI is not recognised by the BIOS (drives are set as *Not Installed*), so don't expect to have anything to boot from, which is why SCSI cards have an optional boot ROM. If you don't have one, you won't be able to boot from your SCSI drive. Most people in this situation boot from a small IDE and then hand over to the SCSI, which can confuse some software.

Ultra2 hard drives should be kept separate from other devices, that is, they should occupy their own channel. This is to avoid what is called *SCSI Drag*, where slower devices pull down the performance of faster ones. LVD (*Low Voltage Differential*) is the technology behind Ultra2 (SE, or *Single Ended* is for Fast and Ultra SCSI). Single-ended signalling uses two wires; one for the data and the other for reference ground. *Differential SCSI* still uses two, but the second carries the data signal in reverse, thus allowing less chance for noise, and is less error-prone. It is used for high performance equipment, and the two are *not* cross-compatible—don't use them on the same bus.

Each target device (that performs operations on behalf of an initiator) can accommodate up to 8 other devices, known as *Logical Units*, or LUNs. If a device (or an ID) is a single closed unit, like a hard disk or CD-ROM, its LUN would be 0, as it is the first and only logical address for that SCSI ID.

Low level formatting of SCSI drives is usually done through the BIOS on the adapter. Some Mylex cards have the software on separate floppies.

There are only four manufacturers in the SCSI field, Fujitsu, IBM, Quantum and Seagate, with the latter controlling over 50% of the market.

Maximum Cable Lengths

Length	Txfer Rate	Devices
25m	U2 (80)	1
12m	U2 (80)	15
3m	Fast (10)	7
3m	Wide (20)	15
3m	Ultra (40)	4
1.5m	Ultra (40)	5-8

As devices have internal cabling and introduce impedance that interferes with the signal quality, reduce the cable length about 2 ft from the theoretical maximum for each connected device. Do the same for cable converters.

SSA

Cables for parallel architectures, such as IDE, can become unwieldy, aside from being limited in length. *Serial Storage Architecture* is a full duplex system based on 4-wire differential pair serial cable, developed by IBM and regarded as somewhat proprietary. Data is transferred in frames 135 bytes long. Derived from mainframes, it uses bandwidth efficiently, typically 97% compared to 60-65% for SCSI (it also costs less). An 80 Mb/sec data transfer rate has been demonstrated, using *frame multiplexing*, which allows data to be transferred at any time, instead of having to wait for the bus to be free.

Data Encoding Methods

This is how data is actually recorded on the disk. Encoding is needed because you need to convert from digital bits to magnetic impulses, and back again.

MFM (Modified Frequency Modulation)

A fixed-length encoding method, using 17 sectors per track, typically found on ST-506 drives. All bits are evenly spaced with error-correction and clocking information stored with the data. Data is recorded as 1s and 0s; the current is not switched on and off, but kept running with the polarity reversed when you want either one; data is recorded as flux changes.

As a 1 results from a change in polarity, it's easily found again, but you get problems with several 0s in a row because no polarity reversals took place to record them, so a 0 was written as 10 (i.e. a pulse and a pause) and 1 was written as 11 (two pulses). The first pulse (or the *clock-bit*) was always present, and the second (the *data-bit*) was your data. As 1s had twice as many pulses, this was called *Frequency Modulation*, or *FM encoding*, but there were overheads like pulses that were only there to let you know where the 0s were, and which took up space. MFM, or *Modified* Frequency Modulation, on the other hand, has a different pulse pattern of 01, with the nature of the 0 changing according to whether the bit in front was a 0 or a 1.

RLL

Run Length Limited is a method which *limits* the amount, or (run) *length*, of data written. In RLL 2,7, for example, 2 is the minimum number (length) and 7 the maximum (limit) of bits between two fluxes, or consecutive zeros. As it makes more use of timing signals to pack more data in the space available, RLL requires fewer bits to be written; three can be packed in the space of two. It uses 26 sectors per track, but needs higher quality media. Although an RLL controller will format an MFM drive, it's not the case the other way round. Most modern drives use RLL, including IDE, ESDI and SCSI.

RLL has other advantages. A drive producing 20 Mb under MFM would give 30 Mb using RLL, with the original 20 Mb *squeezed down*, occupying only two thirds of the disk, so the heads don't have to move so far to reach the same data, effectively reducing the average seek time. RLL drives were actually from MFM production lines, but tested more rigorously. Those that failed were marked up as MFM and sold accordingly, which is why some drives in the tables below are marked up as both, i.e. M/R.

Performance

A slower machine with a fast hard disk will outperform a fast one with something less efficient, since even the slowest processors (and buses) spend around half their time waiting for disks to catch up. Differences between components can account for variations in performance as high as 20%.

A typical (MFM) hard disk transfers data at less than 1 Megabyte per second—on a drive with 17 sectors of 512 bytes per sector, data passes under the read/write head at 522K per second (or 768K with 26 sectors), assuming a rotation speed of 3600 RPM. This is a lot less than even the ISA bus can handle, so *data throughput* is as important as the *access time* when comparing drives, although it really depends on what you're doing.

Databases use disks a lot, but for *searching*, not transferring data, so access time is important. On the other hand, graphic files are typically large (an A4 page takes up 1 Mb) so the data transfer rate will become more significant if you mainly copy these from place to place. Increasing the rotation speed reduces latency and thus performance (the Seagate Cheetah spins at 10,000 rpm). Hard disk performance is actually measured in many ways, including:

Average access time The time to find data in a specific place. Equals Average Seek and Average Latency. Some quote seek time instead!

Seek time The time to locate a sector. Affected by the number of read/write heads and the data encoding method.

Average latency The average time for the required sector to pass under the heads once the right track has been reached, improved by high RPM, equal to half the time taken for 1 rotation. The lower the better.

Command overhead The time to process requests The lower, the better.

Track to track access time The time it takes to move from one track to the next. Affected quite markedly by the data encoding method, MFM or RLL. Mostly useless with LBA type systems.

Sector access time Sectors retrieved in one second (affected by interleaving).

Data Transfer rate The data moved on or off a hard disk in a particular time, but the effective rate can vary due to data compression, cacheing or the slowest component in your system—it works best when data is sequential. Maximum, or burst, rates give the capability of the interface, not the drive. Burst will only be used if the data is already in the buffer (reading) or can fit into it (writing). Expect between 850K-1.2Mbps on a 486/33 with a modern SCSI hard drive.

Head Switch Times The time to switch heads—not instantaneous.

Buffer size The bigger the better (usually 32-64K). Segmented and Adaptive versions are progressive improvements.

Large partition sizes can slow the hard disk down once your files become fragmented, as they will. See *Partitioning with FDISK*.

AV drives do not need thermal recalibration, so the flow of data is not interrupted when they get hot and expand. They use embedded servos to keep the heads aligned, where positioning information is kept with the data. Also, they need to monitor bad sectors so that access times aren't increased unnecessarily. Normally, when a bad sector is marked, the new one is put at the end of the drive - AV drives just mark the bad sector (AV in Maxtor-speak is *ATA Value*).

The *areal density* is the amount of data per square inch, derived from the bits per inch on a track, multiplied by the number of tracks. Limited by head sensitivity, as data gets weaker the closer it's packed, and the amount of throughput the data channel can handle.

Measuring performance

Test software measures the transfer rate by reading from a complete cylinder, which is fine if you're using the physical parameters of the disk. Unfortunately, when using more cylinders than DOS can cope with (1024), and using sector translation, readings could take place over more than one cylinder, and the time taken to switch between them included in calculations. This will give you an *apparent* transfer speed lower than it should be. Under these circumstances, it's best to use such numbers for comparison purposes only, rather than absolute figures.

As the outer tracks on the drive surface are longer than the inner ones, they can hold more sectors. As the track length decreases towards the centre of the drive, the number of sectors also decreases, so with the drive spinning at a constant rate, a track with more sectors gives a proportionally higher transfer rate. The method used to cope with this is called *Zone Bit Recording* (ZBR).

The first cylinder of your drive is in the fastest zone, and it goes downhill from there, so if you benchmark and find it performing less than when you bought it, it’s just because the test program is using sectors in a slower area than when you last did the test (the difference can be as much as a factor of 2).

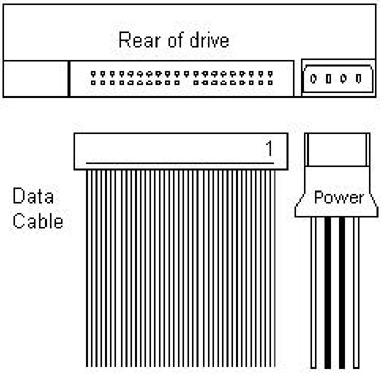
Installation

First of all, you must tell the drive what its position is; for example, two hard drives will have to know which of them is 1 or 2, or Master and Slave in the case of IDE. You will have to set switches or jumpers on the drive itself, or use the alternative method, *Cable Select*, which both drives must support.

ESDI, MFM and RLL drives use two flat data cables, one for control and one for data, whilst IDE and SCSI will combine everything in one (the max length for IDE is 18"). If the wide cable used with ESDI, MFM or RLL drives has no twist at the last connector, set the first drive as no 1 and the next as no 2. If there is a twist between the 19th and 26th wires at the last connector, set *both* drives as no 2 (the twist will sort out who's who). To set the drive ID, look for jumpers or switches marked DS (Drive Select). Drive 0 can mean Drive 1!

With IDE, you will probably only have to set whichever one is going to be the slave (essentially disconnecting the logic board), but some, when Masters, need to be told there is another drive present. Multiple IDE drives are often fraught with difficulty, especially with drives from different manufacturers—don't expect too much! The *Common Access Method* (CAM) is a way of ensuring that drives work together.

The configuration is usually done with jumpers or switches on the device itself, but increasingly, *Cable Selection* (CS) is used, where both are Masters, and the difference is resolved by the way the cable is made (it doesn’t have pin 28 connected at one end, i.e. grounded). If you have a problem connecting 2 drives, try making each a master on its own channel. A CD-ROM should switched as a Master if it’s by itself, but some don’t work at all that way. A SCSI drive needs an ID of 0 if it's to be the boot drive (the card will be 7).



The power lead will only go into its socket one way round, and the other cable(s) will have one edge in a different colour, usually red or blue. This indicates pin 1, and *must* be the right way round (usually, pin 1 goes towards the power connector). Just to make sure, look on the drive's circuit board and see whether one end of the connecting pins has actually been labelled as no 1 (or 34, in which 1 is at the opposite end). If you're using ESDI, MFM or RLL, there will be a slot cut into one side of the *edge connector*. The slot is nearest to pin 1.

CMOS

Now you must tell the computer what drive it will be talking to, through the CMOS Setup.

DO NOT USE THE HARD DISK UTILITY IN THE CMOS SETUP TO LOW LEVEL FORMAT AN IDE, ESDI or SCSI DRIVE!!!!!

Several types of hard disk are catered for, from *Not Installed* upwards, and there's a user-defined type (47) for anything strange, so you need to specify the following for each drive. Use *Not Installed* for SCSI, translating controllers or 8-bit controllers in ATs. The head/cylinder count of the disk must always be equal to or larger than that of the BIOS selection. The sectors per track must equal both the parameters of the hard disk controller and the hard disk.

Here are the settings required:

Cyln Number of cylinders.

Head Number of heads on the drive.

Wpcom When compensation for timing differences between inner and outer edges of the disk is given. Not needed for modern drives, but some manufacturers (e.g. Conner) specify 0; what they really mean to say is "disabled", so set 65535 or 1 more than the last cylinder (-1 will do as well). Setting 0 sometimes means that WPC will actually start at 0 and may confuse the drive.

Lzone The landing zone of the heads, or where they will go when the system is shut down or they are parked. Not needed if your drive is autoparking (most are).

Sectors per Track Usually 17 (MFM) or 26 (RLL), but varies (ESDI, SCSI, IDE).

Capacity The formatted capacity of the drive based on the following formula and further divided by 1048,576: Hds x Cyls x secs per track x 512 bytes (per cylinder).

There may be 3 size selections (and a different CMOS setting for each):

Normal Through the BIOS, with only one translation step inside the drive (so is invisible) and a max drive size of 528 Mb, derived from 1024 cylinders, 16 heads and 63 sectors per track, from the original MFM specification. Use if your drive is below 528 Mb, or your OS has a problem with translation.

Large Uses CHS translation for drives over 1024 cylinders, but without LBA support (see below). The number of cylinders is divided by 2 and the number of heads multiplied by 2 automatically, with the calculation reversed inside INT 13, so one translation is used between the drive and BIOS, and another between the BIOS and the rest of the machine, not at the same time, which is the real trick. This is sometimes known as Extended CHS. CHS stands for Cylinders, Heads, Sectors-per-track. As Intel-based PC's use 16 bit registers, all processes, on XTs or Pentiums, must use them for compatibility purposes. In case you're interested:

- DX uses 8 bits for the head number and 8 for the drive number.
- CX uses 10 bits for the cylinder number and 6 for the sector number.

The largest 10-bit number you can have is 1024 (0-1023), which is where the limit on cylinder numbers comes from, and the largest 6 bit number is 63 (1-63), allowing 63 sectors per track, but as the DX register with 8 bits actually allows up to 256 heads (0-255), you can use translation for drives up to 8 Gb and still remain compatible. Although you would be forgiven for using the same logic to support up to 255 drives as well (8 bits for the drive number in DX), unfortunately, the Interrupt Vector Table only has pointers to two I/O addresses (104h and 118h) in the BIOS Data Area, where such data is stored as the machine boots.

In addition, the WD 1003 controller, on which INT 13 is based, only allowed 4 bits for the head number and one for the drive. SCSI bypasses all this by setting the drive type as Not Installed, and including its own ROM on the controller. With translation, you have two levels of CHS - one for INT 13H and one for the device. The device CHS stops at 16 heads, hence 528 Mb.

Operating Systems still have to check the drive types using INT 13 when they start, however much they may bypass them with their own code later, so everything you need to get things running in the first place should be inside the first 1024 cylinders.

LBA Where CHS is internally translated into sequentially numbered blocks, a system stolen from SCSI. It allows drives larger than 528 Mb to be used (8.4 Gb), but has nothing to do with performance. In fact, it can make things slower, as it only reduces CPU overhead in operating systems using LBA themselves - more CPU cycles are used. It must be supported by the drive and the BIOS.

The BIOS in turn must support the INT 13 extensions, as must any operating system or application to get the best effect; for example, with Phoenix BIOS 4.03, if LBA is enabled with an appropriate drive, LBA will be used on all accesses to the drive. With 4.05, LBA will only be used if the INT 13 extensions are invoked, which saves an extra translation step by the BIOS.

LBA can therefore be enabled, but not necessarily used. Windows '95 supports INT 13, but LBA calls will only be made if its own **fdisk** has been used and a new partition type (0E or 0F) created. You may lose data if LBA is enabled or disabled after partitioning with it (or not), but it depends on the BIOS. Phoenix is OK in this respect.

A Phoenix BIOS converts between the device CHS and INT 13, with LBA in the middle. Others use their own methods, and 32-bit drivers, such as those used in Windows must be able to cope with all the variations, especially when they have to provide backwards compatibility for older drives, since most people insist on using their previous drive when they add a new one. As there so many variations, LBA mode may be slower with your particular BIOS, in which case use the Large setting instead.

Large and LBA may not be supported by Unix, as it can already handle big drives. Also, if your OS replaces INT 13, the drive may not be accessed properly. Some older AMI (pre 4-6-90) and Award BIOSes have compatibility problems with IDE and SCSI drives.

AMI BIOSes dated 7-25-94 and later and support translation, as do some versions of Award 4.0G, which implies various versions of the same BIOS! Revision 1.41a is the latest I have seen, but if yours is earlier than 12/13/1994, the address translation table is faulty. For drives with more than 1024 cylinders, you must use LBA rather than Large. MR have supported it since early 1990. Only BIOSes conforming to the IBM/Microsoft/Phoenix standards allow access to disks larger than 8GB.

Preparing drives for use

Once the drive is in the machine, you have to make it ready for use by formatting it. There are two routines for this, low-level and high-level; the latter is sometimes called the DOS format (both processes are done at the same time with floppy drives). As with all formatting, note that *all data is destroyed*. After low-level formatting, use **fdisk** and **format** to make it useable.

Low Level Formatting

This establishes the relationship between the controller and the drive and creates sectors or blocks, according to whether you use SCSI/ATA or otherwise; the start of a sector is marked with an *Address Mark*, which is not normally generated by data, so it's easily identified. The information which immediately follows contains each sector's unique Cylinder, Head, and Sector number. These overheads mean you will lose a small amount of capacity.

Low level formatting programs allow you to enter the drive's *defect list*, which specifies flawed tracks (defective tracks receive a special code in their sector headers); the bad defect list is usually attached to the drive. Later, high level formatting moves this information into the system's File Allocation Table (FAT) so the operating system doesn't use them.

In theory, you can exchange AT MFM and RLL controllers between drives, but expect to low level format a drive to match them properly (you *must* do this with XT drives and controllers).

XTs

XT class (that is, 8-bit) PCs are usually low-level formatted with a program included in the BIOS ROM of the controller card. You use DEBUG to get to it, and the command is usually:

```
DEBUG G=C800:5
```

for Western Digital, Seagate and Ultrastor controllers, anyway. C800 means the address in memory where the routines can be found (in the ROM on the controller card), and :5 is the location within that area. They could fool you, however, and use a different memory address; try CA00, CC00, CE00 or :6 as alternatives (the ROM is always on a 2K boundary). The address can often be changed with jumpers on the controller card. For SMS-OMTI or Adaptec controllers use **C800:6**, or even **C800:ccc**. For the DMA test on Adaptecs, use **C800:9**.

ATs

With ATs, you generally use third party software; as it happens, this is often supplied with the computer's BIOS. ESDI drives use the same method as XTs (above) if you are using the Translator ROM on the controller card. Set the drive type as 1. SCSI drives will have software supplied with the controller; set as *Not Installed*.

DO NOT LOW LEVEL FORMAT IDE DRIVES UNLESS YOU HAVE SPECIAL SOFTWARE!

You can, however, do it with a debug script; some are in the tables. The reason for having to do it properly is because the positioning information is either kept with the data it relates to, or on a separate platter. Either way, if it is destroyed, the drive becomes unuseable. Using a separate platter increases access times, but requires thermal recalibration every so often, and the resulting pauses aren’t good for multimedia playback.

Interleaving

At some stage during the low-level format, you may be asked what interleave you want. Interleaving is a way of improving performance by judicious positioning of data on the surface, which actually depends on the capability of the whole drive chain (i.e. hard disk, controller, DMA channel and the rest of the PC) to absorb data from the hard disk and pass it on.

This will not apply to IDE, ESDI or SCSI drives, since the majority of the controllers associated with them are powerful enough to cope with a sector of data at a time, and will automatically give a 1:1 interleave (see below). Those with RLL or MFM drives, step forward . . ..

After a sector has been read it must be moved from the controller's buffer into the computer. The time needed to transfer that sector's information determines how soon the controller will be ready to read the next one. If it isn't, the next sector containing the data you want will have passed by the read/write head and you will have to wait till it comes round again, wasting time waiting for data to be in the right position. A 1:1 interleave exists when sectors are filled one after the other in the proper sequence, i.e. 1 2 3 4, etc. If you position sequential sectors alternately, such as 1 3 2 4, you get a 1:2 interleave, where sector 3 is allowed to pass underneath so sector 2 can be taken up by the controller when it's ready.

If you had a less capable controller, you might want to make this looser, such as 1:3, in which case you get something like 1 4 6 2 5 7 3. Try to imagine picking balls up from a roulette wheel, if it makes it any easier.

To sum up; an interleave of 1 reads each sector in succession. An interleave of 2 reads alternate sectors and requires two revolutions of the disk to read the full track, and an interleave of 3 reads every third block, requiring three revolutions of the disk, and so on. It's quite common to see an interleave of 4 or 5 in PC or XT type machines (older Amstrads needed 7). Selection of an interleave where the data rate is excessive for the disk, controller and computer combination will reduce performance, because more disk rotations are required to complete the track read.

If you can't change the PC's ability to transfer data internally (by increasing the DMA channel speed, for instance), you must increase the size of the controller's buffer, to at least 512 bytes, which is the size of a standard sector.

The trouble is that you rarely know before you start what is the best interleave, since the whole PC is involved, but there are several programs, notably *Spinrite* and even some BIOSes that both give you the opportunity to both test and change the interleave factor of your hard disk without affecting your data (although you would be well advised to take a backup!).

RLL controllers may need a looser interleave than MFM controllers, because of the capacity of the ISA bus; and since there are 26 sectors per track, you need more revolutions of the disk to read or write 50% more data.

Partitioning with FDISK

Partitions were originally created to boot from different operating systems; a hard disk can have several, which are managed by the *Partition Table* at the beginning of it. The starting and ending locations for each partition are defined, together with which one controls the system during boot-up. Partitions don't know about the existence of each other, so your operating systems won't get mixed up (only one partition can be active at any time). The bigger your partitions are, the more you are likely to waste hard disk space, though this will depend on the size of file you regularly handle.

With FAT 16, disk space is allocated in *clusters*, the size of which depends on the size of your partition, which is limited in the first place because FAT entries are only 16 bits long and you can't have more than 65,536 clusters on any drive, so the bigger the drive is, the bigger the cluster has to be to compensate; 2K clusters mean a maximum drive size of 128 Mb. The maximum drive size you can have is 2 Gb, from the maximum cluster size of 32K, except with NT which can use 64K clusters.

The point is that if a file is smaller than the cluster it occupies, the rest of that cluster is unuseable. If the file spills over to a second, the remainder of the second is wasted, and so on. Although less FAT space is taken up with larger cluster sizes, to minimise wastage, choose smaller partitions, as far as convenience allows, e.g.:

Partition Size (Mb)	Cluster Size (K)
16-127	2
128-255	4
256-511	8
512-1023	16
1024-2048	32

You can see that with 1 1Gb partition and above, you would be wasting a high proportion of your hard disk space if your files are 20K or so!

FAT 32, as used with Windows 9x, gets around this, but can make things slightly slower, as all the data is not kept in memory, and the management of all those smaller sectors slows the drive down by about 5%. Also, Windows talks directly to the drive with LBA, ignoring the BIOS, assuming it supports INT13 extensions. This is done automatically for drives over 8 Gb, where it is known as FAT32X (0x0C in the partition table). Ordinary FAT32 (0x0B) is used for smaller drives and uses Extended CHS.

You can have up to 24 logical drives on a physical disk, only because there are only that many letters in the alphabet (A and B are already used for floppies).

DOS Format

Lastly, format each partition for the operating system. Once the format has been done, you will end up with five special areas on your hard disk:

- The *partition record*, or *Master Boot Record* (MBR), which indicates how the disk is divided. It is on cylinder 0, head 0, sector 1; the remaining 16 cylinders are not used.

- The *DOS Boot Record*, which contains a pointer to the File Allocation Table (FAT). This lives on cylinder 0, head 1, sector 1. It will contain information about the DOS version used for format, the number of bytes per sector, number of heads, etc.

- The *File Allocation Table*, which is a map of what clusters are associated with what file. DOS keeps a primary and secondary copy. The FAT can be either 12-bit (4096 12-bit entries), taking up 6K per copy, or 16-bit, with 64K 16-bit entries, taking up 128K for each entry. When a file is to be written to disk, DOS asks the FAT where to store it.

  Bad areas are noted in the FAT and marked as unuseable; these will be either hard or soft errors. Hard errors are physical defects on the hard disk surface, and soft ones occur when data fades to the extent that it cannot be read.

- The *Root Directory*, which comes after the second copy of the FAT. It has 128 entries for a 12-bit FAT and 512 for a 16-bit.

- The *Data Area*, for user data, and if the disk is bootable with DOS, the first two entries, **io.sys** and **msdos.sys**.

Notes

HD Tables

Figures given should be put into the CMOS. With MFM and RLL drives using ST-506, these will coincide with the physical characteristics, but larger ones using alternate systems (e.g. ESDI, IDE) will use sector translation to get round the normal maximum DOS/BIOS limits on a hard drive of 1023 cylinders, 16 heads and 63 sectors per track, so the figures won't correspond. Some drives, like the Miniscribe 3650, can format a higher number of cylinders than officially listed; this particular drive is written down as having 809 cylinders, but can safely be formatted to 842, as it actually has 852. If you use other figures, don't exceed the maximum sectors available (use the formula below to calculate this).

SCSI drives, of course, handle their own internal geometry, and the storage space is seen as a collection of LUNs, or *Logical UNits*, in which to store data, so the figures tend to be irrelevant anyway (with DOS, SCSI drives are set up as *Not Installed* in the CMOS).

Capacities are formatted capacities, wherever possible, correct to the highest sectors per track specified (assuming each one is 512 bytes).

However, the actual formatted capacity will depend on the controller used and the BIOS. SpT (*Sectors per Track*) settings may be switchable on the drive—especially with ESDI.

Normally, the formatted capacity of a disk is derived from the form:

$$\frac{\text{Cyls x Hds x SPT x 512}}{\text{1048,756}}$$

ESDI controllers offering alternate sectors per track will use:

```
Cyls x Hds x (SPT-1) x 512
```

Some manufacturers will divide by 1000 to give a better-looking formatted capacity. Modern drives do not require RWC, WPC or LZ, and may actually ignore your settings. For BIOS purposes, just add a 1 to the cylinder value, except where specified in these pages, which will effectively turn it off by using a non-existent cylinder.

Abbreviations

M	MFM, with ST506/ST412—usually 17 sectors per track.
R	RLL, with ST506/ST412—usually 26 sectors per track.
M/R	Either of the above, but may be unreliable with RLL
E	ESDI, with ST506/412—usually 34-36 sectors per track.
S	SCSI 1 Single-Ended (S-2=SCSI-2, F=Fast, W=Wide).
SASI	Shugart Associates System Interface—precursor to SCSI.
A	ATA, commonly known as IDE
I	IPI; Intelligent Peripheral Interface.
SMD	Storage Module Drive
XSMD	Extended SMD
Z	ZBR, or *Zone Bit Recording* (variable secs/track). Actually used by Seagate, but some other manufacturers may call it MZR (Multiple Zone Recording), where more sectors per track are used towards the outside edge of the disk.
H	Hardcard.
P	PCMCIA.
Par	Parallel Port.
F	Fibre
O	Optical

1776 Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
Tom Paine	A	400				Could be RLL
Patrick Henry I	S	2700				Could be ESDI
Patrick Henry II	S	62,000				

Adcomp

Model	Type	Cap	Cyls	Hds	SpT	Notes
ZF1000	S	1000				Sun
ZF250T	S	250				Sun
ZF500T	S	500				Sun
ZF750	S	750				Sun

ADIC

Advanced Digital Information Corp www.adic.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
700-109	S	109				
700-120	S	120				
APL 244D	S	244				
APL 366D	S	386				
APL 488D	S	488				
N1000	S	1000				
N1000/2	S	2000				
N1000/2-DP	S	2000				
N150	S	156				
N150/2	S	312				
N150/2-DP	S	312				
N330	S	332				
N330/2	S	664				
N330/2-DP	S	664				
N650	S	650				
N650/2	S	1326				

Advantage Memory Corp

Model	Type	Cap	Cyls	Hds	SpT	Notes
PCMCIA 170	P3	170				Pocketdrive
PCMCIA 260	P3	260				Pocketdrive

ADS

American Digital Systems

Model	Type	Cap	Cyls	Hds	SpT	Notes
Z 155	S	125				Masterdisk
Z 1600	S	1363				Masterdisk
Z 182	S	110				Masterdisk
Z 376	S	344				Masterdisk
Z 702	S	612				Masterdisk
Z 766	S	676				Portable

Alps Electric

Rebadged Conners? *Alps America* before merger. www.alpsusa.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
DR 232N2	A	86	820	2	51	
DR 232N8	A	135	1288	2	51	
DR 311C901	A	100	732	8	35	DC Pin Open 979 x 8 x 26?
DR 311C901	A	101	527	8	49	DC Pin Shorted
DR 311C911	A	117	545	8	55	DC Pin Open
DR 311C911	A	100	732	8	55	DC Pin Shorted
DR 312C901	A	202	527	16	49	DC Pin Open
DR 312C901	A	202	2108	4	49	DC Pin Shorted
DR 312C911	A	245	545	16	55	DC Pin Open
DR 312C911	A	245	527	16	49	DC Pin Shorted
DRR 040C(N)	A	40	799	4	26	
DRR 100C-50A	A	105	979	8	26	Also 732 x 8 x 35 DC=0 776 x 8 x 33 DC=1 911 x 9 x 25 DC=0,1 1465 x 4 x 35
DRR 100C-91A	A	100	732	8	35	
DRA 010A	M	10	306	4	17	
DRA 020A	M	20	615	4	17	
DRB 040	M	51				Unformatted
DRL 010A	M	10	306	4	17	
DRM 010A	M	10	615	2	17	
DRM 020A	M	20	615	4	17	
DRND 10A	M	10	615	2	17	
DRND 20A	M/R	20/32	615	4	17/26	
DRP 020A	R	20	615	2	26	Weird interface! SCSI?
DRP 020D	R	20	615	2	26	
DRQ 040D	R	40				ST 412
DR 311D901	S-2	106	2108	2	49	
DR 311D911A	S-2	120	2108	2	49	
DR 312D901	S-2	211	2108	4	49	
DR 312D911A	S-2	240	2108	4	49	
DRR 050D	S	49	979	4	26	

Model	Type	Cap	Cyls	Hds	SpT	Notes
DRR 100D	S	99	979	8	26	
DFL41311	?					

DR 31 Series/DRR 100C-50A

Single:	C/D, Act closed
Master:	C/D, Dsp closed
Slave:	Hsp, Dsp, Act, C/D open

31 Series SCSI

ID	0	1	2
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

Parity check enable: PAR=Shorted

Ampex

No longer producing hard drives

Model	Type	Cap	Cyls	Hds	SpT	Notes
PYXIS 13	M	10	320	4	17	
PYXIS 20	M	15	320	6	17	
PYXIS 27	M	20	320	8	17	
PYXIS 40	M	40	320	8	17	
PYXIS 7	M	5	320	2	17	

Amstrad

Model	Type	Cap	Cyls	Hds	SpT	Notes
DRMD 20A12A	A	21	615	4	17	
SRD 3040C-50	A	42	822	2	51	Rebadged Sony
SRD 3080C-50	A	80	964	10	17	Rebadged Sony

Andataco

www.andataco.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
10553	S-2F	1000				

Model	Type	Cap	Cyls	Hds	SpT	Notes
21553	S-2F	2100				
43753	S-2F	4300				
91753	S-2F	9100				

Apple Computer Inc

www.apple.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
HD 20		20				Non-SCSI 512K Mac floppy port
HD 160C	S	160				
HD 20SC	S	20	612	4	17	Mac Plus/SE. Miniscribe 8425SA
HD 40SC	S	40		2		CP 3045—strange i/face. Mac Portable
HD 80SC	S	80		5		
HD 160SC	S	160		5	39	5.25"
HD 160SC	S	160		8	39	3.5" 3600 RPM not sold separately
Internal 40SC	S	40		2		Sony SRD 3040A
Internal 2 Gb	S	2100	2756	19	62-97	ST 12550N

Applied Information Memories

Numbers (capacities) are suspicious!

Model	Type	Cap	Cyls	Hds	SpT	Notes
Dart 130	M	125	519	7	17	
Dart 170	M	160	519	9	17	
Dart 250	M	245			17	

APS Technologies

Alliance Peripheral Systems www.apstech.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
Q 1280	A	1282	2492	16	63	EIDE Fireball
ST 2140A	A	2140				EIDE Medalist
I 1080	S-2F	1080				
I 2160	S-2F	2000				
MS 1.0	S-2	1001				MS 4210 7200 RPM
MS 2.0	S	1955	4150			Micropolis 4221 7200 RPM
MS 4.0	S-2F	4095	3124	19	Var	Micropolis 3243 7200 RPM
MS 9.0	S	8500				
Q 1.0	S-2F	1025	3832	5	79-138	Atlas XP 31070 7200 RPM
Q 1080	S-3	1042	2864	16	46	Fireball 1080S 5400 RPM Sun
Q 18000(W)	S-3	18200				Quantum Atlas III
Q 2.0	S-2F	2050	3850	10	109	Atlas XP 32150 7200 RPM Sun
Q 2000	S	2051				Fireball Stratus +
Q 2100	S	2010				
Q 2210	S-2F	2102	4172	8	129	Capella VP 32210 5400 RPM Sun

Model	Type	Cap	Cyls	Hds	SpT	Notes
Q 3000	S	3079				Fireball Stratus +
Q 4.0	S-2F	4101	3850	20	109	Atlas XP 34300 7200 RPM Sun
Q 4000	S	4000				Fireball Stratus +
Q 4500W	S-3	4345				Quantum Viking
Q 514	S-2	491				Daytona 514S 4500 RPM
Q 6400	S-3	6149				Fireball Stratus +
Q 730	S	699				
Q 8000	S-3	8063				Fireball Stratus +
Q 840	S-2	810	2674	10	62	Trailblazer 850 4500 RPM Sun
ST 1.0	S-2F	1010	3992	5	103	ST 31230N 5400 RPM
ST 18000(W)	S-3	18200				
ST 2.0	S-2F	2047	3510	11	108	ST 32550N 7200 RPM
ST 2000(W)	S-3	3250	6311	4	175	ST 32272N(W)
ST 23000(W)	S-2F	23400	6880	28	237	ST 423451N(W)
ST 4.0	S-2F	4094	3711	21	107	ST 15150N 7200 RPM
ST 4200	S-2	4094	3992	19	110	ST 15230N 5400 RPM
ST 4300(W)	S-3	4340	6311	8	176	ST 34572N(W)
ST 4500(W)	S-3	4550	6526	8	170	ST 34501N(W)
ST 9.0	S-2F	8669	4925	27	133	ST 410800N 5400 RPM
ST 9000(W)	S-3	9100	5333	20	166	ST 19171N(W)
ST 9100(W)	S-3	9100	6256	16	170	ST 19101N(W) Cheetah
T 350	S-2	335	2050	4		MK 1824 FBW 4200 RPM
T 800	S-2	773	2360			MK 2628FB 4200 RPM
WD 2000(W)	S-3	2170				WDE 2170
WD 4300(W)	S-3	4360				WDE 4360
WD 9000(W)	S-3	8900				

Areal

Possible Disctec connection?

Model	Type	Cap	Cyls	Hds	SpT	Notes
A 1120	A	1290				EIDE
A 120	A	137	1024	4	60	AT/XT
A 120AT (1992)	A	136				
A 130	A	130	1438	2	89	Physical AT/XT
A 131	A	130				
A 135	A	130	856	5	60	
A 170	A	172	672	10	50	AT/XT
A 175	A	175	950	6	60	
A 180	A	180	715	10	50	AT/XT 1488 x 4 x 60
A 260	A	260	856	10	60	AT/XT 1438 x 4 x 94
A 265	A	265	856	10	60	
A 340	A	340	1020	12	63	AT/XT 2120 x 4 x 80
A 345	A	350	2106	4	81	Physical
A 520L	A	526	1020	16	63	EIDE
A 525	A	525	1020	16	63	AT/XT 2108 x 6 x 81
A 560	A	559				EIDE

Model	Type	Cap	Cyls	Hds	SpT	Notes
A 60	A	60	1024	7	17	
A 700L	A	735	1424	16	63	EIDE
A 80	A	80	665	14	17	
A 840	A	839				EIDE
A 85	A	85	705	14	17	AT/XT
A 90	A	91	715	10	25	AT/XT 1430 x 2 x 63
AD 2100	A	100				
BP 50	A	43	1720	1	60	
BP 100	A	103	860	4	60	1720 x 4 x 60
BP 200	A	204	3400	2	60	
MD 2050	A	50	819	2	60	
MD 2060	A	62	1024	2	17	AT/XT Glass Technology
MD 2065	A	62	1024	2	60	AT/XT
MD 2080	A	80	665	14	17	AT/XT 1326 x 2 x 60 Glass
MD 2085	A	86	705	14	17	AT/XT 1410 x 2 x 60
MD 2100	A	98	819	4	60	1638 x 2 x 60
RD 200	A	200				
AA 5180	S-2	720		20		
AA 9180	S-2	1440		36		
BP 100	S	106	1720	2	60	
BP 200	S	199	3400	2	60	
BP 50	S	53				
MD 2050S	S	48	819	2	60	
MD 2100S	S	96	1638	2	60	
RD 200	S	200				

Artecon

www.artecon.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
Turbo 1044	S	1044				Mercury
Turbo 134	S	134				Mercury
Turbo 141	S	141				Mercury
Turbo 172	S	172				Mercury
Turbo 318	S	318				Mercury
Turbo 350	S	350				Mercury
Turbo 660	S	636				Mercury

Atasi

HD division sold to Tandon and Western Digital. Possible connection with Vertex?

Model	Type	Cap	Cyls	Hds	SpT	Notes
617	E	149	1223	7	34	
628	E	234	1223	11	34	
638	E	319	1224	15	34	
6120	E	1051	1925	15	71	962 x 30 x 71

Model	Type	Cap	Cyls	Hds	SpT	Notes
676	E	676	1632	15	54	816 x 30 x 54
AT 3020	M/R	17/25	645	3	17/26	635 cyls? Not Xbc 1210
AT 3030	M	28	645	5	17	
AT 3033	M/R	28/42	645	5	17/26	635 cyls? Not Xbc 1210
AT 3046	M/R	39/60	645	7	17/26	635 cyls? (Oli BIOS)
AT 3051	M/R	43/65	704	7	17/26	733 cylinders?
AT 3051+	M	45	733	7	17	
AT 3053	M/R	44	733	7	17/26	
AT 3058	M	70	1024	8	17	
AT 3065	M	52	900	7	17	1024 cyls?
AT 3075	M	60	1024	8	17	900 cyls? (Oli BIOS)
AT 3085	M/R	68/109	1024	8	17/26	
502	M	46	755	7	17	
504	M	46	755	7	17	
519	M/R	160/244	1224	15	17/26	
514	M	117	1224	11	17	
V 130	M	26	987	3	17	Vertex?
V 150	M	43	987	5	17	Vertex?
V 170	M	60	987	7	17	Vertex?
V 185	M	71	1166	7	17	Vertex?
AT 3128	R	104	1024	8	26	ST 412
2053	S	43	1024	5	17	MFM recording
2085	S	68	1024	8	17	MFM recording
2128	S	104	1024	8	26	
2170	S	139	1366	8	26	
3128	S	104	1024	8	26	
519	S	160				
7120	S	1055	1935	15	71	
738	S	329	1225	15	36	
776	S	668	1632	15	54	
MacDisk II	S	380				

ATTO Technology

Model	Type	Cap	Cyls	Hds	SpT	Notes
SiliconDisk +/Pro	S-2F	129				Uses SIMMs (solid state)

AT & T

Model	Type	Cap	Cyls	Hds	SpT	Notes
KS 23054	M	30	697	5	17#	Rebadged CDC 94155-36
SXM 200	S	200				

Aura Associates

Model	Type	Cap	Cyls	Hds	SpT	Notes
AU 211	A	211				
AU 426	A	41	1104	2	38	Not known by manufacturer
AU 43	A	43		2		Discontinued
AU 85	A	85	977	8	17	
AU 126	A	126	872	5	35	Out in 1995
AU 245A	A	245				
AU 853	A	82	980	10	17	Not known by manufacturer
AU 1085P	P3	85				
AU 1170P	P3	170				
AU 126	P	126	872	5	35	
AU 170	P	170		4		
AU 63-III	P	63	2362	2	26	Superseded by AU 170
AU 85	P	85	977	8	17	
AU 211S	S-2	211				
AU 245S	S	245				

Automated Systems Methodologies

Model	Type	Cap	Cyls	Hds	SpT	Notes
Gig-in-box 2.0	Par	2000				
Gig-in-box 1.08	S-2F	1080				
Gig-in-box 1.5	S-2F	1500				
Gig-in-box 3.5	S-2F	3500				

Avastor

See Digiital

BASF

Model	Type	Cap	Cyls	Hds	SpT	Notes
6182	M	6	180	4	17	
6183	M	10	220	6	17	
6184	M	14	306	6	17	
6185	M	23	440	6	17	
6186	M	15	440	4	17	
6187	M	8	440	2	17	
6188	M	12	360	4	17	
6188-R1	M	10	612	2	17	
6188-R3	M	20	612	4	17	615 cyls?
6188-R12	M	10	616	2	17	
6188-R25	M	21	616	4	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
6192	M	41	1024	5	17	
6193	M	58	1024	7	17	
6194	M	75	1024	9	17	
6195	M	66	1024	8	17	
6196	M	90	1024	10	17	

Bay Microsystems Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
Bay 150	E	155				
Bay 320	E	320				
Bay 640	E	640				
Bay Micro 40	S	40				

Belfort

Try the Quantum equivalent

Model	Type	Cap	Cyls	Hds	SpT	Notes
B 5108A	A	1080	2100	16	63	Quantum Bigfoot
B 5128A	A	1220	2492	16	63	
B 5150A	A	1430				
B 5256A	A	2441	4994	16	63	
B 5300A	A	2861				
B 5450A	A	4291				

All drives

	PS	DS	CS
Single:	O	O	O
Master:	C	O	O
Slave:	O	C	O
Cable	O	O	C

Bering Technology

Model	Type	Cap	Cyls	Hds	SpT	Notes
EconoPac II/90	S-2	1200				HP compatible
EconoPac II/90	S-2	2100				HP compatible

Blue Disk

Model	Type	Cap	Cyls	Hds	SpT	Notes
CD 1241-ISA	A	124	976	8	31	
CD 1501-ISA	A	150	989	8	37	

Model	Type	Cap	Cyls	Hds	SpT	Notes
CD 2401-ISA	A	240	977	8	59	
CD 3251-ISA	A	325	1024	12	51	
CD 421-ISA	A	42	976	4	21	
CD 5101	A	510	977	14	72	

Borsu International

Model	Type	Cap	Cyls	Hds	SpT	Notes
HD 1000	S	1000				
HD 1200	S	1240				
HD 2000	S	2000				
HD 500	S	546				

Brand Tech

Makes drives for OEMs

Model	Type	Cap	Cyls	Hds	SpT	Notes
BT 9121A	A	107	1166	5	36	
BT 9170A	A	157	1072	7	41	
BT 9220A	A	200	1209	9	36	
BT 9400A	A	400	801	16	63	Phys 1800 x 6 x 36
BT 9650A	A	650	1800	10	36	Physical?
BT 8170E	E	132	1024	8	34	MFM/RLL?
BT 9121E	E	107	1166	5	36	
BT 9124E	E	105	1166	5	36	
BT 9170E	E	157	1072	7	41	
BT 9220E	E	200	1208	9	36	
BT 8085	M	68	1024	8	17	
BT 8120	R	104	1025	8	26	
BT 8128	R	127	1024	8	31	
BT 8170S	S	150	1024	8	34	
BT 220S	S	200	1208	9	36	
BT 9121S	S	107	1166	5	36	
BT 9170S	S	157	1072	7	41	
BT 9200S	S	200				

BT 9121A/9170A/9220A

Single:	M closed
Master:	M, 8 closed
Slave:	S (or M2) closed

BSM Corp

Model	Type	Cap	Cyls	Hds	SpT	Notes
KDK 20		20				
KDK 30		30				
KDS 49		49				
MacCider 100	S	105				
MacCider 80	S	80				

Bull Peripherals

Now owned by Honeywell—no longer producing hard drives.

Model	Type	Cap	Cyls	Hds	SpT	Notes
D 505	M	5	153	4	17	
D 510	M	10	306	4	17	
D 530	M/R	25/38	987	3	17/26	
D 550	M/R	43/62	987	5	17/26	
D 570	M/R	59/88	987	7	17/26	
D 585	M/R	71/104	1166	7	17/26	583 x 14 x 17

C Itoh

CIE America—Hard drives sold to Y-E Data

Model	Type	Cap	Cyls	Hds	SpT	Notes
YD 3161B	A	46	1057	2		
YD 3162B	A	91	1057	4		
YD 3042	S	41	788	4	26	31 SPT?
YD 3081B	S	46	1057	2		
YD 3082B	S	83	788	8	26	
YD 3083B	S	137	1057	6		
YD 3084B	S	182	1057	8		
YD 3181B	S	46	1057	2		
YD 3182B	S	91	1057	4		
YD 3530	M	32	731	5	17	
YD 3540	M	43	731	7	17	

Calluna Technology

www.callunacard.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
Callunacard 130	P	130				
Callunacard 170	P	170				
Callunacard 260	PII	260				
Callunacard 340	P	340				
Callunacard 510	PIII	510				

Model	Type	Cap	Cyls	Hds	SpT	Notes
Callunacard 1Gb	PIII	1000				
CT 105MC	P3	105	832	8	36	Try 828 x 8 x 31
CT 128MC	P3	130	992	8	32	Try 1009 x 4 x 63
CT 170MC	P3	170				
CT 260MC	P3	260				
CT 340MC	P3	340				
CT 70MC	P3	170	932	8	45	
CT 80MC	P3	85	923	4	45	Try 923 x 5 x 36
CT 1040RM	P	1040				
CT 521RM	P	520				

Canyon Technology

Model	Type	Cap	Cyls	Hds	SpT	Notes
HD 20Z	S	20				
HD 40Z	S	40				
HD 80Z	S	80				
HD 100Z	S	100				
HD 200Z	S	200				

Cardiff

Model	Type	Cap	Cyls	Hds	SpT	Notes
F 3053	M	44	1024	5	17	
F 3080(E)(S)	E/S	66	1024	5	26	
F 3127(E)(S)	E/S	109	1024	5	35	

CDC

Control Data Corp

All Imprimis; i.e. Seagate—original developers of the IDE interface. For jumper settings see Seagate equivalents. For more info, check out deskref.exe from Seagate BBS.

Model	Type	Cap	Cyls	Hds	SpT	Notes
94204-65	A	63	948	5	26	Seagate ST 274A
94204-71	A	71	516	10	27	ST 280A
94204-74	A	65	948	5	26	ST 274A
94204-81	A	71	516	10	27	ST 280A
94208-51	A	42	979	5	17	Compaq type 17
94208-62	A	62	967	5	27	
94208-75	A	60	989	5	25	Compaq type 47
92444-164	A	145	873	6	54	
94244-219	A	193	873	8	54	
94244-274	A	241	873	10	54	ST 2274A

Model	Type	Cap	Cyls	Hds	SpT	Notes
94244-383	A	338	873	14	54	ST 2383A
94244-502	A	502				
94314-136	A	120	1547	5	36	
94335-150	A	135	1072	9	28	
94354-90	A	79	536	10	29	ST 1090A
94354-111	A	98	536	10	36	ST 1111A
94354-126	A	109	536	14	29	ST 1126A
94354-133	A	117	636	10	29	ST 1133A
94354-155	A	139	536	14	36	ST 1156A
94354-156	A	138	1072	7	36	
94354-160	A	139	536	18	29	ST 1162A
94354-162	A	139	536	18	29	
94354-172	A	172	1072	12	26	
94354-186	A	164	636	14	36	ST 1186A
94354-200	A	174	536	18	36	ST 1201A
94354-201	A	174	536	18	36	
94354-230	A	211	954	12	36	ST 1239A
94354-239	A	211	954	12	36	ST 1239A
94604-767H	A	665	1356	15	64	
94156-48	E	40	925	5	17	MFM recording
94156-57	E	57				
94156-67	E	56	925	7	17	MFM recording
94156-72	E	72	925	9	17	MFM recording
94156-77	E	77				
94156-86	E	72	925	9	17	MFM recording
94166-101	E	85	969	5	36	
94166-103	E	104	969	6	35	
94166-121	E	107	969	6	36	
94166-138	E	139	969	8	35	
94166-141	E	118	969	7	36	
94166-161	E	142	969	8	36	
94166-182	E	152	969	9	34	ST 4182E
94166-86	E	87	969	5	35	
94171-300	E	300	1412	9		
94171-344	E		1549	9		
94181-574	E	330	1224	15	36	
94181-702	E	702	1549	15	50	
94186-265	E	234	1412	9	36	706 x 18 x 36
94186-324	E	286	1412	11	36	706 x 22 x 36
94186-383	E	319	1412	13	34	ST 4383E
94186-383H	E	319	1224	15	34	ST 4384E
94186-442	E	368	1412	15	34	ST 4442E
94196-766	E	664	1632	15	53	ST 4766E
94216-106	E	94	1024	5	34	ST 2106E
94246-180	E	152	1453	4	52	
94246-182	E	160	1453	4	54	ST 2182E
94246-186	E	160	1453	4	54	ST 2182E
94246-383	E	338	1747	7	54	ST 2383E

Model	Type	Cap	Cyls	Hds	SpT	Notes
94316-111	E	96	1447	5	26	
94316-136	E	128	1072	5	48	
94316-155	E	36	1072	7	36	
94316-200	E	174	1072	9	36	
94356-111	E	92	1072	5	34	ST 1111E
94356-155	E	128	1072	7	34	ST 1156E
94356-200	E	194	1072	9	36	ST 1201E
97200-23G	I					ST 82272K
97209-12G	I	1056	1635	15	Z	ST 81236K
97209-25G	I	2140	2611	19	Z	ST 82500K
97229-1050	I	1154	1635	14	Z	ST 81154K
97289-21G	I	2105	2611	16	Z	ST 82105K
97299-23G	I	2368	2611	18	Z	ST 82368K
97509-12G	I-2	1200	2101	17	Z	ST 41201K
77731608	M	29	670	5	17	BJ7D5A
77731612	M	27	797	4	17	BJ7D5A
77731613	M	31	733	5	17	BJ7D5A
77731614	M	23	670	4	17	BJ7D5A
94155-21	M	21	697	3	17	
94155-25	M	25	697	4	17	
94155-28	M	24	697	4	17	
94155-29	M	29	697	4	17	
94155-30	M	30	989	3	17	
94155-36	M	30	697	5	17	
94155-37	M	32	925	4	17	
94155-38	M	32	733	5	17	
94155-48	M	48	925	5	17	
94155-51	M	42	989	5	17	
94155-57	M	57	925	6	17	
94155-67	M	67	925	7	17	
94155-77	M	77	925	8	17	
94155-80	M	80	960	10	17	
94155-86	M	86	925	9	17	
94155-120(p)	M	65	960	8	17	
94155-135P	M	74	960	9	17	
94155-19	M	18	697	3	17	BJ7D5-
94155-21	M	21	697	3	17	BJ7D5-
94155-25	M	21	697	3	17	615x4x17 (Victor BIOS)
94155-28	M	24	697	4	17	BJ7D5-
94155-29	M	24	697	4	17	BJ7D5-
94155-30	M	30	733	5	17	
94155-36	M	30	697	5	17	aka AT&T KS 23054
94155-37	M	32	925	4	17	
94155-38	M	31	733	5	17	BJ7D5-
94155-48(p)	M	40	925	5	17	ATs—Disable J1/2
94155-51	M	43	989	5	17	
94155-56	M	72	925	9	17	
94155-57(p)	M	48	925	6	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
94155-67(p)	M	55	925	7	17	ATs—Disable J1/2
94155-77	M	64	925	8	17	
94155-85(p)	M	70	1024	8	17	ST 4085(p)
94155-86(p)	M	71	925	9	17	ST 4086(p)
94155-89	M	72	925	9	17	
94155-92(p)	M	77	989	9	17	
94155-96(p)	M	78	1024	9	17	ST 4097(p)
94156-48	M	40	925	5	17	
94156-67	M	55	925	7	17	
94156-72	M	71	925	9	17	
94156-86	M	72	925	9	17	
9416-182	M	144	969	9	17	
94204-51	M	40	989	5	17	
94204-65	M	64	941	8	17	
94204-71	M	70	1024	8	17	
94205-30	M	25	989	3	17	
94205-41	M	34	989	4	17	
94205-51(7201)	M	42	989	5	17	ST 253 precomp 128
94205-51(7229)	M	42	989	5	17	Wyse (no precomp)
94205-53	M	45	1024	5	17	
94205-55	M	44	1024	5	17	
94208-51	M	44	989	5	17	
94295-51	M	42	989	5	17	
94335-100	M	82	1072	9	17	
94335-150	M	80	1072	9	17	
94335-55	M	46	1072	5	17	
94351-172	M	172		9	17	
94355-100	M	83	1072	9	17	ST 1100 536 x 18 x 17
94355-150	M	128	1072	9	17	
94355-55	M	46	1072	5	17	
94356-200	M	172		9	17	
94155-120	R	102	960	8	26	
94155-130	R	123	1024	9	36	
94155-135	R	115	960	9	26	ST 4135R
94205-77	R	65	989	5	26	ST 279R
94208-75	R	60	966	5	26	Compaq type 47
94216-106	R	90	1024	5	17	
94314-136	R	120	1247	5	36	
94335-150	R	125	1072	9	26	
94354-111	R	71	1072	5	26	
94354-126	R	98	1072	7	26	
94354-133	R	83	1272	5	26	
94354-135	R	209	1072	9	42	
94354-155	R	98	1072	7	26	
94354-160	R	126	1072	9	26	
94354-172	R	172	1072	9	26	
94354-186	R	116	1272	7	26	
94354-200	R	126	1072	9	26	

Model	Type	Cap	Cyls	Hds	SpT	Notes
94354-230	R	150	1272	9	26	
94355-150	R	125	1072	9	26	ST 1150R 536 x 18 x 28
94355-156	R	138	1072	7	36	ST 1156R
94356-111	R	98	1072	5	26	
94356-155	R	138	1072	7	26	
94356-200	R	177	1072	9	26	
24221-125M	S	111	1024	3		
24221-209M	S	183	1024	5		
64161-155	S	140	969	9	34	Seagate MN something
9270-368	S	316	1217	10		
9270-500	S	427	1217	10		
9270-736	S	637	1635	15		
9270-850	S	727	1381	15		
9270-1230	S	1056	1635	15		
94161-101	S	84	969	5	34	
94161-103	S	104	969	6	35	
94161-121	S	121	969	7	35	
94161-138	S	139	969	8	35	
94161-141	S	121	969	7	35	
94161-155	S	152	969	9	34	
94161-182	S	155	969	9	34	ST 4182N
94161-86	S	86	969	5	35	
94171-300	S	300	1412	9	32	1365 x 9? 682 x 18 x ?
94171-307	S	300	1412	9	32	706 x 18 x ?
94171-327	S	300	1412	9	32	706 x 18 x ?
94171-344	S	344	1549	9	32	774 x 18 x ?
94171-350(M)	S	307	1412	9	46	ST 4350N 774 x 18 x ?
94171-375	S	330	1549	9	45	774 x 18 x ?
94171-376(M)	S	315	1549	9	45	ST 4376N 774 x 18 x ?
94181-383H	S	383	1224	15		
94181-385H/M	S	330	791	8	55	ST 4385N
94181-574	S	574	1549	15	32	774 x 30 x ?
94181-702	S	613	1546	15	50	ST 4702N 774 x 30 x ?
94186-383S	S	328	1412	13		706 x 26 x ?
94186-442S	S	442	1412	15	26	706 x 30 x ?
94191-766	S	676	1632	15	54	ST 4766N 816 x 30 ?
94196-766	S	676	1632	15	54	ST 4766N
94211-106	S	91	969	5	34	ST 2106N/94211-091
94211-125	S	107	1544	3	45	ST 2125N
94211-209	S	209	1547	5	26	
94211-91	S	88	969	5	36	aka 94211-106 992x5?
94221-125	S	110	1544	3	45	ST 2125N
94221-169	S	159	1310	5	Z	655 x 10 x ?
94221-184	S	184				
94221-190	S	140	1547	5	36	773 x 10 x ?
94221-209	S	183	1544	5	45	ST 2209N 773 x 10 x ?
94241-383	S	338	1261	7	74	ST 2383N
94241-502	S	435	1755	7	69	ST 2502N

Model	Type	Cap	Cyls	Hds	SpT	Notes
94244-383	S	160	1747	7	26	
94311-136S	S-2	115	1247	5	36	
94316-136	S	120	1247	5	36	
94351-90	S	79	1068	5	29	ST 1090N
94351-230S	S	204	1268	9	36	
94351-111	S	98	1068	5	36	ST 1111N 534 x 10 x ?
94351-126	S	110	1068	7	29	ST 1126N 534 x 14 x 36
94351-128	S	110	1068	7	29	534 x 14 x 36
94351-133S	S-2	113	1268	5	36	ST 1133NS 634 x 10 x ?
94351-134	S	134	1068	7	36	534 x 14 x 36
94351-155(S)	S	138	1068	7	36	ST 1156N(S) 534 x 14 x ?
94351-160	S	142	1068	9	29	ST 1162N 534 x 18 x 36
94351-172	S	172	1068	9	36	534 x 18 x 36
94351-186(S)	S	158	1268	7	36	ST 1186N(S) 634 x 14 x ?
94351-200(S)	S(-2)	174	1068	9	36	ST 1201N(S) 534 x 18 x 36
94351-230(S)	S-2	174	1268	9	36	ST 1239N(S) 636 x 18 x 36
94351-90	S	79	1068	5	29	ST 1090N
94354-90	S	76	1072	5	29	
94354-126	S	106	1072	7	29	
94354-135	S	121	1072	8	29	
94354-160	S	136	1072	9	29	
94354-172	S	151	1072	8	36	
94354-200	S	170	1072	9	36	
94601-12G	S	1037	1931	15	71	ST 41200N
94601-767H/M	S-2	665	1356	15	64	ST 4767N
97201-12G	S	1049	1635	15	Z	ST 81236N
97201-25G	S	2140	2611	19	Z	ST 82500N
97201-368	S	316	1217	10	60	ST 8368N
97201-500	S	378	1217	10	82	ST 8500N
97201-736	S	637	1635	15	Z	ST 8741N
97201-850	S	727	1381	15	Z	ST 8851N
97501-12G	S	1352	2101	17	74	ST 41520N
97501-15G	S-2	1500		17	74	
97501-16G	S	1370	2101	17	74	ST 41600N
97501-16G	S-2F	1719	2129	19	83	2624 cyls?
Wren 3	S	106	969	5		
Wren 8	S	1415	2107	15	87	
Wren 9	S-2F	1900	2573	15	96	
94151-xx SASI	SASI	51	921	3	36	256 bytes per sector
94151-25	SASI	25	921	3	36	256 bytes per sector
94151-27 Wren2	SASI	27	921	3	19	512 bytes per sector
94151-42 Wren2	SASI	85	921	5	36	256 bytes per sector
94151-44 Wren2	SASI	45	921	5	19	512 bytes per sector
94151-59 Wren2	SASI	119	921	7	36	256 bytes per sector
94151-62 Wren2	SASI	63	921	7	19	512 bytes per sector
94151-76 Wren2	SASI	153	921	9	36	256 bytes per sector
94151-80 Wren2	SASI	81	921	9	19	512 bytes per sector
97100-80	SMD	83	823	5	Z	ST 683J

Model	Type	Cap	Cyls	Hds	SpT	Notes
97150-160	SMD	165	823	10	Z	ST 6165J
97150-300	SMDE	315	823	19	Z	ST 6315J
97150-340	SMD	344	711	24	Z	ST 6344J
97150-500	SMD	516	711	24	Z	ST 6515J
97200-368	SMDE	316	1217	10	60	ST 8368J
97200-500	SMDE	428	1217	10	82	
97200-736	SMDE	641	1635	15	60	
97200-850	SMDE	727	1381	15	82	
97200-1130	SMD		1635	15	Z	ST 81123J
97200-12G	SMD	1056	1635	15	Z	ST 81236J
97200-1230	SMD	1056	1635	15	100	
97200-23G	SMD	2272	2611	19	Z	ST 82272J
97200-25G	SMD	2140	2611	19	Z	ST 82500J
97200-500	SMD	378	1217	10	8	ST 8500J
97200-736	SMD	637	1635	15	Z	ST 8741J
97200-850	SMD	727	1381	15	Z	ST 8851J
97500-12G	SMD	1200	2101	17		ST 41201J

94244-164, 219, 502

Single:	A, B, E in
Master:	A, B in; E out
Slave:	A in; no delay on startup
	B in; delay startup for 20 secs

94166-xxx

Bytes/sec	Secs/track	1-2	1-3	1-4
512	34	1	1	0
512	35	1	0	0
512	36	0	1	0
256	64	0	0	0

94151-xx SASI

S=Sector block size; On=512, Off=256

Wren III

J4

1-2	Term Power Source
3-4	Term Power Source
5-6	Parity Check
7-8-11-12	ID select
13-14	Motor Start

Centennial Technologies

Model	Type	Cap	Cyls	Hds	SpT	Notes
MicroDrive 170	P3	170				
MicroDrive 260	P3	260				
MicroDrive 340	P3	340				

Century Data

Model	Type	Cap	Cyls	Hds	SpT	Notes
CAST 10203	E	55	1050	3	35	525 x 6 x 35
CAST 10204	E	73	1050	4	35	
CAST 10304	E	75	1050	4	35	525 x 8 x 35
CAST 10305	E	92	1050	5	35	525 x 10 x 35
CAST 14404	E	112	1590	4	35	795 x 8 x 35
CAST 14405	E	140	1590	5	35	795 x 10 x 35
CAST 14406	E	168	1590	6	35	795 x 12 x 35
CAST 24509	E	253	1599	9	35	799 x 18 x 35
CAST 24611	E	310	1599	11	35	799 x 22 x 35
CAST 24713	E	366	1599	13	35	799 x 26 x 35
SS 170-2180	E	188				
CAST 10203S	S	55	1050	3	35	525 x 6 x 35
CAST 10304S	S	74	1050	4	35	525 x 8 x 35
CAST 10305S	S	92	1050	5	35	525 x 10 x 35
CAST 14404S	S	112	1590	4	35	795 x 8 x 35
CAST 14405S	S	140	1590	5	35	795 x 10 x 35
CAST 14406S	S	168	1590	6	35	795 x 12 x 35
CAST 24509S	S	253	1599	9	35	799 x 18 x 35
CAST 24611S	S	310	1599	11	35	799 x 22 x 35
CAST 24713S	S	366	1599	13	35	799 x 26 x 35

Chinook Technology

Model	Type	Cap	Cyls	Hds	SpT	Notes
CT-20	S	20				
CT-80	S	84				

Ciprico

Model	Type	Cap	Cyls	Hds	SpT	Notes
Rimfire 6703	S	4200				

CMI

Computer Memories Inc. Out of business. Original supplier for IBM AT. Tulin connection?

Model	Type	Cap	Cyls	Hds	SpT	Notes
CM 10E	M	10	650	2	17	
CM 15C	M	15	305	6	17	
CM 20E	M	20	650	4	17	
CM 30E	M	30	650	6	17	
CM 3206	M	10	306	4	17	
CM 3212	M	10	612	2	17	
CM 3412	M	10	306	4	17	
CM 3426	M	21	615	4	17	Not XTs or Xebec 1210/20
CM 4000	M	13		2	17	
CM 4426	M	21	615	4	17	
CM 5018H	M	15	845	2	17	
CM 514	M	58	961	7	17	
CM 5205	M/R	4/6	256	2	17/26	Not XTs or Xebec 1210/20
CM 5206	M/R	5/8	306	2	17/26	
CM 5410	M/R	8/13	256	4	17/26	
CM 5412	M/R	10/16	306	4	17/26	
CM 5616	M/R	13/20	256	6	17/26	
CM 5619	M/R	16/24	306	6	17/26	
CM 5640	M	32	640	6	17	
CM 5826	M	21	306	8	17	
CM 6213	M/R	11/17	640	2	17/26	
CM 6213S	M	5	320	2	17	
CM 6265	M	21	640	4	17	
CM 6413	M	10	615	2	17	
CM 6426	M/R	21/34	640	4	17/26	615 x 4?
CM 6426S	M	22	615	4	17	
CM 6626	M	21	640	4	17	
CM 6640	M/R	33	640	6	17/26	
CM 6853	M	42	640	8	17	
CM 7000	M	43	733	7	17	
CM 7030	M	24	733	4	17	
CM 7038	M	30	733	5	17	
CM 7053	M	43	733	7	17	
CM 7085	M	68	1024	8	17	
CM 7660	M/R	40/76	960	5	17/26	6 hds?
CM 7880	M/R	56/102	960	7	17/26	8 hds?

CMS Enhancements

Found in PS/2s/ASTs/Compaqs/NECs/AT&Ts.
Often disguised Conners and others. Some problems with Epson BIOSes.

Model	Type	Cap	Cyls	Hds	SpT	Notes
ACC 20	A	21	615	4	17	Commodore Colt XT

Model	Type	Cap	Cyls	Hds	SpT	Notes
B 040A1-M3540	A	40	980	5	17	Laptops
B 040A3-13	A	40	980	5	17	Laptops
B 040A5	A	40	820	6	17	
B 040A6	A	40	980	5	17	
B 040M50-P	A	40	820	6	17	
B 060F2	A	64	823	4	17	
B 080A3	A	85	526	8	39	
B 080A3-N	A	80	980	6	26	
B 080A5	A	130	1001	15	17	
B 1.0A1-U1	A	1281	2100	16	63	
B 100A5/M50	A	106	1024	12	17	
B 120 A2	A	125	872	8	35	
B 120A3-13	A	120	762	8	39	
B 120A5	A	130	1001	15	17	
B 150A3	A	170	332	16	63	
B 170A3	A	170	332	16	63	
B 200A2	A	212	989	12	35	
B 200A3	A	212	683	16	38	
B 200 A5	A	213	1024	12	34	
B 240A5	A	245	978	14	35	
B 340A2-N/A4	A	341	1010	12	55	Laptops
B 340A5	A	340	767	14	62	
B 420A4-U1	A	425	1010	16	51	
B 540A4-U1	A	541	1023	16	63	
B 730A4-U1	A	730	1416	16	63	
B 425A5	A	452	978	14	35	Possibly!
B 500A5	A	528	1024	16	64	
CQ Elite 520	A	514				Compaq
CQ LTE-120	A	127	980	15	17	
CQ LTE-340	A	340	969	14	49	
CQ LTE-386-200	A	209	985	13	32	
D 040A3	A	40	980	5	17	
D 40M30-SS	A	42	805	4	26	
F 70286D-WK	A	68	1032	5	26	
H 020A2	A	21	615	4	17	
H 020A3	A	21	782	2	27	
H 040A3	A	42	980	5	17	
H 040A3-AF	A	42	782	4	17	
H 040A3/10	A	42	980	5	17	
H 040CQ285D-P	A	43	805	4	26	Conner CP 344
H 100286	A	104	776	8	33	
H 100386	A	104	776	8	33	
H 100A3	A	104	776	8	33	
H 100CPQ3-P	A	104	776	8	33	
H 100CQ33-P	A	104	776	8	33	
H 140386-P/D	A					
H 20ASTB-P	A	21	782	2	17	
H 20286	A	21				

Model	Type	Cap	Cyls	Hds	SpT	Notes
H 200386	A	212	1366	8	38	
H 200CQ33	A	212	1366	8	36	
H 300CQ33	A					
H 40286	A	42	980	5	17	
H 40386	A	42	980	5	17	
H 40386S-S	A	44	733	7	17	
H 40ASTB-P	A	42	782	4	27	
H 40CQ286D	A	42	980	5	17	
H 40CQ286D-S	A	44	733	7	17	
H 40 CQP3-P	A	42	980	5	17	
H 60286	A	64	948	5	27	
H 60CQ286D	A	60	966	5	26	
H 60CQ-P	A	60	966	5	26	
K 020A2-N	A	21	615	4	17	
K 020A3-AF(N)	A	20	615	4	17	Conner in disguise.
K 020A7	A	21	782	2	17	
K 040A2-AF(N)	A	40	667	4	33	
K 040A3-N	A	40	523	4	41	CP 3044 in disguise
K 040A5	A	43	977	5	17	Try 782 x 4 x 27
K 040A6	A	42	980	5	17	
K 040A7	A	42	782	4	27	
K 045A3	A	44	733	7	17	
K 080A1-AF(N)	A	80	980	10	17	Try 1024 x 4 x 39
K 080A2-AF(N)	A	80	667	8	33	
K 080A3	A	84	832	6	33	
K 085A4	A	89	1024	10	17	
K 1.0A1	A	1020	887	30	77	
K 100A2	A	105	868	7	34	
K 100A3	A	100	776	8	33	Conner in disguise
K 120A2	A	120	667	12	33	1334 x 6 x 34
K 120A3	A	120	762	8	39	
K 120A4	A	130	1001	15	17	
K 160A2	A	180	1334	8	17	
K 160F2	A	160	1024	8	39	
K 180A2	A	180	667	16	33	1334 x 6 x 34
K 20AASTB-P	A	21	782	2	27	
K 20M25-ZS	A	21	636	2	36	
K 200A1-M2540	A	212	987	12	35	Laptops
K 200A2	A	210	1216	10	33	
K 200A3-I3	A	200	1024	8	48	1348 x 8 x 38
K 200A4	A	211	954	12	36	
K 340A5	A	426	895	15	62	
K 40ASTB-P	A	42	782	4	27	
K 40M25	A	42	805	4	26	
K 425A5-M3540	A	425	895	15	62	Laptops
K 500A1	A	560	1020	16	67	
K 500A3	A	544	1023	16	63	
LD 1400J-40LT	A	40				Litedrive

Model	Type	Cap	Cyls	Hds	SpT	Notes
LD CQSLT-40	A	42	1047	2	40	
LD CQSLT-80	A	85	980	10	17	
LD EP286-R80	A	80	1024	9	17	
LDS 3100-40	A	42	948	5	17	
LDS NECHD-20	A	20	612	4	17	
LDS NECMS-20	A	20	612	4	17	
LDZE 386-100	A	100	776	8	34	
NVersa 340	A	520				NEC
TP 750-520	A	524				Thinkpad
T4700-520	A	520				Toshiba
F 115ESDI-T	E	114	914	7	35	PS/2 models 60/80
F 150AT-WCA	E	150	969	9	34	
F 150EQ-WCA	E	150				
F 320AT-WCA	E	320	1224	15	34	
F 320ESDI-T	E	320				PS/2 models 60/80
F 650E1-(N)MV	E	650	1632	15	54	PS/2
F 660E1-AFV	E	660	1632	15	54	
F 70ESDI-T	E	70	582	7	35	PS/2 models 60/80
F 702086D	E	73				
H 130E1-MV(N)	E	130	1224	7	33	PS/2
H 140E1-AFV	E	140	1224	7	33	
H 330E1 Express	E	329	1780	7	54	890 x 14 x 54 PS/2
H 340E1 Express	E	329	1780	7	54	890 x 14 x 54
K 080F2-M5070	EFB2	80				
K 095E1-AFV	E	95	915	7	36	
K 120M50Z70-P	EFB2	120	925	8	32	PS/2
K 160F2-M5070	EFB2	160				
K 30M30E-P	EFB2	30	615	4	25	PS/2
K 60M50Z/70-P	EFB2	60				
PS Express 140	E	140				
PS Express 150	E	150	969	9	34	PS/2 models 60/80
PS Express 320	E	320	1224	15	34	PS/2 60/80 aka K 020M3-N
PS Express 340	E	340				
PS Express 670	E	670				
PS Express 95	E	95				
D 020M30	H	20	615	4	17	Not in AT&Ts
D 020M6-X	H	20	615	4	17	XTs only
D 030R6-X	H	30	615	4	26	RLL XTs only.
D 030XT-OK	H	32	615	4	26	aka D 030R6-X RLL
D 20ATT-WS	H	20	615	4	17	AT&T 6300 aka K 030M3-N
D 30ATT-SS	H	30	615	4	26	RLL AT&T
D 30ATTW3	H	30	615	6	17	MFM AT&T
D 40XT-WS	H	40	977	5	17	XTs
D 80XT	H	80	1024	9	17	aka K 080M2-N
K 020M3-N	H	20	615	4	17	aka D 20M30
K 030M3-N	H	30	615	6	17	aka D 30ATTWS
K 080M2-N	H	80	1024	9	17	aka D 80XT-WC XTs
AH 20TAN-WS	M	20	615	4	17	Tandy 1000

Model	Type	Cap	Cyls	Hds	SpT	Notes
AH 40DS	M	40	820	6	17	XTs
D 20M30-OK	M	20	615	4	17	
D 20XT-OK	M	21	615	4	17	XTs only
D 40XT-WS	M	42	977	5	17	
D 80XT-WC	M	80	1024	9	17	aka K 080M2-N
F 070M3-A(N)	M	70	1024	8	17	
F 40-K	M	42	1024	5	17	
F 60-K	M	61	1024	7	17	
F 65M60K	M	65	1024	8	17	PS/2 models 60/80
F 70-K	M	70	1024	8	17	
F 80-K	M	80	1024	9	17	
H 020M6-A(X)	M	20	615	4	17	aka H 20AT-S/AH20TAN
H 080M3-A	M	80	1071	9	17	aka K 080M2-A
H 080M4-A(N)	M	80	1314	7	17	
H 040M3-A,N,X	M	40	820	6	17	X=XT
H 40M50P	M	42	977	5	17	
H 65M50P	M	65	1024	9	17	
HD 20AT-S	M	21	615	4	17	
HD 30AT-S	M	32	615	6	17	
HD 40AT-S1	M	43	820	6	17	
K 020M3-N	M	20	615	4	17	XTs AT&T 6300
K 020M25-OK	M	21	615	4	17	
K 020M25-WS	M	21	615	4	17	
K 020M4-M2530	M	20	615	4	17	PS/2 25/30
K 020M4-N(X)	M	20	615	4	17	X=XT
K 030M25-OK	M	32	615	6	17	
K 030M25-WS	M	32	615	6	17	
K 040M25-WS	M	42	820	6	17	
K 040M3-N	M	40	977	5	17	
K 040M5-N	M	40	820	6	17	
K 080M2-A(N)	M	80	1071	9	17	aka H 080M3-A
K 080M25Z	M	84	1072	9	17	
K 20M25/30	M	20	615	4	17	XTs OK/-WS
K 30M25/30-WS	M	30	615	4	17	
K 40	M	40	1024	5	17	
K 60	M	60	1024	7	17	
K 70	M	71	1024	8	17	
K 80	M	82	1024	9	17	
B 030F1-PS1	PS/1	30	920	2	33	Plug in and Play
H 40M50-P	PS/2	40	977	5	17	Embedded MFM
H 65M52-P	PS/2	65	1071	9	17	PS/2 model 50
K 030F1-M2530	PS/2	30	920	2	33	Model 25/30 286
K 040M3-M2530	PS/2	40				Model 25/30 286
K 120M50Z-70	PS/2	120	925	8	32	ESDI PS/2 50Z/70
K 30M30E-P	PS/2	30	615	4	17	
K 50M50Z	PS/2	63	767	6	27	
K 60M50Z/70-P	PS/2	60	767	6	26	
D 30XT-OK	R	32	615	4	26	

Model	Type	Cap	Cyls	Hds	SpT	Notes
H 040 R6-X	R	40	667	4	31	aka H 40RLL-SS X=XT
K 030M4-M2530	R	30	615	4	26	PS/2 models 25/30
K 030R4-X	R	30	615	4	28	XT
K 30M25/30-OK	R	30	615	4	26	
H 65M50-P	SMD	65	1024	9	17	
1133OSI-NV	S	330				
E 1.0S1-NV	S	1000	831	15	28	Lanstack 1000
E 150S1-NV	S	150	1780	7	54	Lanstack 150
E 200S2-N	S	200				
E 325S0-NV	S	325	1457	8	57	External
E 330S1-NV	S	330	1780	7	54	Lanstack 330
E 650S0-NV	S	650	1457	16	57	External
E 660S1-NV	S	660	831	15	28	Lanstack 660
F 1.0S1-NV	S	1000	831	15	28	Sentry 1000
F 325S0-NV	S	325	1457	8	17	
F 650S0-NV	S	650	1457	16	57	
F 660S1-NV	S	660	831	15	28	Sentry 660
H 150S1-NV	S	150	1780	7	54	Sentry 150
H 330S1-NV	S	330	1780	7	54	Sentry 330
H 60SCSI-S	S	65	628	6	34	
H 80AT	S	84	1072	9	17	
H 80SCSI	S	81	820	6	34	
H C60SCSI-S	S	60	628	6	34	
K 080S1-M55N	S	80	1021	4	39	PS/2 55SX
K 080S1-M70N	S	80	1021	4	39	PS/2 50Z/70
K 080S1-M80N	S	80	1021	4	39	PS/2 80
K 160S1-M55N	S	160	1021	8	39	PS/2 55SX
K 160S1-M70N	S	160	1021	8	39	PS/2 50Z/70
K 160S1-M80N	S	160	1021	8	39	PS/2 80
K 200S2-N	S	200				
K 320S1-M55N	S	320	951	15	44	PS/2 55SX
K 320S1-M70N	S	320	951	15	44	PS/2 50Z/70
K 320S1-M80N	S	320	951	15	44	PS/2 80
K 380S1-6000N	S	380	1199	14	39	IBM RISC System 6000
K 400S1-M55N	S	400	1199	4	48	PS/2 55SX
K 400S1-M70N	S	400	1199	4	48	PS/2 70
K 400S1-M80N	S	400	1199	4	48	PS/2 80
K 45M30286	S	48	615	6	26	
K 60M30286	S	60	921	5	26	
K 80M30286	S	84	906	7	26	
LDMAC20	S	20				MacLite
LDMAC40	S	40				MacLite
MacStack 40U	S	40				
MacStack SD20	S	21				
MacStack SD30	S	31				
MacStack SD45	S	47				
MacStack SD60	S	62				
MacStack SD81	S	82				

Model	Type	Cap	Cyls	Hds	SpT	Notes
MC 100	S	100				Mac (NEC)
MC 20	S	20				Mac (Seagate)
PB 340	S-2	340				
PB 520	S-2	520				
PC Stack 80	S	80				
PC Stack 45	S	45				
PI E660S1-II	S	660	831	15	28	
PI E1.0S5-II	S	1000				
PI E1.0S1-II	S	1000				
PI E1.3S1-II	S	1300				
PI E1.4S1-II	S	1400				
PI E1.75S1-II	S	1800				
PI II Enh 1	S	1050	1747	15	58-94	Micropolis 2112
PI II Enh 2	S	2100	2280	21	71-94	Micropolis 1924
PI 80B	S	81				PI=Platinum
PI 80C	S	81				
PI 80R	S	81				
PI PD 100	S	101				
PI PD 1000	S	1007				
PI PD 130	S	131				
PI PD 150	S	150				
PI PD 170	S	172				
PI PD 175	S	176				
PI PD 175B	S	176				
PI PD 175C	S	176				
PI PD 20	S	20				
PI PD 200	S	202				
PI PD 200	S	202				
PI PD 300	S	291				
PI PD 40	S	40				
PI PD 600	S	585				
PI PD 80	S	81				
PI PI 1000A	S	1007				
PI PI 100B	S	101				
PI PI 100C	S	101				
PI PI 100R	S	101				
PI PI 130B	S	131				
PI PI 130C	S	131				
PI PL 150A	S	150				
PI PI 170A	S	172				
PI PI 200B	S	202				
PI PI 200C	S	202				
PI PL 20R	S	20				
PI PL 300A	S	291				
PI PL 40B	S	38				
PI PL 40C	S	38				
PI PL 40R	S	38				
PI PI 600A	S	585				

Model	Type	Cap	Cyls	Hds	SpT	Notes
Pres 160	S	160				Pres=Presidential
Pres 320	S	320				
Pres 80	S	80				
Prevail 325	S	325				
Prevail 660	S	650				
Sentry 180	S	180	1546	5		
Sentry 300	S	290	1546	9		
Sentry 600	S	600	1546	15		
Sentry 90	S	90	1024	5		
Sprinter 45E	S	45				(SSTSETUP) External
Sprinter 45EMC	S	44				MCA Run AutoConfig
Sprinter 45I	S	44				Internal, Removable
SSE-155	S	155				
SSE-300	S	300				
SSE-702	S	702				
SSE-766	S	766				
Zeroslot 45	S	45				
Zeroslot 60	S	60				
Zeroslot 80	S	80				

F 070M3-A

W2 On	Write fault
W8	Drive Slct

W1, W2 always jumped. Sw 8 should be closed on some Mac SCSI drives - reset line on pin 40, handshaking.

K 080S1/K 160S1

J3	1-2	3-4	5-6
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

K 020A3-AF(N)/K 100A3

Single:	ACT, C/D
Master:	C/D, DSP
Slave:	None

K 200A3

Single:	E2
Master:	E1, E2
Slave:	None

Sprinter 45E

ID	1	2	3
0	D	D	D
1	D	D	U
2	D	U	D
3	D	U	U
4	U	D	D
5	U	D	D
6	U	U	D

Sprinter 45EMC/451

0	0
1	1
2	2
3	1,3
4	4
5	1,3
6	2,3
7	1,2,3

K 380S1-6000/K 320S1-M55N

ID	0	1	2
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

Do not use bit 3 (inside)

Cogito

Model	Type	Cap	Cyls	Hds	SpT	Notes
CG 906	M	5	306	2	17	
CG 912	M	11	306	4	17	
CG 925	M	21	612	4	17	
PT 912	M	11	612	2	17	
PT 925	M	21	612	4	17	

Columbia

Model	Type	Cap	Cyls	Hds	SpT	Notes
Columbia SCSI	S	42	834	3		

Commodore

Made by JCT

Model	Type	Cap	Cyls	Hds	SpT	Notes
1000	M	5	131	4	17	
1005	M	7			17	
1006	M	7	436	2	17	
1010	M	14	436	4	17	

Compaq

See also Conner Peripherals. Model nos = part nos

Model	Type	Cap	Cyls	Hds	SpT	Notes
107357	A	41	980	5	17	
107790	A	96	748	8	33	
108058	A	43	980	5	17	
108080	A	135	966	16	17	
110358	A	43	524	4	40	
1107790	A	101	748	8	33	
112438	A	80	832	6	33	
112525	A	112	832	8	33	
112526	A	43	805	4	26	
112527	A	21	615	4	17	
113016	A	20	615	4	17	
113030	A	43	980	5	17	
113217	A	62	966	5	25	
113219	A	300	611	16	52	ESDI?
114106	A	41	980	5	17	
114463	A	20	615	4	17	
114465	A	21	615	4	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
115181	A	621	1631	15	52	ESDI?
115182	A	310	872	14	52	
115668	A	80	832	6	33	
116560	A	116	760	8	39	
116805	A	203	683	16	38	
116806	A	116	760	8	39	
117115	A	20	615	4	17	
117288	A	41	548	4	38	
123785	A	340	659	16	63	Conner CP 3361 Type 63
123786	A	510	989	16	63	Conner CP 3541 Type 61
131390	A	121	760	8	39	Conner CP 30121E Type 50
137772	A	126	895	5	55	Conner CFS 210A Type 65
137773	A	171	332	16	63	Conner CFA 170A Type 65
137774	A	128	919	16	17	Quantum LPS 120AT Type 50
137790	A	244	720	13	51	Quantum LPS 240 Type 1
137867	A	426	826	16	63	Conner CFS 420A Type 65
139716	A	528	1023	16	63	Conner CP 30541 Type 42
141086	A	244	720	13	51	Quantum LPS 240AT Type 1
141647	A	121	760	8	39	Quantum LPS 120AT Type 50
143343	A	121	760	8	50	Quantum LPS 127AT Type 50
143344	A	42	966	5	17	Quantum ELS 40AT Type 18
143345	A	84	832	6	33	Quantum ELS 85AT Type 27
147203	A	121	760	8	39	Conner CP 30121 Type 50
147204	A	244	720	13	51	Conner CP 30251 Type 1
160162	A	270	997	10	53	Conner CFA 270A Type 65
160163	A	252	895	10	55	Conner CFA 240A Type 65
160686	A	104	905	9	25	Seagate ST 3123A Type 32
160687	A	107	905	9	25	Conner CFS 210A Type 65
160688	A	213	683	16	38	Seagate ST 3243A Type 51
160689	A	213	685	16	38	Conner CFS 210A Type 65
163668	A	211	723	15	38	Quantum LPS 210A Type 65
164830	A	343	665	16	63	Conner CFS 420A Type 65
177079	A	422	1010	16	51	Quantum LPS 420AT Type 65
168727	A	171	1011	15	22	Quantum LPS 170AT Type 65
184037	A	212	1024	12	34	Seagate ST 3250A Type 50
184053	A	271	944	14	40	Quantum Mav 270AT Type 65
184054	A	528	1024	16	63	Quantum Mav 540AT Type 65
184055	A	730	1416	16	63	Quantum Ltng 730AT Type 65
184150	A	340	659	16	63	Seagate ST 3391 Type 63
194328	A	171	332	16	63	Conner CP 30171 Type 65
194346	A	270	942	14	40	Quantum LPS 270 Type 65
194357	A	340	659	16	63	Seagate ST 3390A Type 63
198347	A	528	1023	16	63	Quantum LPS 540 Type 42
198375	A	342	1011	15	44	Quantum LPS 340AT Type 65
100703	M	10	306	4	17	
102626	M	70	925	9	17	
104404	M	20	615	4	17	
106269	M	20	612	4	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
107338	M	20	615	4	17	
107339	M	40	980	4	17	
108076	M	40	980	9	17	
142002	S	330	314	64	32	Fujitsu M2622FA 1429 x 7 x 56-70 Ph
142003	S	558	532	64	32	HP C 2244 1981 x 8 x 58-96 Ph
142004	S	1050	1001	64	32	HP C 2247 1981 x 13 x 56-96 Ph
142153	S	558	532	64	32	Micropolis 2105 1744 x 8 58-94 Ph
142154	S	1050	1001	64	32	Micropolis 2112 1744 x 8 58-94 Ph
148158	S	536	511	64	32	CP 30540 2242x6x59-89 Ph
142188	S	558	532	64	32	Fujitsu M 2691ES 1819x8x58-96 Ph
142189	S	1050	1001	64	32	Fujitsu M2694ES 1819x15x58-96 P
142215	S	2097	255	255	63	HP C 2490 2582 x 18 x 68-108 Ph
142292	S	1050	1001	64	32	IBM 0662 4119 x 5 x 90-108 Ph
142294	S	2104	255	255	63	Seagate ST 12550 2707x19x58-97
199513	S	536	511	64	32	DEC DSP 3053L 3117x 4 x 59-119 P

Comport

Model	Type	Cap	Cyls	Hds	SpT	Notes
2040	A	44	820	4	26	
2041	R	44	820	4	26	
2082	S	86	820	6	34	

Computer Connection

Model	Type	Cap	Cyls	Hds	SpT	Notes
PL 540U	A	540				
PL810U	A	810				
PL 1200U	A	1200				
Plugger 540	Par	540				
Plugger 810	Par	810				
Plugger 1200	Par	1200				

Computer Network

See Maxtor

Computer Product Center

Model	Type	Cap	Cyls	Hds	SpT	Notes
HICN(M) 245I	A	245				Hilite
HICM 340I	A	345				Hilite

Conner Peripherals

Originally partly owned by Compaq. Now owned by Seagate.

CFA spec is superior to CFS
Drives ending in: 1=Compaq 2=Conner 3=Zenith
www.seagate.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
CFA 1080A	A	1080	2100	16	63	Filepro Advantage
			524	64	63	Large
CFA 1275A	A	1275	2479	16	63	Filepro Advantage Table 8
			619	64	63	Large
CFA 170A	A	170	332	16	63	As for CP 30174 Table 8
CFA 210A	A	210	685	16	38	
CFA 2161A	A	2147	1023	64	63	ST 32161A
CFA 240A	A	252	895	10	55	
CFA 270A	A	270	524	16	63	2805 x 2 x 72-114
CFA 340A	A	340	665	16	63	As for CP 30344 Table 8
CFA 420A	A	420	826	16	63	
CFA 425A	A	426	839	16	63	
CFA 540A	A	540	1048	16	63	2805 x 4 x 72-114 Ph Table 8
			524	32	63	Large
CFA 810A	A	810	1572	16	63	2801 x 6 x 71-113 Ph Table 8
			786	32	63	Large
CFA 850A	A	850	1651	16	63	Table 8
			826	32	63	Large
CFL 350A	A	350	905	12	63	Filepro notebook Table 5
CFL 420A	A	422	818	16	63	Kiwi Table 5
CFN 170A	A	170	326	16	63	1339 x 4 x 47-72 Table 5
CFN 250A	A	250	489	16	63	1339 x 6 x 47-72 Table 5
CFN 340A	A	340	667	16	63	Filepro notebook Table 5
CFN 422A	A	422	826	16	63	EIDE
CFP 1370	A	1400				
CFP 545	A	545				
CFS 1080A	A	1080	2100	16	63	Table 8
CFS 1081A	A	1080	2097	16	63	ST 31081A
			524	64	63	Large
CFS 1275A	A	1275	2479	16	63	Table 8
			2477	16	63	Revision A
			619	64	63	Large
CFS 1276A	A	1275	2479	16	63	
			524	64	63	Large
CFS 1621A	A	1621	3146	16	63	
			786	64	63	Large
CFS 210A	A	210	685	16	38	2395 x 2 x 63-100 Table 8
CFS 270A	A	270	600	14	63	Cabo Table 5
CFS 420A	A	420	826	16	63	2395 x 4 x 63-100 Table 8
CFS 425A	A	425	839	16	63	Cabo Table 5
CFS 540A	A	540	1048	16	63	Cabo Table 8

Model	Type	Cap	Cyls	Hds	SpT	Notes
			525	32	63	Large
CFS 541A	A	541	1048	16	63	
			599	28	63	Large
CFS 635A	A	635	1238	16	63	
			619	32	63	Large
CFS 636A	A	635	1238	16	53	
CFS 850A	A	850	1651	16	63	EIDE Cabo Table 5
			826	32	63	Large
CP 1034	A	32	917	4	17	
CP 1044	A	42				1.8"
CP 2022	A	23	615	4	17	Laptops Try 733 x 2 x 26
CP 2024 Kato	A	21	615	4	17	Laptops Try 653 x 2 x 32 Table 3
CP 2027	A	20	615	4	17	
CP 2031	A	30	41	4	38	Compaq Type 59
CP 2034 Pancho	A	32	823	2	38	Laptops Try 411 x 4 x 38 Table 3
CP 2041 Pancho	A	42	548	4	38	Compaq Type 53 Table 3
CP 2044 Pancho	A	42	980	5	17	Laptops Try 548 x 4 x 38 Table 4
CP 2048 Pancho	A	42	548	4	38	Compaq Type 53 Table 3
CP 2061 Pancho	A	60	823	4	38	Compaq type 60 Table 3
CP 2064 Pancho	A	64	823	4	38	Laptops Table 3
CP 2064E	A	64	823	4	38	1181 x 2 x 53 Sahara
CP 2067	A	64	823	4	38	
CP 2081	A	80	665	14	17	Compaq
CP 2084 Pancho	A	85	548	8	38	1096 x 4 38 Table 4
CP 2088 Honshu	A	85	548	8	38	1096 x 4 x 38 Table 3
CP 2104	A	121	762	8	39	1123 x 4 x 53
CP 2124 Pancho	A	120	762	8	39	1123 x 4 x 53 Table 4
CP 2124HCD	A	126	582	8	53	1164 x 4 x 53 Table 4
CP 2174	A	168	326	16	63	
CP 2254 Trigger	A	253	489	16	63	1339 x 6 x 47-72 Table 5
CP 2304	A	209	1348	8	39	
CP 3000	A	42	980	5	17	1045 x 2 x 40 Table 1
CP 30061 Hopi	A	61	759	4	39	Compaq 55 Table 6
CP 30064(H)	A	61	762	4	39	1524 x 2 x 39 Table 7
CP 30081	A	84	526	8	39	
CP 30084 Hopi	A	84	526	8	39	1053 x 4 x 39 Table 6
CP 30084E	A	84	903	4	46	1806 x 2 x 46 Table 5
CP 30100	A	121	761	8	39	Compaq
CP 30101(G)	A	121	762	8	39	Compaq type 50 Table 6
CP 30103	A	121	762	8	39	
CP 30104(H)	A	121	762	8	39	Cpq 50/NEC 1504x4 x39 Table 6
CP 30109	A	121	762	8	39	Compaq type 50
CP 30120	A	121	762	8	39	Compaq
CP 30121	A	121	762	8	39	Compaq type 50
CP 30121E	A	116	999	14	17	Compaq type 50
CP 30124	A	125	895	5	55	1985 x 2 x 62 Table 8
CP 30160	A	160				
CP 3017	A	170	332	16	63	Aka CFA 170A - as for CP 30174

Model	Type	Cap	Cyls	Hds	SpT	Notes
CP 30171	A	171	332	16	63	
CP 30174	A	170	332	16	63	2111 x 2 x 67-91 Table 5
CP 30174 (E,H)	A	170	903	8	46	As for CFA 170A Table 5
CP 30201	A	210	671	12	51	
CP 30204	A	212	683	16	38	2124 x 4 x 49 Cougar Table 5
CP 3021(i)	A	21	615	4	17	Compaq Try 805 x 2 x 26 Table 7
CP 3022	A	21	615	4	17	636 x 2 x 33 Table 7
CP 3023	A	18	733	2	26	
CP 3024	A	21	615	4	17	636 x 2 x 33 Table 1
CP 30251	A	244	720	13	51	
CP 30254	A	250	895	10	55	1985 x 4 x 62 (-1 Cpq) Table 8
CP 30256	A	250	895	10	55	
CP 3026	A	21	615	4	17	CP 3024 remade for Olivetti
CP 3034	A	340	665	16	63	Aka CFA 340A – as for CP 30344
CP 30344	A	343	667	16	63	As for CFA 340A Table 8
CP 3041	A	43	805	4	17	Compaq 22 Try 980 x 5 x 17
CP 3041I	A	43	548	4	38	Compaq
CP 3042	A	43	980	5	17	Compaq
CP 3044	A	42	980	5	17	Aka CMSK040A3-N Table 1
CP 3046	A	43	980	5	17	Table 1
CP 30541A	A	528	1023	16	63	
CP 30544 Aegean	A	545	1023	16	63	2249 x 6 x 59-89 Table 5
CP 3084	A	84	832	6	33	Compaq
CP 3101	A	101	748	8	33	Compaq 45 Try 762 x 8 x 39
CP 3102(A)(B)	A	105	776	8	25	
CP 3103	A	103	776	8	34	748 x 8 x 33?
CP 3104	A	104	776	8	33	Try 925 x 13 x 17 Table 1
CP 3106	A	106	776	8	33	Found in Olivetti M290
CP 3111	A	112	832	8	33	Compaq 33 Try 805 x 2 x 26
CP 3114	A	112	832	8	33	Table 1
CP 31374	A	371	2386	14		
CP 3181	A	84	832	6	33	Compaq 27 Table 1
CP 3184	A	84	832	6	33	Table 1
CP 3201F(G)	A	212	683	16	38	Compaq Type 51 CP 3204(F)
CP 3204(F)	A	212	683	16	38	1366 x 8 x 38 Table 6
CP 3209(F)	A	212	683	16	38	
CP 321	A	21	615	4	17	Cpq 2 Try 805 x 2 x 26 Table 7
CP 321i	A	21	615	4	17	Compaq
CP 323	A	18	733	2	26	
CP 324	A	20	615	4	17	
CP 3304 Summit	A	304	659	16	63	1806 x 8 x 46 Table 5
CP 3361	A	361	659	16	63	Compaq Part no 123785
CP 3364 Summit	A	362	702	16	63	1808 x 8 x 49 Table 5
CP 340	A	40	788	4	26	
CP 341	A	42	980	5	17	Cpq type 17 Try 805x4x26 3:1
CP 341i	A	42	788	4	26	Cpq type 43 Try 805x4x26 1:1
CP 342	A	40	980	5	17	Try 805 x 4 x 26
CP 343	A	42	980	5	17	Zenith portables

Model	Type	Cap	Cyls	Hds	SpT	Notes
CP 344	A	42	980	5	17	Aka CMS H40CQ285D-P Table 1
CP 346	A	42	980	5	17	
CP 3501	A	510	989	16	63	
CP 3504 Summit	A	510	987	16	63	1806 x 12 x 46 Table 5
CP 3505	A	510	987	16	63	
CP 3541	A	510	989	16	63	Compaq 61
CP 3544 Summit	A	540	1023	16	63	1808 x 12 x 49 Table 5
CP 3554	A	554	1054	16	63	
CP 4021 Stubby	A	20	615	4	17	Compaq 2 or 54
CP 4024 Stubby	A	21	627	2	34	XT/AT
CP 4041 Stubby	A	43	548	4	38	Compaq 53
CP 4044 Stubby	A	42	1096	2	38	XT/AT
CP 4084	A	85	832	6	33	
CP 4094 Gator	A	85				
CPS 1081A	A	1080	2100	16	63	
CPS 1621A	A	1621				
DS 1275A	A	1280	2479	16	63	Repackaged CFA 1275 Table 5
DS 270A	A	270	525	16	63	Table 5
DS 30084E	A	85	526	8	39	
DS 30084EC	A	85	903	4	46	
DS 30104	A	120	762	8	39	
DS 30174	A	170	903	8	46	
DS 30204	A	216	683	16	38	
DS 30254	A	251	895	10	55	
DS 30344	A	343	665	16	63	
DS 30424	A	420				
DS 30544	A	545	1024	12	86	
DS 340A	A	340				
DS 420A	A	426	826	16	63	EIDE DS=DiskStor Table 5
DS 540A	A	541	1048	16	63	EIDE Table 5
DS 850A	A	850	1652	16	63	EIDE Table 5
CP 1034	P	32	826	2	38	
CP 1044	P	42	1926	2		Derringer
DS 30344P	P	340				
CP 30069	PS/2	61	1524	2	39	
CP 30089 Hopi	PS/2	84	1058	4	39	
CP 30100	PS/2	21	1524	4	39	
CP 30109	PS/2	121	1522	4	39	
CP 3209F	PS/2	209	1366	8	38	
CP 3209M	PS/2	209	1348	8	38	
CFA 1080S	S-2F	1080	2156	8	66-111	Conner SCSI ID Jumpers
CFA 1275S	S-2F	1200		6	80-152	
CFA 170S	S-2	170	2111	2	79	
CFA 270S	S	270	2805	2	72-114	
CFA 340S	S-2	340	2111	4	67-91	
CFA 425S	S-2	426		2	79	
CFA 540S	S	540	2805	4	94	
CFA 810S	S-2	810	2794	6	94	

Model	Type	Cap	Cyls	Hds	SpT	Notes
CFA 850S	S-2	852	3613	4	115	
CFN 170S	S	170	1339	4	61	
CFN 250S	S	250	1339	6	61	
CFN 340S	S	340	1598	6	53-89	
CFP 1060D	S2FW	1062	2757	8	94	
CFP 1080S(E)	S2FW	1080	3658	6	96	ST 31080WC
CFP 1370	S-2F	1400				
CFP 2105E,S,W	S2FW	2147	3948	10	106	
CFP 2107E,S,W	S2FW	2147	3999	10	104	7200 RPM
CFP 2117S,W	S-3	2147	6028	5		
CFP 2120D	S2FW	2120	2756	16	63-111	
CFP 4207E,S,W	S2FW	4220	3999	20	104	7200 RPM
CFP 4217S	S-3	4294	6028	10		
CFP 545	S-2F	546				
CFP 9117S	S-3	9100	6028	20		
CFS 1060S	S-2	1062	2156	8	63-111	Superseded by CFS 1080S
CFS 1080S	S-2	1080	2156	8	66-111	Supersedes CFS 1060S
CFS 2105S	S-2F	2147	3892	10	71-144	
CFS 540S	S-2	541	2805	4	72-114	
CP 2020 Kato	S	21	642	2	32	
CP 2040 Pancho	S	42	548	4	38	Mac/Sun
CP 2045	S	40				
CP 2060 Pancho	S	64	823	4	38	
CP 2105	S2FW	2100				
CP 2107	S2FW	2100				
CP 2120			762	8	39	
CP 2250 Trigger	S	253	1339	6	47-71	
CP 3000	S	42	1045	2	40	
CP 30010 Hopi	S	121	1524	4	39	
CP 30060 Hopi	S-2	60	1524	2	39	
CP 30080 Hopi	S	84	1053	4	39	Compaq
CP 30080E	S	85	1806	2	46	
CP 30100 Hopi	S	122	1522	4	39	
CP 30120	S	120				
CP 30170	S-2	170	2111	2	67-91	Filepro
CP 30170E	S	170	1806	4	46	
CP 3020	S	21	636	2	33	
CP 30200	S-2	212	2124	4	49	
CP 30340	S-2	343	665	16	63	
CP 30250	S-2	251	1985	4	62	
CP 3040	S	42	1026	2	40	
CP 3045	S	40				Apple 40SC—strange interface
CP 30540	S-2F	545	2242	6	79	Logical: 511 x 64 x 32
CP 30548	S-2F	540				
CP 3040SC	S	42	1026	2	40	
CP 3100(D)	S	105	776	8	33	D Rebadged as DEC RZ23
CP 3110	S	107	805	8	34	
CP 31370 Baja	S-2F	1370	2386	14	80	

Model	Type	Cap	Cyls	Hds	SpT	Notes
CP 3150	S	52	776	4	33	
CP 3180	S	84	832	6	33	
CP 320	S	20	1366	8	38	
CP 3200(D)(F)	S	212	1366	8	37	D Rebadged as DEC RZ 24
CP 3300 Summit	S	340	1806	8	46	
CP 3360 Summit	S-2	362	1807	8	49	
CP 340	S	42	788	4	26	
CP 3500 Summit	S	510	1806	12	46	
			987	16	63	
CP 3540 Summit	S-2	543	1807	12	49	
CP 4207	S-2F	4200				
CP 5500 Chinook	S-2	510	2034	10	49	
DS 1060S(e)	S-2F	1000				
DS 2105Se(l)	S-2F	2000				
DS 30340	S	343	2111	4	67-91	
DS 30540	S-2F	545	2242	6	59-89	
DS 31060	S	1000				
DS 540S	S	540				
Macintosh 1060	S-2F	1020				DiskStor
Macintosh 2105	S-2F	2050				DiskStor
Macintosh 4207	S-2F	4100				DiskStor

Debug script for IDE low level format

```
Debug
-A
MOV AX,30A
MOV CX,1
MOV DX,80
MOV BX,3800
INT 13
INT 3
<CR>
-G=100
-Q
```

Table 1

Single:	Act, C/D
Master:	Act, C/D, DSP
Slave:	None

Table 2

Single:	C/D
Master:	C/D, E1
Slave:	None

Table 3

Single:	E1
Master:	E1 (+E2?)
Slave:	None

Table 4

Single:	M/S (C/D open)
Master:	M/S (C/D open)
Slave:	None

Table 5

Single:	C/D
Master:	C/D
Slave:	None

Table 6

Single:	C/D
Master:	C/D, Dsp
Slave:	None

Table 7

Single:	C/D,Dsp
Master:	C/D,Dsp
Slave:	None

Table 8

Single:	C/D
Master:	C/D, ATA/ISA
Slave:	None

CFP 1080S

ID	A0	A1	A2
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

TE	Termination
EP	Parity Checking
WS	Wait/Spin
J13	Term power On=host

Conner SCSI ID Jumpers

ID	E1	E2	E3	E4
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

Parity is always enabled except:

CP 3180	E4=disable
CP 3100	E4=disable
CP 3200	E4=disable
CP 1060	E7=disable

rzspinup (DEC) software for spin on power up.

CFA 170S/340S

TERM power enable	E1 In
DSPN	Disable Spin

CFA 540S/CFP 1080S

TERM power enable	E1 In
0E4	Disable Spin

CFS 31081A

Single:	1-2
Master:	1-2
Slave:	None
CS:	5-6

CFA 540S/CFP 2105S

E4	Reserved
E5	Disable spin on power up
E6	Spin delay by ID
E7	Disable Parity
E8	Enable Term power

CFP 1060W/2107S(W)/4207S(W)

E1-4	SCSI ID
E5	Disable spin on power up
E6	Spin delay by ID
E7	Disable Parity
E8	Enable Term power

CP 30200

E1-3		SCSI ID
E4	On	Disable spin
E5	Off	Enable term

CP 30540/31370

E1-3		SCSI ID
E4	On	Disable spin
E5	Off	Enable term
E6	Off	Enable term power

Core International

OEMs from Seagate, HP, Fujitsu

Model	Type	Cap	Cyls	Hds	SpT	Notes
HC 200	A	200	986	12	33	
AT 115	E	115	968	7	35	
AT 150	E	151	1024	8	36	986 x 9 x 35?
AT 260	E	260	1212	12	35	
HC 100F	E	101				
HC 1000(-20)	E	1056	1787	15	77	
HC 1350	E	1341				
HC 150	E	152	1250	7	34	
HC 175	E	176	1225	8	35	
HC 25	E	250				
HC 260	E	256	1212	12	35	606 x 24 x 35
HC 310	E	418	1582	15	35	791 x 24 x 35
HC 315(-20)	E	338	1447	8	57	723 x 16 x 57
HC 380	E	382	1447	12	43	
HC 40	E	40	564	4	35	
HC 650	E	658	1661	15	53	830 x 30 x 53
HC 655(-20)	E	676	1447	16	57	723 x 32 x 57
HC 90	E	85	969	5	35	
AT 145	M	58	968	7	17	
AT 20	M	20	615	4	17	
AT 26	M	26	988	3	17	
AT 30/R	M/R	31/48	733	5	17/26	
AT 30M	M	31	733	5	17	
AT 32/R	M/R	31/48	733	5	17/26	
AT 40/R	M/R	40/61	924	5	17/26	
AT 43	M	43	988	5	17	
AT 63/R	M/R	42/64	988	5	17/26	
AT 72/R	M/R	71/108	924	9	17/26	
AT +43/R	M/R	43/66	988	5	17/26	
AT +44/R	M/R	45/68	733	7	17/26	
AT +56	M	56	924	7	17	
AT +72/R	M/R	72/111	924	9	17/26	
AT +80/R	M/R	80/127	1024	9	17/26	
AT +82	M	82	968	5	35	
ATDP 70	M	71	924	9	17	
Optima 30/R	M/R	31/48	733	5	17/26	
Optima 40/R	M/R	41/63	963	5	17/26	
Optima 70/R	M/R	71/108	918	9	17/26	
Optima 80/R	M/R	80/123	1024	9	17/26	
MC 120	PS/2	120.5	920	8	32	
MC 80	PS/2	60.8	928	4	32	
3SHC230	S	230	1511	5		Var

Model	Type	Cap	Cyls	Hds	SpT	Notes
3SHC320	S	320				
3SHC420	S	420				
3SHC520	S	520				
AT 40F	S	40	564	4	17	MFM recording
CPR 100	S	1322				
CPR 200	S	2649				
CPR 400	S	4065				
CPR 500	S	5200				
HC 1000S	S	1005	1918	16	64	
HC 150S	S	152	969	9	34	
HC 200	S	202	1250	9	35	
HC 230	S	230		5		
HC 310S	S	331	1447	8	56	
HC 650	S	650	1661	15	51	
HC 650S	S	643	1661	14	54	
HC 90S	S	83	969	5	35	
HC Fast 1GB	S-2F	1000				DSS11007
HC Fast 1.3GB	S	1300				DSS12006
HC Fast 2Gb	S	2000				
HC Fast 3Gb	S	3000				
HC Fast 420	S	420				
HC Fast 520	S-2F	520				DSS00520
HCMAC 1000	S	1000				
HCMAC 1000/2	S	2000				
HCMAC 1300	S	1300				
HCMAC 330	S	330				
HCMAC 330/2	S	660				
HCMAC 650	S	650				
HCMAC 650/2	S	1300				
Optima 1000	S	1000				
Optima 120	S	120				
Optima 1300	S	1300				
Optima 200	S	213				
Optima 540	S	543				
Optima 80	S	80				
SLN09009	S-2F	520				SLAN Fast 520
SLN 09010	S-2F	1000				SLAN Fast 520
SLN12007	S-2F	1300				SLAN Fast 1.3GB
SLN O4001	S-2F	4000				
SLN 9001	S-2F	9000				
SSI 1000	S	1000				Also parallel port

Corvus

Model	Type	Cap	Cyls	Hds	SpT	Notes
H 11	M	14		4	17	
H 20	M	21		6	17	
H 6	M	7		4	17	

COS

Model	Type	Cap	Cyls	Hds	SpT	Notes
Filecard Q40	H	40				Quantum?
Filecard SO48	H	48				
Filecard SO80	H	80				

Craft Data

Model	Type	Cap	Cyls	Hds	SpT	Notes
3010	S	128				Removable
5031	S	650				Removable
5200	S	256				Removable
DMA 370	S	20				Removable
DMA 5500	S	50				Removable

Crate Technology

Model	Type	Cap	Cyls	Hds	SpT	Notes
InnerCrate 100	S	100				
InnerCrate 160	S	160				
InnerCrate 190	S	190				
InnerCrate 30	S	30				
InnerCrate 300	S	300				
InnerCrate 40	S	40				
InnerCrate 50	S	50				
InnerCrate 60	S	60				
InnerCrate 600	S	600				
InnerCrate 80	S	80				
MacCrate 100	S	100				
MacCrate 20	S	20				
MacCrate 300	S	338				
MacCrate 318	S	600				
MacCrate 40	S	40				
MacCrate 60	S	60				
MacCrate 80	S	80				

Cristie

Model	Type	Cap	Cyls	Hds	SpT	Notes
Mach 40	S	43	1057	2	42	
Swallow 110	S	98	1252	4	40	
Swallow 40	S	42	1074	2	40	
Swift 90	S	79	1552	2	52	

Cybernetics

Model	Type	Cap	Cyls	Hds	SpT	Notes
CY 2.1GB	S-2F	2100				
CY 4.2GB	S-2F	4200				
CY 8.7GB	S-2	8700				
CY 9GB	S-2	9000				

Cybernex

Model	Type	Cap	Cyls	Hds	SpT	Notes
10203	E	54	1050	3	35	
10304	E	72	1050	4	35	
10305	E	90	1050	5	35	

Cynthia

Something to do with Disctron?

Model	Type	Cap	Cyls	Hds	SpT	Notes
D520	M/R	21/34	640	4	17/26	
530	M	25	987	3	17	
550	M	40	987	5	17	
570	M	60	987	7	17	
585	M	71	1166	7	17	

Daeyoung Electronics

Model	Type	Cap	Cyls	Hds	SpT	Notes
DX 3040A	A	40				
DX 3060A	A	60				
DX 3120A	A	120	866	8	34	

Data General

Model	Type	Cap	Cyls	Hds	SpT	Notes
6410	A	20				
6556	A	42.8				
6557	A	104				
6664	A	202				
6778B	A	116				
6301	M	37	640	7	17	
6338	M	68	1024	8	17	
6339	M	120	950?	15	17	
6555B	E	645				
6597B	E	156				
660B	E	330				

Data Technology

Division of Qume

Model	Type	Cap	Cyls	Hds	SpT	Notes
DTM 553	M	40	1024	5	17	
DTM 853	M	40	640	8	17	
DTM 885	M	70	1024	8	17	
HF 12	S	10	301	2	17	MFM recording
HF 24	S	21	506	2	17	MFM recording

Dauphin Technology

Model	Type	Cap	Cyls	Hds	SpT	Notes
Dynadrive 85		85				Removeable

DEC

Digital Equipment

Model	Type	Cap	Cyls	Hds	SpT	Notes
DSP 2022A	A	220	995	8	54	
PCXAR-CE	A	85				
PCGXR-DA	A	85				
PCGXR-DD	A	120				
PCXAR-CA	A	120				
PCXAR-CC	A	120				
PCGXR-DE	A	170				
PCGXR-EB	A	210				
PCGXR-ED	A	240				
PCXAR-CB	A	240				
PCXAR-CD	A	240				

Model	Type	Cap	Cyls	Hds	SpT	Notes
PCGXR-ED	A	340				
PCGXR-GD	A	510				
PCXAR-CG	A	525				
DSP 2022S	S-2F	220	1484	5	58	
DSP 3053L(W)	S2FW	535	3100	4	59	Avastor
DSP 3055 (R,W)	S-2F	550	3115	4		Capella
DSP 3080	S-2	852				
DSP 3085	S-2F	852	2086	14	57	
DSP 3105	S-2F	1050	2570	14	57	
DSP 3107L(W)	S2F(W)	1070	3100	8	59	Avastor
DSP 3110 (R,W)	S-2F	1100	3115	8		Capella
DSP 3133L(W)	S2F(W)	1337	3100	10	59	Avastor
DSP 3160(W)	S2F(W)	1600	2599	16	57	Avastor; also OEM
DSP 3200	S-2F	2000				
DSP 3210(W)	S2F(W)	2148	3042	16	59	Avastor
DSP 3221 (R,W)	S-2F	2200	4125	8		Capella
DSP 5200	S-2F	2000	2620	21	71	
DSP 5300(W)	S2F(W)	3000	3055	21	80	Avastor
DSP 5350(W)	S-2F	3500	3055	25	80	Avastor
DSP 5400(W)	S2F(W)	4000	3055	26	80	Avastor
ESP 510	S-2F	107				Solid State
ESP 530	S-2F	267				Solid State
ESP 540	S-2F	428				
ESP 580	S-2F	856				
PCXAR-AB	S	426				
PCXAR-AD	S	1000				
PCXAR-AG	S	245				
RZ 23L	S	105	776	8	33	CP 3100D in disguise
RZ 24	S	212	1366	8	38	CP 3200D in disguise
RZ 24L-E	S	240				Quantum 240S
RZ 25	S	426				
RZ 26L(W)	S(W)	1050		7		
RZ 28(W)	S(W)	2100		16		
RZ 29B	S	4300				
RZ 73	S	2000				
RZ 74	S	3500		25		
SP 3430(N)	S-2F	4300	3832	20	71-138	
SWXD3-S/WC	S-2	1050				
VP 3107(W)	S-2F	1075	3832	5	71-138	Quantum?
VP 3215	S-2F	2150	3832	10	71-138	Quantum?
RA 71	SDI	700				
RA 72	SDI	1000				
RA 73	SDI	2000				
RF 31T	DSSI	381				
RF 35	DSSI	852				
RF 36	DSSI	1600				
RF 72	DSSI	1000				
RF 73	DSSI	2000				

Model	Type	Cap	Cyls	Hds	SpT	Notes
RF 74	DSSI	1357 Gb				

DSP3133L/3160/3210/5300/5350/5400/5200/VP 3107/VP 3215

SCSI ID	5-6	3-4	1-2
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

DSP 3053L/3107L

ID	5-6	3-4	1-2
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

7	Open	Fault LED
8		Key
9	Open	Busy LED
10	open	Spindle sync ref
11	open	+5v out
12	open	Reserved
13-14		Delay Spin/WP
15-16		LED
17-18		Reserved
19-20		Spindle Sync ref

RZ Series

ID	E1	E2	E3
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

Parity E4=disable

RZSPINUP software for spin on power up.

Delta Microsystems Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
HPS 292D	S	292				
HPS 320D	S	320				
HPS 583D	S	583				
SS 1002D	S	1002				
SS 1003D	S	1003				
SS 1291DUS	S					
SS 149D	S	149				
SS 292D	S	292				
SS 320D	S	320				
SS 583D	S	644				
SS 644D	S	644				

Deltiac Systems

Model	Type	Cap	Cyls	Hds	SpT	Notes
DS100Q	S	105				
DS40Q	S	40				
Server 100H	S	103				
Server 1200	S	1000				
Server 300Q	S	320				
Server 320H	S	320				
Server 420H	S	420				

Dickens Data Systems Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
1.2GB	S	1000				
396	S	331				
793	S	663				

Disctec

Made first removeable 2.5” drive.
See Areal for IDEs.

Model	Type	Cap	Cyls	Hds	SpT	Notes
RD 52	A	40	563	4	34	
RD 53	A	67	977	4	33	
RHD 120	A	120				
RHD 180	A	183				
RHD 210	A	210				
RHD 260	A	260				
RHD 340	A	340				

Model	Type	Cap	Cyls	Hds	SpT	Notes
RHD 520	A	520				
RHD 20	H	20	733	2	26	615 x 2 x 34?
RHD 60	H	60	1024	7	17	1024 x 2 x 60?
RHD 80	H	80	980	10	17	
CXD60	Par	120				Roadrunner
RXD20	Par	20				Roadrunner
RXD60	Par	60				Roadrunner
Trip XD120	Par	120				Roadrunner
Trip XD20	Par	20				Roadrunner
XD 540	Par	540				Roadrunner
XD 60	Par	60				Roadrunner
XD 730	Par	730				
XD 850	Par	850				
XD 1200	Par	1200				

Disctron

Formed from merger of RMS and Data Peripherals. Later sold to Otari and Disk Tech One—Cynthia?

Model	Type	Cap	Cyls	Hds	SpT	Notes
D 214	M	10	153	8	17	
D 226	M	20	612	4	17	
D 503	M	3	153	2	17	
D 504	M	4	215	2	17	
D 506	M	5	153	4	17	
D 507	M	5	306	2	17	
D 509	M	8	215	4	17	
D 512	M	11	153	8	17	
D 513	M	11	215	6	17	
D 514	M	11	306	4	17	
D 518	M	15	215	8	17	
D 519	M	16	306	6	17	
D 525	M	20			17	
D 526	M/R	21/32	306	8	17/26	
D 620	M	25		4	17	
D 640	M	42		6	17	

Disk Technologies Corp

See *Disctec*

Disk Tech One

Bought Disctron. See *Disctec*

Model	Type	Cap	Cyls	Hds	SpT	Notes
5007	M	5	306	2	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
5012	M	10	306	4	17	
5014	M	10	306	4	17	
5019	M	15	306	8	17	
5028	M	20	306	8	17	

DMA

(Ricoh) Out of business

Model	Type	Cap	Cyls	Hds	SpT	Notes
306	M	11	612	2	17	Removeable
360	M/R	11/26	612	2	17/26	Removeable
370	M	25	612	2	17	
371	M	25	1224	4	17	
RH 5130	M/R	10/15	612	2	17/26	
RH 5260	M	10	615	2	17	
380	S	39	1285	2	62	
381	S	39	1285	2	62	
RH 5261	S	25	612	2	42	MFM recording
RH 5500	S	50	1285	2	38	Cartridge
RS 9250AR	S	47	1285	2	36	Cartridge

DPI

Model	Type	Cap	Cyls	Hds	SpT	Notes
144(II)	S	138				
160	S	160				
20	S	21				
30	S	32				
300	S	300				
600	S	582				
70	S	68				
90	S	91				

DPL

Model	Type	Cap	Cyls	Hds	SpT	Notes
Optistore 1000	S	644				
Optistore 128	S	128				
Optistore 650	S	650				
Optistore 650	S	650				

DTM

Model	Type	Cap	Cyls	Hds	SpT	Notes
553	M	42	1024	5	17	
853	M	44	640	8	17	
885	M	70	1024	8	17	
HF 12	S	23	301	2	78	
HF 24	S	38	506	2	78	

Dynatech Systems

Model	Type	Cap	Cyls	Hds	SpT	Notes
NDS 1.2	S	1000	1658	15	85	External
NDS 180	S	173	1334	8	34	External
NDS 2.0	S	1600	1893	20	103	External
NDS 350	S	340	1658	8	34	External
NDS 520	S	520	1435	11	60	External
NDS 650	S	640	1658	9	53	External

Dynatek Automation Systems

Model	Type	Cap	Cyls	Hds	SpT	Notes
HDA 520FSI(D)	S-2	520				
HDA 540	S-2	540				
HDA 1.0FSI(D)	S-2	1000				
HDA 1.1FSD	S-2	1080				
HDA 1.0 GB	S-2	1079	1658	15	85	Fujitsu M 2266S-512. Sun 1648 cyls
HDA 2.0 GB	S-2	1662				Fujitsu M 2265S-512
HDA 2.0ISD	S-3	2100				
HDA 2.2ISD	S-2	2160				
HDA 2.4FSI(D)	S-2	2000				
HDA 4.0MSD	S-3	4350				
HDA 9.0MSD	S-3	9100				

ECOL 2

Model	Type	Cap	Cyls	Hds	SpT	Notes
EC 100	A	100	1005	2	17	
EC 50	A	50	860	2	60	
EC3-100	A	100	957	2	17	
EC3-200	A	200	986	2	33	

ECCS Inc

www.eccs.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
Space 300E	E	300				
Space 1000S/D	S	1000				
Space 1600S/D	S	1600				
Space 2000S/D	S	2000				
Space 3000S/D	S	3000				
Space 300D	S	300				
Space 300S	S	300				
Space 3600S/D	S	3600				
Space 4000S/D	S	4000				
Space 600S/D	S	600				

E F Industries

Model	Type	Cap	Cyls	Hds	SpT	Notes
3046	M	39	645	7	17	
3051	M	43	704	7	17	

Ehman Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
E105Q	S	105				
E135	S	130				
E165S	S	165				
E180	S	170				
E20	S	21				
E30+	S	32				
E330	S	330				
E40Q	S	42				
E45	S	47				
E60+	S	62				
E665	S	660				
E80+	S	82				
E80Q	S	84				

Eiger Labs

Model	Type	Cap	Cyls	Hds	SpT	Notes
EMS 170	P3	170				
EMS 260	P3	260				

Elcoh

Model	Type	Cap	Cyls	Hds	SpT	Notes
Discache 10	M	11	320	4	17	
Discache 20	M	22	320	8	17	

EMAC

Model	Type	Cap	Cyls	Hds	SpT	Notes
20SE	S	20				
40CX/ID	S	40				
40SE	S	40				
80CX/ID	S	80				
80SE	S	80				
Impact 105	S	105				
Impact 170	S	168				
Impact 20	S	20				
Impact 40	S	40				
Impact 40 Plus	S	40				
Impact 60	S	66				
Impact 80	S	80				
Metro 105	S	105				
Metro 105CX	S	105				
Metro 170	S	168				
Metro 170CX	S	168				
Metro 20	S	21				
Metro 40	S	42				
Metro 80	S	84				

Emerald DOS

Used in PS/2s? In which case proprietary ESDI interface.

Model	Type	Cap	Cyls	Hds	SpT	Notes
150-3000	E	150				

Emerald Systems

Used in PS/2s? In which case proprietary ESDI interface.

Model	Type	Cap	Cyls	Hds	SpT	Notes
PS 36 3002	E	36		5		
PS 50 3002	E	50		5		
PS 70 3002	E	70		8		
PS 140 3002	E	140		16		
PS 280 3002	E	280		32		

Emulex

Model	Type	Cap	Cyls	Hds	SpT	Notes
ATS 170	E/S	142	1022			
ATS 380	E/S	310	1222			
EMS 760	E	663				
ER2E/760	E	663				
ES36/760-1	E	663				

Epson

Model	Type	Cap	Cyls	Hds	SpT	Notes
94216	E	94	1024	5	36	Seagate 2106E
HD 560	M	20	615	4	17	
HD 720	M	20	615	4	17	
HD 806	M	21	615	4	17	
HD 830	M/R	10	612	2	17/26	
HD 850	M	11	306	4	17	
HD 860	M/R	21	612	4	17/26	
HMD 710	M	10	615	2	17	
HMD 720	M	20	615	4	17	
SMD 710	M	10	615	2	17	
SMD 720	M	21	615	4	17	
SMD 830	M	10	612	4	17	
SMD 850	M	10	306	4	17	
SMD 860	M	20	612	4	17	
EHDD 170	P3	170				
EHDD 260	P3	260				
EHDD 340	P3	340				
HMD 755	R	21	615	2	34	
HMD 765	R	42	615	4	34	
HMD 726A	S	21	615	4	32	
HMD 976	S	69				

Espert

Purchased by Daeyoung Electronics.

Model	Type	Cap	Cyls	Hds	SpT	Notes
EP 340A	A	43		4		XT
PT 338		32				
PT 351		43				
EP 340S	S	42				

Everex Systems

Possible Microscience connection?

Model	Type	Cap	Cyls	Hds	SpT	Notes
HH 612	M	12	306	4	17	
HH 725	M	26	500?	6	17	

Evotek

Model	Type	Cap	Cyls	Hds	SpT	Notes
5820	M	26	375	8	17	

EZI

Somewhere in Germany.

Model	Type	Cap	Cyls	Hds	SpT	Notes
1200	E	171	1216	8	36	
1300	E	261	1216	12	35	
4410	E	334	1100	11	54	
2200	S	174	1216	8	35	
2300	S	261	1216	12	35	
4420	S-2	334	1100	11	54	

Feith Systems Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
Big Boy 636	S	636				
XM/SCSI	S	147				
XM/SCSI	S	312				
XM/SCSI	S	80				

First Class Peripherals

Model	Type	Cap	Cyls	Hds	SpT	Notes
D7 Turbo	S	70				
DF4	S	40				
DF7	S	70				
Sider C96	S	90				
Sider D2	S	20				
Sider D4T	S	40				
Sider D9 Turbo	S	87				

Focus Enhancements

Model	Type	Cap	Cyls	Hds	SpT	Notes
Focus 1.2GB	S	1050	1747	15	58-94	Micropolis 2112

Frame Electronics

Drives made by IBM

Model	Type	Cap	Cyls	Hds	SpT	Notes
FAV 55F5974	S	1000				0663
FEV 93X2500	S	?				0661
FH 155F9964	S	?				0663
FHS 6475646	S	?				0663
FMS 75G3577	S	?				0664
FMS 73F9122	S	400				

Fuji

No longer producing hard drives.

Model	Type	Cap	Cyls	Hds	SpT	Notes
FK 316A-105R	A	105	804	15	17	FK 307A??
FK 316A-120R	A	120	1310	4	46	Physical
FK 316A-130R	A	130	1331	4	46	Physical
FK 317A-210R	A	210	671	12	51	
FK 317A-240R	A	240	766	12	51	
FK 301-13(-1)	M	10	306	4	17	
FK 302-13	M	10	612	2	17	
FK 302-26	M	20	612	4	17	615 cyls (Victor BIOS)
FK 302-39	M	32	612	6	17	
FK 303-52	M	42	615	8	17	
FK 305-26	M	21	615	4	17	
FK 305-39	M	32	615	6	17	
FK 309-26	M	21	615	4	17	
FK 309-39	M	32	615	6	17	
FK 305-26R	R	32	615	4	26	
FK 305-39R	R	32	615	4	26	
FK 305-58R	R	48	615	6	26	
FK 308-39R	R	30	615	4	26	
FK 308-58R	R	45	615	6	26	
FK 309-39R	R	32	615	4	26	
FK 308S-39R	S	32	615	4	32	
FK 308S-58R	S	45	615	6	32	
FK 308S-59R	S	45	615	6	32	
FK 309S-50R	S	40	615	4	32	

FK 316A

Single:	P1 P2 open
Master:	P1 close
Slave:	P1 P2 close

FK 317A

Single:	P2 open
Master:	P2 open
Slave:	P2 close

Fujisawa

Made stuff for IBM

Model	Type	Cap	Cyls	Hds	SpT	Notes
90X8627	E	60				IBM Part No
90X7392	E	120				IBM Part No
90X9403	M	30				IBM Part No

Fujitsu

Drives sold through OEM channels.
See also *Fujitsu Knowledge System*
www.fujitsu-computers.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
M 1603TA	A2	544	1055	16	63	Discontinued
M 1604	A2	850	3456	5		
M 1606TA	A2	1089	2111	16	63	Discontinued
M 1612	A2	545	1057	16	63	Discontinued
M 1614 TAU	A2F	1091	2114	16	63	Discontinued
M 1623 TAU	A2	1702	3298	16	63	Discontinued
M 1624 TAU	A2	2100	4092	16	63	Discontinued
M 1636 TAU	A2	1286	2490	16	63	Discontinued
M 1638 TAU	A2	2571	4982	16	63	Discontinued
M 2611T(#D)	A	45	667	4	33	88,044 max secs Discontinued
M 2612 (E)T	A	90	667	8	33	176,088 max secs Discontinued
M 2613 (E)T	A	135	667	12	33	264,132 max secs Discontinued
M 2614 (E)T	A	180	667	16	33	352,176 max secs Discontinued
M 2616 (E)T	A	104	771	8	33	203,544 max secs Discontinued
M 2617T	A	105	718	6	48	206,784 max secs Discontinued
M 2618T	A	210	718	12	48	413,568 max secs Discontinued
M 2621T	A	235	1435	5	63	
M 2622T	A	326	1013	10	63	Try 1429 x 7 x 63 Discontinued
M 2623T	A	420	1002	13	63	Try 1429 x 9 x 63 Discontinued
M 2624T Eaglet	A	513	995	16	63	Try 1429x11x63 Discontinued
M 2631T	A	45	916	2	48	

Model	Type	Cap	Cyls	Hds	SpT	Notes
M 2633T	A	90	916	4	48	Discontinued
M 2634T	A	120	698	6	56	Discontinued
M 2635T	A	160	698	8	56	Discontinued
M 2636T	A	200	698	10	56	Discontinued
M 2637T	A	240	698	12	56	Discontinued
M 2681TA	A	252	977	11	48	Discontinued
M 2682TA	A	352	992	11	63	Discontinued
M 2684TA	A2	528	1024	16	63	Discontinued
M 2704T	A	353	1991	4	86	
M 2705T	A	442	1991	5	86	
M 2706T	A	532	1991	6	86	
M 2712T	A	540	3916	2		
M 2713T	A	816	1581	16	63	Discontinued
M 2714T	A2	1087	2108	16	63	2.5” Discontinued
M 2723T	A3	1234	2371	16	63	
M 2724	A3	1632	3162	16	63	
MHA 2021AT	A3	2170	4200	16	63	
MHA 2032AT	A3	3250	6300	16	63	
MHC2040AT	A	4090	7944	16	63	12.5mm
MHD2021AT	A3	2170	4200	16	63	9.5mm
MHD2032AT	A3	3250	6304	16	63	9.5mm
MHE 2043AT	A3	4327	8944	15	63	
MHE 2064AT	A3	6495	13424	15	63	
MHF 2021AT	A3	2168	4200	16	63	
MHF 2043AT	A3	4327	8944	15	63	
MPA 3017AT	A3	1740	3390	16	63	
MPA 3026AT	A3	2620	5086	16	63	
MPA 3035AT	A3	3500	6780	16	63	
MPA 3043AT	A3	4370	9042	15	63	
MPA 3052AT	A3	5250	10850	15	63	
MPB 3021AT	A3	2160	4470	15	63	
MPB 3032AT	A3	3240	6704	15	63	
MPB 3043AT	A3	4320	8940	15	63	
MPB 3052AT	A3	5240	10850	15	63	
MPB 3064AT	A3	6480	13410	15	63	
MPB 3065AH	A3	6510	13456	15	63	
MPC 3032AT	A3	3240	6704	15	63	
MPC 3043AT	A3	4320	8940	15	63	
MPC 3045AH	A3	4550	9408	15	63	
MPC 3064AT	A3	6480	13410	15	63	
MPC 3065AH	A3	6480				
MPC 3084AT	A4	8450	16383	16	63	UDMA 66
MPC 3096AT	A3	8450	16383	16	63	9450 unformatted
MPC 3102AT	A4	8450	16383	16	63	UDMA 66
MPD 3108AT	A3	10800				
MPD 3137AH	A4	13700				7200 RPM
MPD 3173AT	A4	17300				UDMA/66 5400 RPM
MPD 3182AH	A3	18200				7200 RPM

Model	Type	Cap	Cyls	Hds	SpT	Notes
MPE 3204AT	A4	27000				5400 RPM
M 2227D	E	111	615	8	45	
M 2244E	E	86	823	5	35	
M 2245E	E	120	823	7	35	
M 2246E	E	172	823	10	35	
M 2247E	E	181	1243	7	35	621 x 14 x ?
M 2248E	E	240	1243	11	35	
M 2249E	E	389	1243	15	35	621 x 30 x ?
M 2261E	E	321	1658	8	54	15 Mhz
M 2262E	E	571	1658	11	54	
M 2263E	E	667	1658	15	54	15 Mhz
M 2266E	E	674	1658	15	54	
M 2331P	IPI-2	168	823	5		
M 2333P	IPI-2	337	823	10		
M 2381P	IPI-2	556	745	15		
M 2382P	IPI-2	844	745	27	82	
M 2651P	IPI-2	1300	1893	16	84	
M 2652P	IPI-2	1586	1893	20	84	
M 2653P	IPI-2	1404	2078	15	88	
M 2654P	IPI-2	2000	2179	21	88	
M 2671P	IPI-2	2200	2671	15		
M 2691P	IPI-2	648	1819	9	58-96	
M 220	M	10	306	4	17	
M 2220A	M	6	306	2	17	
M 2223A	M	13	306	4	17	
M 2224A	M	19	306	6	17	
M 2225(A,D,2)	M	25	615	4	17	
M 2226(A,D,2)	M	30	615	6	17	Also SA 4000
M 2227(D,2)	M	40	615	8	17	Also SA 4000
M 2230AS	M	5	320	2	17	Also SA 4000
M 2230AT	M	5	306	2	17	320 cyls?
M 2231	M	5	306	2	17	
M 2232	M	10	306	6	17	
M 2233(A)(S)	M	11	320	4	17	Also SA 4000
M 2233(A)(T)	M	10	306	4	17	320 cyls?
M 2234(A)(S)	M	16	320	6	17	Also SA 4000
M 2235(A)(S)	M	21	320	8	17	Also SA 4000
M 2241(ABS2)	M	26	754	4	17	Also SA 4000
M 2242(ABS2)	M	46	754	7	17	Also SA 4000
M 2243(ABS2)	M	68	754	11	17	P/N B03B 4805 B003A
M 2243T	M	68	1186	7	17	593 x 14 x 17 Also SA 4000
M 2244	M	68	754	11	17	
M 2311K	M	84	589	4	17	
M 2321K	M	84	823	5	17	
M 3343AS	M	72	754	11	17	
M 2511A	O	128	9952	1	25	SCSI
M 2512A	O	230	17840	1	25	SCSI-2
M 2225DR	R	32	615	4	26	

Model	Type	Cap	Cyls	Hds	SpT	Notes
M 2226DR	R	48	615	6	26	
M 2227DR	R	64	615	8	26	
M 2243R	R	130	1186	7	26	593 x 14 x 26
M 1603SA	S2FS	545	3547	3	94	+15 cyls for SA Discontinued
			3772	3	94	Sun 5400 RPM
M 1604	S-2F	850				
M 1606SA	S-2F	1092	3547	6	94	+15 cyls for SA Discontinued
			3778	6	94	Sun 5400 RPM
M 1638S	S	2200				
M 2226 SA	S	32	615	6		Discontinued
M 2241B	S	25	754	4	32	
M 2242B	S	43	754	7	32	
M 2243B	S	68	754	11	32	
M 2244S(B)	S	80	823	5	35	
M 2245S(A,B)	S	112	823	7	65	
M 2246S(A,B)	SSync	160	823	10	35	
M 2247SA	S	149	1243	7	35	
M 2248SA	S	234	1243	11	35	
M 2249S(A)	S	334	1243	15	35	621 x 30 x ?
M 2261S(AHB)	S-2	357	1658	8	54	829x16x53 Discontinued
M 2262S(AHB)	S	492	1658	11	53	Discontinued
M 2263S(AHB)	S-2	707	1658	15	53	829x30x53. Sun 1648 cyls Disc
M 2654S-512	S	1957				
M 2265S-512	S	1662				Dynatek 2.0 GB
M 2266S(AHB)	S-2	1079	1658	15	85	Sun 1648 cyls Discontinued
M 2344KS	S	675	624	27	82	
M 2372KS	S	700	745	27	68	
M 2511A	S-2	128	9950	1	25	Sun 3600 RPM
M 2512A	S	17	850	1	25	Sun 3600 RPM
M 254SA	S	2000				
M 2611SA#D	S	45	1334	2	34	667 x 4 x ? Discontinued
M 2612(E,S,A)	S	91	1334	4	34	667 x 8 x ? Sun 1304 cyls
M 2613(E,S,A)	S	137	1334	6	34	MJ=Mac. Sun 1307 cyls
M 2614E(S,A,B)	SSync	182	1334	8	34	MJ=Mac. Sun 1307 cyls
M 2615ESA	S	52	1542	2	33	
M 2616SA	SSync	105	1542	4	34	MJ=Mac Discontinued
M 2621S(A)	S-2	234	1435	5	63	
M 2622(FSHA)	S-2F	330	1153	7	80	Sun 1151 cyls Discontinued
M 26232(FSAB)	S-2F	425	1153	9	80	Sun 1151 cyls Discontinued
M 2624(F,S,A)	S-2F	520	1465	11	63	Sun 1463 cyls Discontinued
M 2631S	S-2	45	916	2	48	
M 2633S	S-2	90	916	4	48	
M 2635S(A)	S-2	160	1572	4	63	Discontinued
M 2636S(A)	S-2	200	1572	5	63	Discontinued
M 2637S(A)	S-2F	240	1572	6	63	Discontinued
M 2651(HDSA)	S-2	1396	1944	16	88	Sun 1934 cyls Discontinued
M 2652(HDSA)	S-2F	1746	1944	20	88	Sun 1935/1942 cyls
M 2653(HDSA)	S-2	1404	2078	15	88	Sun 2067 cyls

Model	Type	Cap	Cyls	Hds	SpT	Notes
M 2654(HSA)	S-2F	2055	2179	21	88	Sun 2170 cyls
M 2681S	S					Discontinued
M 2682S	S					Discontinued
M 2684S	S					Discontinued
M 26818SA	S-2F	264	2379	3	74	
M 2682SA	S-2F	353	2379	4	74	
M 2684SA	S-2F	532	2379	6	74	
M 2691(ESHA)	S-2F	649	1819	9	74	Discontinued
M 2692(ESHA)	S-2F	794	1819	11	74	Discontinued
M 2693(ESHA)	S-2F	939	1819	13	74	Discontinued
M 2694(EHSA)	S2FW	1083	1832	15	77	Sun 1830 cyls Discontinued
M 2703	S-2	264	2305	3		
M 2704SA	S-2	353	2305	4		Discontinued
M 2705SA	S-2	442	2305	5		Discontinued
M 2706SA	S2FS	532	2305	6	74	Discontinued
M 2903(HQRS)	S2FW	2130	3150	13		Discontinued
M 2909(HQRS)	S2FW	3066	3150	19		Discontinued
M 2914	S2FW	2100				
M 2915(HQRS)	S2FW	2176	3182	15	89	Sun 7200 RPM Discontinued
M 2927(H,S)A	S2FW	1120	3150	7		Discontinued
M 2932S	S-2F	2170	3551	18	133	Sun 7200 RPM Discontinued
M 2934S(W)	S2FW	4350	3429	18	113-147	7200 RPM Discontinued
M 2949/S/Q/R/E	S-2F	9100	5770	18		7200 RPM Discontinued
M 2952/S/Q/R/E	S-3	2200	5713	5		7200 RPM Discontinued
M 2954/S/Q/R/E	S-3	4400	5713	9		7200 RPM Discontinued
MAA 3045	S-3	4550	8490	3		7200 RPM
MAA 3091	S-3	9100	8490	10		7200 RPM
MAA 3182	S-3	18200	9040	19		7200 RPM
MAB 3045	S-3	4550				
MAB 3091	S-3	9100				
MAC 3045	S-3	4550				
MAC 3091	S-3	9100				
MAE 3091LC	S-U2	8500				LVD
MAE 3182 LP	S	17400				7200 RPM
MAF 3364LC	S	34700				10,000 RPM
MAG 3182L©	S	17400				10,000 RPM
M 2321K	SMD	84	823	5		MFM recording
M 2322K	SMD	168	823	10		
M 2331KS	SMD		823	5		
M 2333KS	SMD		823	10		
M 2343K	SMD	383	624	15	81	
M 2361A	SMD	686	842	20	81	
M 2380K	ESMD	1000	745	27		
M 2382K	ESMD	844	745	27	82	
M 2391D,K	ESMD	965	1916	11	83	
M 2392D,K	ESMD	1842	1916	21	83	
M 2344K	HSMD	586	624	27	69	
M 2360A	HSMD	585	841		68	

Model	Type	Cap	Cyls	Hds	SpT	Notes
M 2372K	HSMD	700	745	27	69	
M 2331K,S	MSMD	168	823	5		
M 2333K,S	M-SMD	337	823	10		
M 2343KS	M-SMD	383	624	15	69	
M 2344KS	M-SMD	690	624	27	69	
M 2381K	M-SMD	556	745	15		
M 2382K	M-SMD	1000	745	27		Unformatted capacity
M 2230B(T)	S4000	5	320	2	17	
M 2233B(T)	S4000	10	320	4	17	
M 2234B	S4000	16	320	6	17	
M 2235B	S4000	21	320	8	17	
M 2241B	S4000	25	754	4	17	
M 2242B	S4000	44	754	7	17	
M 2243B	S4000	69	754	11	17	
M 2301K	S1000	9	244	4	20	
M 2302K	S1000	19	244	8	20	

1603/1606TA

Single:	CNH1	1-2 on
Master:	CNH1	1-2 on
Slave:	CNH1	1-2 off

1612/1614

Single:	CNH1 MS (2-3)
Master:	CNH1 MS (2-3)
Slave:	None

M 1623/1624/1636/1638

Single:	1-2 (B01-B02)
Master:	1-2
Slave:	3-4

Cable Select: 2-3

M 2681/2/4

Single:	1-2 On
Master:	1-2 On
Slave:	1-2 Off

3-4 On	IOCHRDY output enabled
5-6 On	ACMODE connected. Allows the system to tell the drive whether its own power save takes priority.
7-8 Off	Auto Idle Control enabled
9-10	CSEL connected. Special cable.
11-12	Reserved
13-14	Reserved

M 2617/8

S/N 00001-30000

Master:	SW 2/1 Off, SW1/2 off, 3 on
Slave:	SW 2/1 On

with remainder off

S/N 30001 or larger

Master:	SW 2/1 Off, SW1/4 off, 3 on
Slave:	SW 2/1 On

with remainder off

M 261xT

Single:	CNH1	1-2 On
Master:	CNH1	1-2 On
Slave:	CNH1	1-2 Off

MAA3182/MAB3045, 3091/MAC 3045, 3091

SCSI ID (SP models - none for SC)

ID	*1-2*	*3-4*	*5-6*	*7-8*
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0

ID	1-2	3-4	5-6	7-8
8	1	1	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

CN6 1-2	Open	Term pwr from HD Off
CN6 3-4	Open	Use Start/Stop Unit
	Short	Spinup at pwr on
CN6 5-6	Open	Term not connected
	Short	Connected
13-14	Open	Enable writes
	Short	Disable

MPA 3017/3026/3035/3043/3052AT MPB 3021/3032/3043 3052/3064AT MPC 3032/3043/3064/3084/3096AT/3102AT

Single:	1-2, 3-5
Master:	As above
Slave:	3-5

CS 2-4, 3-5.

Legacy BIOS: 5-6 instead of 3-5

2611T#D/261xET

Single:	SW2/1 on,2, 3 off
Master:	SW2/1, 3 on, 2 off
Slave:	SW2/1 off, 2.3 on

SW2/4 on = write protect

2635/6/7/T

Single:	2-4 open
Master:	2-4 open
Slave:	2-4 short

2622/3/4T

SW1

1	Off	Pin 27 = IOCHRDY
	On	Reserved
2	Off	SPSYNC disabled
	On	Enabled
3	Off	WP disabled
	On	Enabled
4	Off	4-byte ECC
	On	7-byte ECC
5	Off	Master
	On	Slave
6	Off	Reserved

CNH1

1-2	Open	Sp sync not active
	Short	Sp sync pulse to/from pin 28
3-4	Short	Reserved
5-6	Short	Reserved
7-8	Short	Reserved

CNH2 – Factory Test

CNH3

1-2	Short	Pin 39 DASP
3-4	Open	reserved

M 2611

CNH1

1-2		ID 1
3-4		ID 2
5-6		ID 4
7-8	Out	Spin up via comd
	In	Spin on power up

CNH2

1-2	In	Term power from IDD
3-4	In	Term power TERMPWR
5-6	out	Reserved

Dip Switch

1	On	Write Protect
2	On	Self starting
3	On	Normal
Off	Test	

M 2615/2616

CNH2	14-13	12-11	10-9
0	2-3	5-6	8-9
1	1-2	5-6	8-9
2	2-3	4-5	8-9
3	1-2	4-5	8-9
4	2-3	5-6	7-8
5	1-2	5-6	7-8
6	2-3	4-5	7-8
7	1-2	4-5	7-8

CNH1

7-8	10-11	SCSI bus term power
	9-10	SCSI bus term power
8-9	10-11	IDD term power used
4-5		Enable Synch Transfer
6-7		Disable Synch Transfer
1-2		Enable parity
2-3		Disable parity

Dip Switch

1	On	Write Protect
2	On	Self starting
3	On	Normal
	Off	Test

M 2261/2262/2263/2266H

ID	14-13	12-11	10-9
0	0	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

7-8	Short	Time monitoring disabled
5-6	Short	Read-ahead cahce enable
3-4	Short	Reserved
1-2	Short	Normal operation
	Open	Diagnostics

2903/2909/2915

ID	0	1	2
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

1603/6

1-2	ID bit 1
3-4	ID bit 2
5-6	ID bit 3
7-8	Spin up

CNH1

ID	1-2	3-4	5-6
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

2704/5/6 2635/6/7

ID	J5	J6	J7
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

JMP4	Short	Spinup at pwr on
	Open	Use start/stop unit
JMP3	Short	Parity enabled
	Open	Disabled
JMP2	Short	Unit ATTN enabled
	Open	Disabled
JMP1	Short	Common Comd Set
	Open	SCSI-2

2681S/2682S/2684S/2622/3/4

CNH 1	1-2	3-4	5-6
0	0	0	0
1	1	0	0

CNH 1	1-2	3-4	5-6
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

7-8 on Unit attention enabled
9-10 off Parity enabled
11-12 On SCSI 2
13-14 On Spindle motor auto

CNH 2

1-2	Open	Termpwr from IDD disable
	Short	Enable
3-4	Open	Termpwr from TERMPWR disable
	Short	Enable
5-6	Open	Reserved

2652/54

CNH 1	1-2	3-4	5-6
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

7-8 on SCSI port enabled
9-10 off Reserved
11 N/C
13-14 External LED
15-16 On W/P Disable
17-18 On Normal (Off=diags)
19-20 Open Drive reset

CNH 1

1-2	Short	LED active connected to bus
	Open	LED active when drive ready
3-4	Open	SCSI 1
	Short	SCSI 2
5-6	Open	Init from Host (INIT)
		Init from Drive (TARG)
7-8	Short	Resel/Ack executed
	Open	Not executed

2622/23/24SA(HA)(FA)

CNH1

1-2	On		PER default 0
	Off		PER default 1
3-4	On		SCSI-1/CCS mode
	Off		SCSI-2
5-6	On		Self-diags executed
	Off		Normal operation
7-8	On		Report condition status
	Off		No report
9-10	On		Retry count unlimited
	Off		10 times
11-12			Reserved
13-14	On		Enable Parity Checking
	Off		Disable
15-16	On		Enable SDTR fm RATG
	Off		Disabled from TARG
17-18	On		LED en during seeking
	Off		During drive idle
19-20	On		Spin Up on power up
	Off		With Start Unit comd
21-22	**3-4**	**5-6**	
	Short	Short	Termpwr from IDD & TERMPWR
	Open	Short	Only from IDD
	Short	Open	Only from TERMPWR

CNH2

1-2 open Reserved
3-4 open Reserved

CNH3

1-2 open Reserved
3-4 open No termination

CNH7

7-8 open Enable WP
9-10 open Reserved

CNH7	1-2	3-4	5-6
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

2694ES

SW1

1	On	SCSI-1/CCS mode
	Off	SCSI-2
2	On	Self-diags executed
	Off	Normal operation
3	On	Reports check condition status
	Off	No report check condition
4	On	Retry count unlimited
	Off	10 times
5	On	Enable Parity Checking
	Off	Disable
6	On	Enable SDTR from RATG
	Off	Disabled from TARG
7	On	LED enabled during seeking
	Off	During drive idle
8	On	Spin Up on power up
	Off	With Start Unit comd

CNH10

1-2 Short*		Sp sync term resist pwr
3-4	5-6	
Short	Short	Termpwr from IDD & TERMPWR
Open	Short	Only from IDD
Short	Open	Only from TERMPWR

CNH11

7-8 open	WP enabled
9-10 open*	Reserved

CNH11	*1-2*	*3-4*	*5-6*	*7-8*
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	1	1	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

M 2949/2952/2954

CN4 (294x), CN7 (295x)

ID	*1-2*	*3-4*	*5-6*	*7-8*
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	1	1	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

CN6 1-2	Open	Use Start/Stop Unit
	Short	Spinup at pwr on
CN6 3-4	Open	Parity check not done
	Short	Performed
CN6 3-4	Open	Term resist DB08-DB15, n/c
(295xE)	Short	Connected
CN6 5-6	Open	Self diags stopped
	Short	Executed
CN7 5-6	Open	Enable write protect
(294x)	Short	Disable
CN7 11-12	Open	Enable write protect
(295xS)	Short	Disable
CN7 13-14	Open	Enable write protect
(295xQ)	Short	Disable
CN7 7-8	Open	Term resistor not connected
(294x)	Short	Connected
CN7 13-14	Open	Term resistor not connected
(295xS)	Short	Connected
CN10	Open	Term resist n/c to bus lines
1-2,3-4	Short	Connected

M 2932/2934

ID	*1-2*	*3-4*	*5-6*	*7-8*
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0

ID	*1-2*	*3-4*	*5-6*	*7-8*
6	0	1	1	0
7	1	1	1	0
8	1	1	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

CN6 1-2	Open	Use Start/Stop Unit
	Short	Spinup at pwr on
CN6 3-4	Open	Parity check not done
	Short	Performed
CN6 5-6	Open	Self diags stopped
	Short	Executed
CN7 5-6	Open	Enable write protect
	Short	Disable
CN7 7-8	Open	Term resistor not connected
	Short	Connected
CN7 7-8	Open	8-bit SCSI mode
	Short	16-bit SCSI mode
CN10	Open	Term resist n/c to bus lines
1-2,3-4	Short	Connected

M 2927

ID	*1-2*	*3-4*	*5-6*
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

CN6 A	Open	Use Start/Stop Unit
	Short	Spinup at pwr on
CN6 P	Open	Parity check not done
	Short	Performed
CN6 D	Open	Self diags executed
	Short	Stopped
CN7 SY	Pin 1	Ground
	Pin 2	Execute Sp Sync I/O pulse
CN7 R	Open	No connection
	Short	Ext reset when to ground
CN7 WP	Open	Enable write protect
CN7 TM	Open	Term resistor disabled
	Short	Enabled

Fujitsu Drive Lettering

2	Storage product
E	Enhanced
T	IDE
TA	IDE
S	Single-ended SCSI @ 256 bytes/blk
SA	Above, 512 bytes/blk
SB	Above, 1024 bytes/blk
H	Diff SCSI
F	Fast SCSI
Q	Fast Wide S-ended
R	Fast Wide Diff

FWB Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
Hammer 1000FMF	S-2F	1050	2570	14	57	DEC DSP 3105
Hammer 1400	S	1400				
Hammer 600	S	600				
Hammer 100is	S	100				
Hammer 155MFi	S	155				
Hammer 300MF	S	300				
Hammer 425i	S	425				
Hammer 50is	S	50				
Hammer 2000	S	2000				Sledgehammer
Hammer 87000	S	8700				
Hammer PB 340	S	340				
Hammer PB 500	S	500				
Hammer PE 270	S	270				
Hammer PE 350	S	350				
Hammer PE 700	S	698				
PH 1000FMF	S-2F	1050	2570	14	57	Pockethammer DEC DSP 3105
PH 1760FMF-W	S	1760				Pockethammer
PH 2000FMF	S-2F	2129	2624	19	83	Pockethammer ST 42400N
PH 2050FMF	S	2050				Pockethammer
PH 4100FMF	S	4100				Pockethammer
PH 530FMF	S	500				Pockethammer
PH 975FMF	S	975				Pockethammer
Sldgehmmr 2000FMF	S-2F	2000				DEC DSP 3105(?)

GCC Technologies Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
MAX 105	S	105				Easydata
MAX 40	S	42				Easydata
MAX 80	S	80				Easydata
UltraDrive 100	S	100				Sun
UltraDrive 1000S	S-2F	1054	1872	15	73	ST 11200N
UltraDrive 175	S	175				
UltraDrive 20	S	20				
UltraDrive 200	S	200				
UltraDrive 2000X	S-2F	2129	2624	19	83	ST 42400N
UltraDrive 430	S	430				Sun
UltraDrive 45	S	45				
UltraDrive 45i	S	45				
UltraDrive 4OS	S	40				
UltraDrive 50R	S	50				Sun (removable)
UltraDrive 80	S	80				

General Microsystems Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
WN/D 220	S	1000				

Gigastorage

Model	Type	Cap	Cyls	Hds	SpT	Notes
B 5256A	A3	2500				
B 5300A	A3	3000				

Glyph Technologies

Model	Type	Cap	Cyls	Hds	SpT	Notes
GHD 600R	S-2	525				
GHD 1200R	S-2	1050				
GHD 2000RB	S-2	2100				

GVP

Great Valley Products Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
HardCard 100	H	100				SCSI
HardCard 30	H	30				SCSI
HardCard 40Q	H	40				SCSI
HardCard 45	H	45				SCSI
HardCard 80Q	H	80				SCSI

Grant

Made stuff for IBM

Model	Type	Cap	Cyls	Hds	SpT	Notes
72X8519	E	70				IBM Part No
90X7392	E	115				IBM Part No

Greenery Technology

Model	Type	Cap	Cyls	Hds	SpT	Notes
C 3100-12A	A	120	100	16	63	

Hard Drives International

Model	Type	Cap	Cyls	Hds	SpT	Notes
CardDrive 20		20				
CardDrive 30		30				
CardDrive 50		49				
105Q	S	105				Powerdrives
105Q	S	105				
105T	S	105				
105T	S	105				
200M	S	200				
200M	S	200				
20S	S	20				
20S	S	20				
210Q	S	210				
30S	S	30				
30S	S	30				
40Q	S	40				
40Q	S	40				
45S	S	45				
45S	S	45				
60S	S	60				
80Q	S	80				
80Q	S	80				
80S	S	80				
1050M	S	1050				
1050S	S	1050				
320M	S	320				
320S	S	320				
600S	S	600				
630	S	630				
660M	S	660				

Hewlett-Packard

Mostly for OEMs; e.g. Core Intl. Buys some IDE drives from Maxtor.

Model	Type	Cap	Cyls	Hds	SpT	Notes
C 2220A	A	332				
C 2221A	A	664				
C 222A	A	1000				
C 2233A	A	238	733	12	53	Try 462 x 16 x 63
C 2234A	A	334	823	13	61	Try 647 x 16 x 63
C 2235A	A	429	917	15	61	Try 832 x 16 x 63
C 3012 Kittyhawk	A	14		2		-001=ATA; -002=PCMCIA
C 3013 Kittyhawk	A	21	615	4	17	-001=ATA; -002=PCMCIA
C 3014A	A	42	799	4	26	
C 3015 Kittyhawk	A	30		4		-001=ATA; -002=PCMCIA

Model	Type	Cap	Cyls	Hds	SpT	Notes
C 3016 Kittyhawk	A	40		4		-001=ATA; -002=PCMCIA
C 3031A	A	21	400	4	26	
C 3335	A	1000				
C 5270A	A	1100	2105	16	63	
C 5271A	A	1100	2595	16	63	
C 5272A	A	1670	3244	16	63	
C 5273A	A	2004	3893	16	63	
C 5435A	A	1336	2595	16	63	
C 5436A	A	2004	3893	16	63	
D 1445A	A	100	624	10	34	
D 1446A	A	150	624	14	34	
D 1660A	A	330	646	16	63	Try 728 x 16 x 57
D 1661A	A	667	728	32	57	294x16x63 in HP BIOS
D 1665A	A	40	965	5	17	
D 1666A	A	80	965	10	17	
D 1674A	A	100	791	8	32	
D 1675A	A	150	791	12	32	
D 1676A	A	300	791	16	48	
D 1679A	A	120	814	9	32	
D 1680A	A	170	968	10	34	
D 1694A	A	52	751	8	17	Quantum LPS 52 AT
D 1696A	A	120				
D 1697A	A	240				
D 2329A	A	85	977	10	17	Quantum ELS 85AT
D 2330	A	170	1011	15	22	Quantum ELS 170AT
D 2387	A	210	723	15	38	Quantum LPS 210AT
D 2389A	A	540	1049	16	63	Quantum Maverick (ProDrive)
Surestor 1.080A	A	1080				
Surestor 1300A	A	1300				EIDE
Surestor 1600A	A	1620	3721	6	91-155	Physical
Surestor 2000A	A	2004	3893	16	63	EIDE Maxtor 72004A
7941A	HPIB	30	968	3		
7942A	HPIB	30	968	3		
7945A	HPIB	72	968	7		
79501A	HPIB	14	698	2		
97501A	HPIB	14	698	2		Possibly misnumbered 79501A
97501B	HPIB		1400	2		
97530E	E	136	1663	4	41	
97532E	E	103	1663	4	64	831 x 8 x 64
97533E	E	153	1663	8	64	831 x 16 x 64
97536E Coyote	E	315	1583	12	64	831 x 24 x 64
97544E	E	338	1457	8	57	728 x 16 x 57
97548E	E	680	1457	16	56	728 x 32 x 57
97556E	E	680	1680	11	72	840 x 22 x 72
97558E	E	1084	1961	15	72	980 x 30 x 72
97560E	E	1381	1961	19	72	980 x 38 x 72
D 1296A	M	21	615	4	17	Seagate ST 225
C 3012 Kittyhk	P3	14		2		-001=ATA; -002=PCMCIA

Model	Type	Cap	Cyls	Hds	SpT	Notes
C 3013 Kittyhk	P3	21	615	4	17	-001=ATA; -002=PCMCIA
C 3014A	P3	42	799	4	26	
C 3015 Kittyhk	P3	30		4		-001=ATA; -002=PCMCIA
C 3016 Kittyhk	P3	40		4		-001=ATA; -002=PCMCIA
C 3031A	P3	21	400	4	26	
Kittyhk II PSM	P3	43				
1000S+	S-2F	1050	3610	5	72-120	SureStor
2000LP	S-2F	2170	3610	9	72-120	
9000S	S-2F	2100				SureStor
97500-85600	S	20				
97500-85620	S	20				9000 Series
97530S	S	204	1619	6	41	
97532D/S/T	S	108	1663	4	64	831x8x64 OEM only
97533D/S/T	S	216	1663	8	64	831 x 16 x 64
97536D/S/T	S	311	1663	12	64	831 x 24 x 64
97544D/S/T/P	S-2	311	1447	8	56	723 x 16 x 56
97548D/S/T/P	S	660	1447	16	56	723 x 32 x 56
97549T/P	S-2	1000	1911	16	64	955 32 x 64
97554	S	340				
97556-300T/P	S-2	673	1670	11	72	835 x 22 x 72
97558-300T/P	S-2	1069	1952	15	72	976 x 30 x 72
97560-300T/P	S-2	1357	1952	19	72	976 x 38 x 72
C 2220B,M	S	330				
C 2221B,M	S	670				
C 2222B,M	S	1070				
C 2223B,M	S	1355				
C 2228B,M	S	234				
C 2229B,M	S	422				
C 2233S	S-2F	234	1511	5	48-72	755 x 10 x ?
C 2234S	S-2F	328	1511	7	48-72	755 x 14 x ?
C 2235S	S-2F	422	1511	9	48-72	755 x 18 x ?
C 2244	S2FW	600	1974	7	56-96	
C 2245	S-2F	750	1974	9	56-96	
C 2246	S-2F	900	1974	11	56-96	
C 2247-60062	S	1050	1974	13	56-96	OEM
C 2249M	S	422				
C 2270S	S	320				
C 2271S	S	663				
C 2451M	S	677				
C 2452M	S	1000				
C 2453M	S	1300				
C 2490A	S	2100	2582	18	68-108	255 x 255 x 63 Logical
C 3007	S2(W)	1370	2255	13	76-96	
C 3009	S-2	1792	2255	17	76-96	
C 3010	S	2000	2255	19	76-96	
C 3010-100	S-2	1027	1099	19	96	
C 3323SE(A)	S	1050	2910	7	72-120	
C 3325A	S-2	2170	3708	9	127	5400 RPM

Model	Type	Cap	Cyls	Hds	SpT	Notes
C 3330A	S-2	2170				
C 3331A	S-2	4350				
C 3550	S2FW	2000				
C 3555	S2FW	1000				
C 3724	S	1200	3610	5		
C 3725	S	2140	3610	7		
D 1685A	S	440				
D 1686A	S	670				
D 1687A	S	1000				
D 1699A	S	430				
D 2077A	S-2F	2100				
D 3340A	S-2	2100				
D 3341A	S-2	4200				
SureStor 2000LP	S-2F	2140				

C 2247

1	WP based on Mode Page
2	Unit Attention
3	Init SDTR msg at pwr on and reset
4	Parity Checking
5	Spin Up with Start Unit comd
6	Key
7-8	Sync spindle (unused)
9	Key
10	SCSI Address 1
11	SCSI Address 2
12	SCSI Address 3

C 2490

1	SCSI Address 1
2	SCSI Address 2
3	SCSI Address 3
4	Reserved
5	Key
6	Synchronise spindle
7	SCSI pin 29
8	Key
9	Spin Up with Start Unit comd
10	Parity Checking
11	Init SDTR msg at pwr on and reset
12	Unit attention
13	WP based on mode page
14	Reserved
15	Term
16	Term pwr

Hitachi

Model	Type	Cap	Cyls	Hds	SpT	Notes
DK 211A-34	A	340	969	14	49	
DK 211A-51	A	510	987	16	63	
DK 211A-68	A	680	2094	8		
DK 212A-10A	A	1000	2605	8		EIDE, ATA-2
DK 212A-81	A	810	2602	6		EIDE, ATA-2
DK 213A-11	A	1080				
DK 213A-13	A	1350	2605	10		EIDE
DK 213A-18	A	1800	3116	10		
DK 22AA-18	A5	18100				
DK 221A (1993)	A	340	692	16	60	
DK 222A-54	A2	540	1050	16	63	2.5”
DK 223A-81	A	810	2605	6		EIDE
DK 224A-14	A	1440	2792	16	63	EIDE 2.5”
DK 225A-21	A	2100	4188	16	63	EIDE 2.5”
DK 226A-21	A3	2160	4188	16	63	
DK 226A-32	A3	3240	4283	16	63	
DK 227A-41	A3	4090	7944	16	63	
DK227A-50	A3	5000				
DK 228A-65	A3	6400				
DK 229A-10	A3	10000				
DK 237A-32	A3	3200				
DK 239A-48	A3	4871				
DK 239A-65	A3	6490				
DK 23AA-12	A5	12072				
DK 23AA-18	A5	18000				
DK 23AA-60	A5	6007				
DK 23AA-90	A5	9042				
DK 512-8	E	67	823	5	64	RLL?
DK 512-10	E	86	822	6	34	
DK 512-12	E	94	823	7	64	
DK 512-17	E	134	823	10	64	
DK 514-38	E	330	903	14	51	
DK 522-10	E	86	823	6	34	
DK 515-78	E	673	680	28	69	
DK 516-12	E	1056	1787	15	77	
DK 516-15	E	1321	2235	15	77	
DK 522-10	E	91	823	6	36	
DK 5514-38	E	330	903	14		
DK 319H-18FC	F	18200				
DK 16-20M	I	2000	1790	15		
DK 301-1	M	10	306	4	17	
DK 301-2	M	16	306	6	17	
DK 501-1	M	11	320	4	17	
DK 502-1	M	10	320	4	17	
DK 502-2	M	15	320	6	17	615 x 4 x 17?

Model	Type	Cap	Cyls	Hds	SpT	Notes
DK 502-3	M	21	320	8	17	320 cyls?
DK 503-1	M	5	320	2	17	
DK 503-2	M	10	306	4	17	
DK 505-2	M	21	615	4	17	
DK 511-3	M	31	699	5	17	714 hds on Victor BIOS
DK 511-5	M	43	699	7	17	714 hds on Victor BIOS
DK 511-8	M	70	823	10	17	
DK 512-12	M	94	823	8	17	
DK 512-17	M	134	823	11	17	
DK 512-8	M	67	823	6	17	
DK 521-5	M	40	823	6	17	
WP-HD260	P	260				
DK 512-8	R	67	823	5	26	
DK 215C-14	S					
DK 312C-20	S	209	1076	10	38	
DK 312C-25	S	251	1076	12	38	
DK 314C-41	S	419	1169	14	50	
DK 316C-10	S-2F	1000				
DK 315C-11	S-2F	1100		15		
DK 315C-14	S-2F	1400		15		
DK 318A-91	S3	9100				
DK 319H-18WS	S-U	17100				
DK 31AH-36LW	S	35200				7200 RPM
DK 32AH-18LW	S	17600				7200 RPM
DK 326C-10	S-2F	1050		7		
DK 328C-10	S-2F	1050		3		
DK 328C-21	S-2F	2100		5		
DK 328C-43	S-2F	4300		10		
DK 329H-91WS	S-U	8600				
DK 512C-12	S	103	823	7	35	
DK 512C-17	S	147	819	10	35	
DK 512C-8	S	67	823	5	35	
DK 514C-38	S	322	903	14	51	
DK 515C-78	S	670	1361	14	69	680 x 28 x 69
DK 516C-16	S	1342	2172	15	81	
DK 517	S-2	1900				
DK 517C-37	S	2900		21		
DK 522C-10	S	88	819	6	35	
DK 815-10		1000	1737	16		
DK 815-5		525	1241	15		
SVF 501-18	S	200		10		Solid State
SVF 502-18	S	200		10		Solid State
SV 502C-32D	S	128				Solid State
SV 502C-32F	S	160				Solid State
SV 502C-32H	S	64				Solid State
SV 502C-64D	S	256				Solid State
SV 502C-64F	S	320				Solid State
SV 502C-64H	S	128				Solid State

Model	Type	Cap	Cyls	Hds	SpT	Notes
DK 512S-12	SMD	99	823	7	35	
DK 512S-17	SMD	141	823	10	35	
DK 512S-8	SMD	70	823	5	35	
DK 514S-38S	ESMD	330	903	14	51	Minicomputer
DK 515S-78	ESMD	673		14		
DK 515-12	HSMD	1222	1989	15	80	
DK 815-10A	SMD+	1067	1737	15		

DK 215C-14

JP2

1-2 Spindle Sync (Def=On) (Master)
3-4 Spindle Sync (Def=On) (Slave)
5-6 Motor Auto Start (On=Start at power on)
7-8 SCSI Parity (On=Disable)
9-16 All on

JP3

1-2 INTMP (On=+5V for term from drive)
3-4 EXTMP (On=+5V for term from bus)
5-6 TMEN (On=Enable Terminator)
7-8 SPNTM (On=Master Clock Line terminated

JP6

1-2 ID LSB (1) (none=ID 0)
3-4 ID (2)
5-6 ID MSB (4)
7-8 LED

JP7

All off

DK 515C

JP 248	*12-11*	*10-9*	*8-7*
0	1	1	1
2	1	0	1
3	0	0	1
4	1	1	0
5	0	1	0

Hi-Tech Marketing

Model	Type	Cap	Cyls	Hds	SpT	Notes
Giganstor		643				

Honeywell

Seagates – Use CDC numbers

Hyosung

Model	Type	Cap	Cyls	Hds	SpT	Notes
HC 8085	M	71	1024	8		
HC 8128	R	109	1024	8		
HC 8170E	Auto	151	1024	8	36	

IBM

Uses Xyratex and others as sub-contractors.
www.storage.ibm.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
30/2.5	A?	30				
60/2.5	A?	60				
00K0381	A	3200				
00K0394	A4	8400				UDMA 66
0AT1GBM	A	1000				
06G6421	A	40	977	5	17	
06H4152	A	270	944	14	40	Quantum Maverick 270AT
06H6111	A	1080	1049	16	63	DALA 3540
06H7141	A	540				
06H7142	A	540				
06451047	A	40	977	5	17	
0662-A10	A	1052	2038	16	63	Spitfire
09J0308	A4	6400				UDMA 66
17G3178	A	234	967	16	31	Maxtor 7245AI
2120	A	126	1248	4	50	
3120	A	120	820	6		
32G3861	A	212				
32G4194	A	245				
32G4195	A	340				
32G4196	A	527				
32G4338	A	2880				
364MBAT	A	364				
46H3426	A	3240		16	63	DeskStar 3
527MBAT	A	527				
53G 8704	A	340				
64F4132	A	40	932	5		
64F4133	A	80	932	10		
70G7424	A	170				

Model	Type	Cap	Cyls	Hds	SpT	Notes
70G8486	A	527				
70G8487	A	270				
70G8488	A	364				
70G8499	A	1440				
70G8500	A	1440				
70G8511	A	728				
70G8512	A	1000				
70G8847	A	270				
70G8848	A	364				
70G8849	A	527				
70G8850	A	728				
71G0666	A	1000				
76H7236	A	2559	4960	16	63	Caviar 22500
728MBAT	A	728				
79F1009	A	60	820	4		
82G5926	A	270				
82G5927	A	364				
82G5928	A	540				
82G5929	A	1000				
82G6106	A	527				
84G8998	A	1000				
85G3596	A	810	1571	16	63	
93F0076	A	120	936	16	17	
93F0118	A	212	682	16		
93F2360	A	163	984	10	34	Maxtor 7170A
94G3183	A	1080				
94G3186	A	1080				
94G4196	A	527				
95F4721	A	80	984	10	17	
95F4728	A	170	984	10	34	
95F7204	A	85				
DALA 3540AT	A	540	1049	16	63	06H7141
DAQA 32160	A	2160	4200	16	63	Deskstar 3. Sold to others.
DAQA 33240	A	3240	6296	16	63	
DBOA 2360	A	361	700	16	63	12.5 mm
DBOA 2528	A	528	1024	16	63	12.5 mm
DBOA 2540	A	541	1050	16	63	12.5 mm
DBOA 2720	A	722	1400	16	63	12.5 mm
DCAA 33610	A	2160	4200	16	63	17 mm
DCAA 34330	A	4330	8400	16	63	17 mm
DCRA 22160	A	2160	4200	16	63	17 mm
DDLA 21215	A	1215	2384	16	63	9.5 mm
DDLA 21620	A	1620	3152	16	63	9.5 mm
Deskstar 16GP	A4	16800				
Deskstar 20GP	A4	20300				
Deskstar 22XGP	A4	22000				
Deskstar 25XGP	A4	25000				
Deskstar 34GXP	A4	34200				7200 RPM

Model	Type	Cap	Cyls	Hds	SpT	Notes
Deskstar 37GP	A4	37500				
DHAA 2270	A	270	524	16	63	17 mm
DHAA 2344	A	344	915	5	49	
DHAA 2405	A	405	785	16	63	17 mm
DHAA 2528	A	528	1024	16	63	
DHAA 2540	A	540	1047	16	63	17 mm
DHEA 34330	A3	4300				
DHEA 36480	A3	6400	1259	16	63	
DHEA 38451	A4	8024				
DJAA 31270	A2	1270	2480	16	63	
DJAA 31700	A2	1705	3308	16	63	DeskStar
DJNA 352030	A4	20000				
DJNA 352500	A4	23800				
DLGA 22690	A	2690	5216	16	63	17 mm
DLGA 23080	A	3080	5968	16	63	17 mm
DMCA 21080	A	1080	2100	16	63	12.5 mm
DMCA 21440	A	1440	2800	16	63	12.5 mm
DPEA 30540	A	541	1050	16	63	
DPEA 30810	A	812	1574	16	63	
DPEA 31080	A	1083	2100	16	63	DeskStar XP EIDE
DPRA 20810	A	810	1572	16	63	17 mm
DPRA 21215	A	1215	2358	16	63	17 mm
DPTA 353750	A4	37500				UDMA/66 2 Mb buffer
DPTA 373420	A4	34200				Deskstar 34GXP
DSAA 31700	A	1700				
DSAA 3270	A	245	954	16	36	
DSAA 3360	A	365	929	16	48	
DSAA 3540	A	548	1062	16	63	V2 1024x16x63
DSAA 3720	A	730	1416	16	63	
DSOA 20540	A2	540	1050	16	63	12.5 mm
DSOA 20810	A2	810	1575	16	63	12.5 mm
DSOA 21080	A2	1080	2100	16	63	12.5 mm
DTNA 21800	A	1800	3500	16	63	12.5 mm
DTNA 22160	A	2160	4200	16	63	12.5 mm
DTTA 351680	A4	16104				
DTTA 371010	A4	9400				
DTTA 371440	A4	13500				DeskStar 14GXP 7200 RPM
DVAA 2810	A	810	1571	16	63	
H 2172-A2	A	172	989	10	34	17 mm
H 2258-A3	A	258	989	15	34	17 mm
H 2344-A4	A	344	915	15	49	17 mm
H 3133-A2	A	133	1023	15	17	
H 3171-A2	A	171	984	10	34	
H 3256-A3	A	250	872	16	36	
H 3342-A4	A	342	872	16	48	
Travelstar 4GN	A4	3200				
Travelstar 6GT	A4	5400				
Travelstar 8GS	A4	8100				

Model	Type	Cap	Cyls	Hds	SpT	Notes
WD 2120D	A	120	921	8	32	
WD 240A	A	41	615	4	33	
WD 25A	A	20	615	4	17	
WD 260A	A	60	1044	4	30	
WD 3158A	A	120	920	8	32	
WD 3160A	A	160	1024	8	39	
WD 380A	A	80	1024	4	39	
WD 387A	A	60	520	6	32	
WDA 2080	A	86	980	10	17	
WDA(S) 2120	A	126	969	15	17	
WDA 2160	A	172	989	10	34	
WDA 240	A	41	619	8	17	
WDA(S) 260	A	63	969	8	17	
WDA 280	A	86	989	10	17	2.5"
WDA 3158(G)	A	120	920	8	32	
WDA 3160	A	160	1021	8	39	
WDA 380	A	81	1021	4	39	
WDA 387(G)	A	60	520	4	32	
WDA L40(S)	A	39	977	5	17	1067 x 2 x 39 Ph
WDA L42(S)	A	40	977	5	17	1067 x 2 x 39 Ph
WDA L80	A	85	984	10	17	1923 x 2 x 44
WDA L85	A	85	984	10	17	
WDA L120	A	120	936	16	17	
WDA L160	A	170	984	10	34	1923 x 4 x 44
WDA S260	A	63	909	8	17	
WDL 340	A	40	1038	2	39	
0645-0355	E	70	583	7	36	10 Mhz
0645-0377	E	115	915	7	36	10 Mhz
0645-0381	E	314	1225	15	34	10 Mhz
0645-1073	E	40	1038	2	39	10 Mhz
0645-1074	E	80	1027	4	39	10 Mhz
0667-61	E	52	582	5	35	
0667-85	E	71	583	7	36	582 x 7 x 35?
0669	E	115	915	7		
0669-133	E	133				
0671	E	314	1225	15		
0671-315S	E	315				
72X8519	E	70	583	7	76	Grant
90X7392	E	115				Grant
90X8627	E	60				Fujisawa
90X8745	E	314	1225	15		0671
90X9286	E	120				Fujisawa
90X7392	E	115	915	7		Grant 0669
0664-P1S	IPI-2	1741	2304	15		
DCHS 38700	IPI-2	8700				
0665-30	M	21	615	4	17	
0665-38	M	31	733	5	17	
0665-53	M	44	733	7	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
0667	M	20	615	4	17	
1430	M	13	306	5	17	
1431	M	30	733	5	17	
1470	M	30	733	5	17	
1471	M	43	733	7	17	
4956-G10	M	43	733	7	17	
5160-088	M	20	306	8	17	
5170-099	M	20	615	4	17	
5170-319	M	30	733	5	17	Type 20
6150-473	M	43	733	7	17	Type 31
6128287	M	30	615	4	17	WD 336RT
61X8929	M	20	612	4	17	Type 26 Fujisawa
62X1031	M	20				
6278099	M	20	615	4	17	Type 6
6489907	M	20	306	8	17	Type 13
6489907-2	M	20	615	4	17	Type 2
64F4146	M	30	615	4	17	WD 336RT
72X8522	M	20	612	4	17	Type 30 Miniscribe/IBM Japan
72X8541	M	44	733	7	17	Type 31 Seagate
8286216	M	30	733	5	17	0665
8529275	M	10	306	4	17	WD12 Type 1
90X9403	M	30				Type 33 (?) Fujisawa
WD 12	M	10	306	4	17	Type 10
WD 25(A)	M	21	306	8	17	Type 13
WD 30	M	30	733	5	17	
WD 336RT	M	30	615	4	17	
40G3166	P1	5				SSD
40G3167	P1	10				SSD
40G3168	P1	20				SSD
40G3169	P2	30				SSD
40G3170	P2	40				SSD
32G4199	P3	105				
3513364	P3	364				
3513527	P3	527				
70G8495	P3	40				
56F8892	PS/2	80	1021	4		WD 380S
56F8894	PS/2	80	1021	4		WD 380S
56F8895	PS/2	160	1021	8		WD 3160S
56F8896	PS/2	40	1038	2		WD L40S
61X8929	PS/2	20	612	4		
6128279	PS/2	30	920	2		
6128285	PS/2	20	612	4		
6128287	PS/2	30	920	2		WD L330R
6128291	PS/2	120	920	8	32	WD 3158
6128294	PS/2	60	762	6		WD 387
85F0049	PS/2	60	762	6		WD 387
92F0016	PS/2	45	581	6		
WD 2120	PS/2	126	1248	4	50	

Model	Type	Cap	Cyls	Hds	SpT	Notes
WD 240	PS/2	43	1120	2	38	
WD 280	PS/2	86	1120	4	38	2.5". CL57SX Portable
WD 3158	PS/2	120	920	8	32	6128291
WD 3160S	PS/2	163	1021	8	39	
WD 3168	PS/2	157		8		
WD 325N	PS/2	20	615	4	17	MFM PS/2 50
WD 325Q	PS/2	20	612	4	17	MFM PS/2 30
WD 336P(R)	PS/2	31				PS/2 30E R=50Z
WD 380(S)	PS/2	81	1021	4	39	S=PS/2 70
WD 387,G,T	PS/2	60	520	6	32	928 x 4 x 32?
WDI 325N	PS/2	20	615	4	17	MFM
WDI 325Q	PS/2	20	612	4	17	MFM
WDL 320	PS/2	30	612	4	17	
WDL 330P/R	PS/2	30	920	2		P=PS/2 30E R=PS/2 70
WDL 340	PS/2	40	1038	2	39	
WDL 352N	PS/2	30				Type 20
WDL 40(S)	PS/2	41	1038	2	39	S=PS/2 70
WDM 240	PS/2	41	1123	2	38	
WDM 3158(G)	PS/2	120	920	8	32	
WDM 3160	PS/2	160	1021	8	39	
WDM 380	PS/2	80	1021	4	39	
WDM 387	PS/2	60	520	6	32	
WDM 387G,T	PS/2	60	520	6	32	
27F4130	R	32	615	4	26	Seagate ST 125R
		20	402	4		According to IBM
DCHC 38700	SSA	8700		18		
DCHC C4X	SSA	4510	1879	16		
DCHC 9X	SSA	9000				
DFHC 31080	SSA	1099	4416	4		
DFHC 32160	SSA	2202	4416	8		
DFHC 34320	SSA	4406	4416	16		
DFHC C4X	SSA	4510	1879	16		
032 G4336	S	2000				
03431	S	595-650				Removable Optical
045G0001	S	1300				
045G9466	S	1000				
045G9467	S	1050	1001	64	32	See 0662-S12
055F9824	S	1200				
055F9825	S	1000				
06H3370	S-2F	2250				
06H3372	S2FW	2250				
06H5338	S-2	540	4892	2		DALS 3540
06H5709	S2FW	4510				
06H5710	S2FW	5318				
06H6740	S-2D	2255				
06H6741	S-2F	4510				
06H6742	S-2D					
06H6749	S-2D	5318				

Model	Type	Cap	Cyls	Hds	SpT	Notes
06H6750	S-2D	5318				
06H8558	S-2F	540				
06H8891	S-2F	1080				
06H8892	S-2F	1080				
061G9231	S	650				
0645-0606	S	60	920	4	32	
0645-1045	S	80	1027	4	39	
0645-1046	S	160	1024	8	39	
0645-1050	S	120	920	8	32	
0645-1052	S	1000				
0645-1081	S-2	400	1201	14	48	
0645-1108	S-2	320	949	14	48	
0645-1234	S	320	949	14	48	
0645-1235	S	400	1199	14	48	
0645-1241	S	104				
0645-1242	S	212				
0661	S-2	320	949	14		
0661-1111	S	865	2051	13	66	
0661-1283	S	1004	2051	15	66	
0661-371	S-2	320	949	14	48	WD SC8320 Condor ucyls
0661-437	S-2	437				
0661-467(R)	S-2	400	1149	14	48	WD SC8400 Condor
0662-S1D	S2FD	1052		5		
0662-S12(D)	S2FW	1050	1001	64	32	Adstar FRU 45G9467
0662-SW1(D)	S2FW	1062	1001	64	32	
0663-E12	S-2F	1044	2469	14	59	
0663-E15(R)	S-2F	1206	2469	16	59	
0663-H11	S-2	868	2051	13	66	
0663-H12	S-2	1004	2051	15	66	
0663-L08	S-2	600	2051	9	66	
0663-L11	S-2	868	2051	13	66	
0663-L12(R)	S-2	1004	2051	15	66	
0663-W2H	S-2F	2412		30		
0664-C(DE)SH	S-2F	4027	2870	30	91	Includes -DSH ESH FSH
0664-M/N1H	S-2F	2014	2870	15	91	
0671S	S	387		15		
0671-S11	S	234	1224	11	34	
0671-S15	S	319	1224	15	34	
0681	S-2	1050		20		
0681-1000	S	865	1458	20	58	
0681-500	S	476	1458	11	58	
06G8905	S	128				
086F0102	S	2000				
090F6677	S	4000				
095F7193	S	85				
155F9964	S	?				0663
32G3796	S2FW	2000				
32G4198	S-2F	1000				

Model	Type	Cap	Cyls	Hds	SpT	Notes
32G4336	S-2F	2000				
55F5974	S	1000				0663
56F8851	S	160	1021	8	39	WDS 3160
56F8854	S	81	1027	4	39	WDS 380
56F8866	S	40	1120	2	38	WDS 240
6128291	S	120	920	8	32	WDS 3158
6128296	S	60	920	4	32	
6128298	S	120	920	8	32	WDS 3158
6475646	S	?				0663
70G7164	S-2F	1000				
70G8480	S-2F	170				
70G8481	S-2	340	2111	4		
70G8491	S-2F	540				
70G8492	S-2F	1052				
70G8493	S-2F	2014				
70G8494	S2FW	2014	2870	15		
70G9743	S2FW	1000				
71G6550	S-2F	170				
73F9122	S	400				
7204	S	80				
74G7037	S	7000				
74G7044	S	2000				
74G7045	S	4000				
75G3577	S	?				0664
82G5930	S-2F	270				
82G5931	S-2F	364				
82G5932	S-2F	540				
82G5933	S-2F	728				
85F0011	S	320	949	14	48	
85F0012	S	400	1199	14	48	
85G3623	S	1000				
92F0089	S	1000	2057	15		L12
92F0428	S-2F	1052				
92F0440	S-2F	2014				
93X2500	S	?				0661
94G2413	S-2F	1052				
94G2439	S-2F	270				
94G2440	S-2F	364				
94G2441	S-2F	540				
94G2442	S-2F	728				
94G2644	S-2F	270				
94G2645	S-2F	364				
94G2546	S-2F	540				
94G2647	S-2F	728				
94G2649	S2FW	1120				
94G2650	S2FW	2250				
94G2651	S2FW	4510				
94G3052	S2FW	1120				

Model	Type	Cap	Cyls	Hds	SpT	Notes
94G3054	S2FW	2250				
94G3055	S2FW	2250				
94G3056	S2FW	2255				
94G3057	S2FW	4510				
94G3059	S2FW	5318				
94G3184	S2FW	1080				
94G3187	S-2F	1080				
94G3192	S-2F	2250				
94G3193	S2FW	2250				
94G3195	S2FW	4510				
94G3196	S2FW	4510				
94G3197	S2FW	5318				
94G3198	S-2F	4510				
94G3199	S-2D	2255				
94G3200	S-2D	4512				
94G3201	S-2D	5318				
94G3203	S-2D	2255				
94G3204	S-2D	4512				
94G3205	S-2D	5318				
94G3787	S-2F	5318				
94G3794	S-2F	5318				
95F4748	S	104				
95F4749	S	212				WDS 3200
DALS 3540	S-2F	3540	4892	2		06H5338
DCAS 32160	S-3	2160		3		5400 RPM
DCAS 34330	S-3	4330		6		5400 RPM
DCHS 2XP	S-3W	4550	6076	9	120-184	See UltraStar 2XP
DCHS 34550	S	4560		9		7200 RPM
DCHS 38700	S-2F	8700		18		
DCHS 39100	S	9111		18		7200 RPM
DCMS 310800	S2FW	10800		20		
DFHS S1x	S-2	1126	1872	4	100	1893 tcyls
DFHS S2x	S-2	2255	1877	8	100	1893 tcyls
DFHS S4x	S-2	4512	1879	16	100	1893 tcyls
DFHS 31080	S-2F	1120	4416	4	100	
DFHS 32160	S-2F	2250	4416	8	100	
DFHS 34320	S-2F	4510	4416	16	100	
DFMS 31080	S-2F	1327	4416	4	105-180	
DFMS 32160	S-2F	2324	4416	7	105-180	
DFMS 32600	S-2F	2657	4416	8	105-180	
DFMS 34320	S-2F	4320	4416	13	105-180	
DFMS 351AV	S-2F	5106		16		
DFMS 35250	S-2F	5318	4416	16	105-180	
DFHS-S1x	S-2	1120	4416	4	100	
DFHS-S2x	S-2	2250	4416	8	100	
DFHS-S4x	S-2	4510	4416	16	100	
DFMS-S1x	S-2	1327	4416	4	105-180	
DFMS-S2x	S-2	2324	4416	7	105-180	

Model	Type	Cap	Cyls	Hds	SpT	Notes
DFMS-S3x	S-2	2657	4416	8	105-180	
DFMS-S4x	S-2	4320	4416	13	105-180	
DFMS-S5x	S-2	5318	4416	16	105-180	
DHAS 2270	S-2F	270	2788	2		
DHAS 2344	S-2F	344	2788	3		
DHAS 2405	S-2F	405	2788	3		
DHAS 2540	S-2F	540	2788	4		
DORS 31080	S-3F	2160				
DORS 32160	S-3W	2160	6717	5	99-148	Physical: UltraStar
DPES 30540	S-2	540	4896			
DPES 30810	S-2F	810	4896			
DPES 31080	S-2F	1080	4896	4	Var	DeskStar XP/Apple
DPES 3540	S-2F	540				
DPES 3810	S-2F	810				
DPRS 20810	S-2	810	3478	4		
DPRS 21215	S-2	1215	3478	6		
DSAS 3270	S-2F	270				
DSAS 3360	S-2F	364				
DSAS 3540	S-2F	548	3875	4		
DSAS 3720	S-2	730	3875	4		
DVAS 2810	S-2F	810	2788	6		
H 2172-S2	S-2	172	2264	2		
H 2258-S3	S-2	258	2264	3		
H 2344-S4	S-2	344	2264	4		
H 3133	S-2	133	2420	2		
H 3171	S-2	171	2420	2		
H 3256-S3	S-2	256	2420	3		
H 3342-S4	S-2	342	2420	4		
Pegasus	S	1000				
PN09L3903	S (U2)	36700				Ultrastar 36LZX
PN09L3905	S (U2)	18300				Ultrastar 18LZX
Ultrastar ES216	S-2F	2160				
Ultrastar 18LZX	S (U2)	18300				10000 RPM
Ultrastar 18XP/ZX	S(UW)	18000				7200 RPM 1 Mb 15.5W 42 mm
UltraStar 2XP	S-3W	4550	6076	9	120-184	See DCHS 2XP.
Ultrastar 36LZX	S (U2)	36700				10000 RPM
Ultrastar 9LP	S(UW)	9100				7200 RPM 1 Mb 25 mm
Ultrastar 9(L)ZX	S(UW)	9100				10,020 RPM 1 Mb 15.4 W
WD 160	S-2	160		8		
WD 40	S	41		2		
WDL 100	S	100	1990	2	44	
WDL 12	S	1000	2057	15		
WDL 200	S	200	1990	4	44	
WDL 340	S	40	1038	2	39	
WDS 240	S	41	1120	2	38	
WDS 260	S-2	63	1248	2	50	
WDS 280	S	86	1120	4	38	
WDS 3100	S-2	105	1990	2	44	

Model	Type	Cap	Cyls	Hds	SpT	Notes
WDS 3158(G)	S	120	920	8	32	6128291
WDS 3160	S-2	163	1021	8	39	
WDS 3168	S	160				
WDS 3200	S-2	210	1990	4	44	
WDS 380	S	81	1027	4	39	
WDS 387(G)	S	60	520	6	32	P/N 6128258
WDS L160	S-2	171	1923	4	44	
WDS L40	S-2	43	1038	2	39	
WDS L42	S-2	42	1066	2	39	
WDS L80	S-2	86	1923	2	44	
2311	?	4				Mainframes
2314	?	30				Mainframes
3030	?	60				Mainframes

662-A10

Single	End jumper inside
Master:	As above
Slave:	Next to end.

WDA L42(S)/L40(S)

Single:	2 on
Master:	2 on
Slave:	2 off

WDA L80/L160

Single:	3/4 closed
Master:	3/4 closed
Slave:	3/4 open

WDA L85, 120

Single	JP1, 2 closed
Master	As above
Slave	JP1 closed, 2 open

WDA 240/280, S260, 2120

Single:	JP1 closed
Master:	JP1 closed
Slave:	JP1 open

WDA 380/3160

Single:	SW 2 on
Master:	As above
Slave:	SW 2 off

H 3171-A2

Single:	JP1
Master:	JP1
Slave:	None

H 3256-A3 DSAA 3540

Single:	1,2 closed
Master:	As above
Slave:	3,4 closed

H 3342

Single:	1 closed
Master:	1 closed
Slave:	2 closed

DDLA 21215/21620, DLGA 22690/23080, DMCA 21080/21440, DCRA 22160, DTNA 21800/22160

Single:	None
Master:	None
Slave:	47-48 on (outside)

CS = 48-50 (along bottom)

DHAA 2270/2405/2540, H 2172-A2/2258-A3/2344-A4, DBOA 2360/2528/2540/2720, DSOA 20540/20810/21080, DPRA 20810/21215

Single:	47-48 on (outside)
Master:	47-48 on
Slave:	None

CS = 48-50 (along bottom)

DSAA 3270/3360/3720/3540

Single:	JP1 closed (1-2)
Master:	JP1 closed (1-2)
Slave:	JP2 closed (3-4)

DVAA 2810

Single:	45-46 (outside)
Master:	As above
Slave:	None

CS = 48-46

DPEA 31080/30810/30540, DALA 3540, DJAA 31270/31700, DAQA 32160/33240, DCAA 33610/34330

Single:	1-2 (outside)
Master:	As above
Slave:	3-4 (next one in)

DPES 30540/31080

1-2	Off	ID Bit 0
3-4	Off	ID Bit 1
5-6	Off	ID Bit 2
7-8	On	Auto spin
9-10	Off	Unit Attn enabled
11-12	Off	Term on
13-14	Off	TI Synch Negotiation

Many IBM SCSI Drives

ID	*0*	*1*	*2*
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

DSAS 3270/3360/3540/3720

ID	*JP1*	*JP2*	*JP 3*
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

JP4	Auto Spin up
JP 5	Unit Attn
JP 6	Term Connect
JP 7	TI Negotiation

60/120 Mb/320/400Mb/1Gb*

On=switch down on connector side of switch. S is startup shunt (off in normal use). * D is unused

ID	*Switches*
6	B, C On, A Off
5	A, C On, B Off
4	C On, A, B Off
3	A, B On, C Off
2	B On, A, C Off
1	A On, B, C Off
0	A, B, C Off

80/160 Mb drives

ID	*Jumper*
6	A, B On, C Off
5	A, C On B Off
4	A On, B, C Off
3	B, C On, A Off
2	B On, A, C Off
1	C On, A, B Off
0	A, B, C Off

S is startup shunt (normally off)

Spitfire

1	ID	*7*	Spindle Sync
2	ID (2)	*8*	LED
3	ID	*9*	Write Protect
4	Reserved	*10*	Reserved
5	Auto Start	*11*	Reserved
6	Enable term	*12*	Term Power

ICL

Model	Type	Cap	Cyls	Hds	SpT	Notes
EDS 30	?	30				Mainframes IBM 2314?
EDS4	?	4				Mainframes IBM 2311?

ICM

Model	Type	Cap	Cyls	Hds	SpT	Notes
SFX 12	A	42	615	4	34	
SFX 12-54S	S	42	615	4	34	

IDE Associates

Model	Type	Cap	Cyls	Hds	SpT	Notes
DA 40 FI	M	40?		8	17	

IEM

Model	Type	Cap	Cyls	Hds	SpT	Notes
5010S	S	1050				
5023S	S	2100				

IMI

International Memories, Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
2306H	M	5	306	2	17	
2312H	M	10	306	4	17	
5006H	M/R	5/8	306	2	17/26	
5012H	M/R	10/16	306	4	17/26	
5014H	M	13				
5018H	M/R	16/24	306	6	17/26	
5021H	M	20	306	8	17	
7710		10				
7720		20				
7740		40				

Imperial Technology

Model	Type	Cap	Cyls	Hds	SpT	Notes
Megaram 35S	S	512				Solid State
Megaram-SCSI	S	320				Solid State

Imprimis

See *CDC*—previously Magnetic Peripherals (MPI), owned by CDC, which was sold to Seagate.

Infinity

Model	Type	Cap	Cyls	Hds	SpT	Notes
PAS-ATA02014	A	1440				2.5”
PCQ-EL02014	A	1440	2800	16	63	2.5”
PCQ-EL01014	A	1440				2.5”
PCQ-ATA02014	A	1440				2.5”
PCQ-AR01014	A	1440				2.5”
PDL-LA02014	A	1440				2.5”
PIB-TP03014	A	1440				2.5”
PIB-TP02014	A	1440				2.5”
PIB-TP01014	A	1440				2.5”
PIB-ATA02014	A	1440				2.5”
PNC-VS02014	A	1440				2.5”
PNC-ATA02014	A	1440				2.5”
PNC-VS01014	A	1440				2.5”
PTS-TS02014	A	1440				2.5”
PTS-TS01014	A	1440				2.5”
PTS-ATA02014	A	1440				2.5”
PAS-ATA02021	A	2160				2.5”
PCQ-EL02021	A	2160				2.5”
PCQ-EL01021	A	2160				2.5”
PCQ-ATA02021	A	2160				2.5”
PCQ-AR01021	A	2160				2.5”
PDL-LA02021	A	2160				2.5”
PIB-TP03021	A	2160				2.5”
PIB-TP02021	A	2160				2.5”
PIB-TP01021	A	2160				2.5”
PIB-ATA02021	A	2160				2.5”
PNC-VS02021	A	2160				2.5”
PNC-ATA02021	A	2160				2.5”
PNC-VS01021	A	2160				2.5”
PTS-TS02021	A	2160				2.5”
PTS-TS01021	A	2160				2.5”
PTS-TS01021	A	2160				2.5”
PTS-ATA02021	A	2160				2.5”
PAS-ATA01030	A	3080				2.5”
PCQ-EL02030	A	3080				2.5”
PCQ-EL01030	A	3080				2.5”
PCQ-ATA02030	A	3080				2.5”
PCQ-AR01030	A	3080				2.5”
PDL-LA01030	A	3080				2.5”
PIB-TP03030	A	3080				2.5”
PIB-TP02030	A	3080				2.5”

Model	Type	Cap	Cyls	Hds	SpT	Notes
PIB-TP01030	A	3080				2.5"
PIB-ATA02030	A	3080				2.5"
PNC-VS02030	A	3080				2.5"
PNC-ATA02030	A	3080				2.5"
PNC-VS01030	A	3080				2.5"
PTS-TS02030	A	3080				2.5"
PTS-TS01030	A	3080				2.5"
PTS-ATA02030	A	3080				2.5"

Insight

Model	Type	Cap	Cyls	Hds	SpT	Notes
Talon TA3122A	A	250				
Power Drive 1075	S-2	1079	1658	15	85	Fujitsu M 2266S-512
Power Drive 1750	S-2	1662				Fujitsu M 2265S-512

Integra Technologies Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
Integra 1	A	500				
Integra 1	S	500				
Integra III	S	3000				

Integral Peripherals

Vipers manufactured for DIP Systems Ltd.

Model	Type	Cap	Cyls	Hds	SpT	Notes
2100	A	1000	1900	16	63	
Platinum 1080	A	1080				2.5"
Platinum 1200	A	1200				2.5"
Silhouette 31650	A	1650				
Silhouette 32160	A	2160				
Silhouette 4090	A	4100				3" 10.5 mm
1820 Mustang	P	21	608	2		XT/AT
1841P(A) Ranger	P/A	42		2		
1842 Stingray	P	43		4		XT/AT
1862 Maverick	P	64		3		
1862P Maverick	P	64		3		
1882P(A) Cobra	P	85		3		
1885 McKinley	P	85				
8105 PA	P	105				
8170 PA	P	170				
Cobalt 420	P	170				
Pocketfile 105	P	105				

Model	Type	Cap	Cyls	Hds	SpT	Notes
Pocketfile 170	P	170				
Pocketfile 260	P	260				
Pocketfile 42	P	42				
Pocketfile 85	P	85				
Viper 105	P	105		4		
Viper 170	P	170		4		
Viper 260	P	260		4		
Viper 340	P	340		4		
Viper 510	P	510				

Integrated Data Storage Systems

Model	Type	Cap	Cyls	Hds	SpT	Notes
iDS100i	S	102				
iDS130i	S	132				
iDS180i	S	182				
iDS200i	S	204				
iDS20i	S	22				
iDS20p	S	22				
iDS40iC	S	42				
iDS40iQ	S	42				
iDS80i	S	60				

Introl Corp

Model	Type	Cap	Cyls	Hds	SpT	Notes
1200D	S	1000				

Iomega

Model	Type	Cap	Cyls	Hds	SpT	Notes
Insider 90 Pro	S-2	90				Bernoulli
Multidisk	S	150				

Irwin

aka Olivetti

Model	Type	Cap	Cyls	Hds	SpT	Notes
416	M	13	819	2	17	
510	M	10	628	2	17	HD/Tape
516	M	13	819	2	17	HD/Tape
HD 561	M	5	180	4	17	

Itochu

See C Itoh

Jasmine Technologies Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
Backpac 40	S	42				
Backpac 80	S	80				
DD 40	S	40				Blueflower
DD 80	S	80				Blueflower
DD 180	S	174				
DD 130	S	130				
DD 80	S	90				Platinum
DD 40	S	40				Platinum

JCT

Now Maxcard (e.g. Maxtor). No longer producing hard drives.

Model	Type	Cap	Cyls	Hds	SpT	Notes
100	M	5	306	2	17	
1000	M	5	131	4	17	Commodore
1005	M	7			17	Commodore
1006	M	7	436	2	17	Commodore
1010	M	14	436	4	17	Commodore
105	M	7	436	2	17	
110	M	14	436	4	17	
120	M	20	615	4	17	

Jets Cybernetics Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
FileSurfer	S	300				
FileSurfer	S	1000				

JTS

Formed by executives from Seagate and Tandon.
Makes 3" hard disks (Nordic) for OEMs.
www.jtscorp.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
C 1700-2AF	A3	1700	3312	16	63	25.4 mm Champion
C 2000-2AF	A3	2000	3882	16	63	25.4 mm Champion
C 2500-3AF	A3	2500	4970	16	63	25.4 mm Champion

Model	Type	Cap	Cyls	Hds	SpT	Notes
C 3000-3AF	A3	3000	5824	16	63	25.4 mm Champion
C 1000-2AF	A	1000	1957	16	63	16.5 mm Champ
C 1300-2AF	A	1300	1300	16	63	16.5 mm Champ
C 1700-3AF	A	1700	3314	16	63	16.5 mm Champ
C 2000-3AF	A	2000	3882	16	63	16.5 mm Champ
N 1080-2AR	A3	1080	4032	4		10.5 mm Nordic
N 1440-3AR	A3	1440	4032	6		12.5 mm Nordic
N 1620-3AR	A3	1620	1620	6		12.5 mm Nordic
N 2160-3AR	A3	2160	4435	6		12.5 mm Nordic
P 1000-2AF	A	1000	1942	16	63	
P 1200-2AF	A	1200	2332	11	63	
P 1600-3AF	A2	1600	3108	16	63	
P 3250A	A	251	961	16	32	P=Palladium
P 3360A	A	362	791	16	56	
P 3540A-2AF	A	540	1049	16	63	
P 3850-2AF	A	816	1649	16	63	

P 1000-2AF/1200-2AF/3850AF

Single:	JP2 3-4
Master:	JP2 5-6
Slave:	JP2 1-2

Cable Select: JP2 1-3

C 1000-2AF/1300-2AF/C1700-3AF/2000-3AF/P 1600-3AF

Single:	JP1 3-4
Master:	JP1 5-6
Slave:	JP1 1-2

Cable Select: JP1 1-3

C 1700-2AF/2000-2AF/2500-3AF/3000-3AF

Single:	2-4
Master:	2-4
Slave:	1-2

Cable Select 3-4

JVC Information Products Inc

No longer producing hard drives

Model	Type	Cap	Cyls	Hds	SpT	Notes
JD 3812M0Z0	A	21	436	2	48	Zenith XT laptops JVC Interface
JD 3824R00-1	A	21	436	2	48	Supersport XT laptop JVC I'face

Model	Type	Cap	Cyls	Hds	SpT	Notes
JD E3824TA	A	21	436	2	48	Toshiba laptops
JD E3848HA	A	43	436	4	48	
JD E2042M	A	42	973	2	43	JVC Interface
JD E2064M	A	64	532	4	59	
JD E2085M	A	85	973	4	43	JVC Interface
JD E2130M	A	130	538	8	59	
JD E2825P(A,X)	A	21	581	2	36	
JD E2850P(A,X)	A	42	793	3	36	
JD E3848V10-2	A	42	862	2	48	Toshiba Laptops
JD E3896V	A	85	862	4	48	
JD F2042M	A	42	973	2	43	JVC Interface
JD 3806M	M	5	306	2	17	
JD 3812M	M	10	612	2	17	
JD E2825P	S	21	436	2	48	
JD 2850P	S	43				
JD E3848V(H)	S	43				
JD E3896V	S	85	862	4	48	

Kalok

Division of JTS Something to do with Xebec?

Model	Type	Cap	Cyls	Hds	SpT	Notes
KE 3080	A	50	979	4	40	
KL 1000	A	105	978	6	35	
KL 3100	A	105	979	6	35	
KL 3120	A	120	820	6	40	
KL 343 Oct 40	A	42	676	4	31	644 x 4 x 30?
KL 383 Oct 2	A	64	815	6	26	
KL 386 Oct 2	A	43				
P 3250AR/DS	A	251	961	16	32	K-Stor Removeable
P 3260/DS	A	251				Removeable Flash BIOS
P 3360AR	A	362	791	16	56	
P 3540AR/DS	A	540	1024	16	63	Removeable Flash BIOS
P5 125A .5	A	126	2048	2	80	Try 872 x 8 x 35
P5 250A .5	A	252	2048	4	80	Try 1010 x 9 x 55
KL 320 Oct 20	M	21	615	4	17	
KL 340 Oct 2	M	42	820	6	17	
KL 360	M	42	820	6	17	
KL 332 Oct 30	PS/2	48	615	4	30	
KL 342	PS/2	35	676	4	26	RLL
KL 330 Oct 30	R	33	615	4	26	Also MFM; 17 sectors. WPC 300
KL 341 Oct 40	R	40	644	4	26	
KL 360 Oct 2	R	65	820	6	26	
KL 341 Oct 40	S	43	644	4	31	676 cyls?
KL 381	S	84	815	6	34	
P5 125S .5	S-2	126	2048	2	80	
P5 250S .5	S-2	252	2048	2	80	

Kalok 343

Master:	5/6 on
Slave:	7/8 on

Kingston Technology Corp

Model	Type	Cap	Cyls	Hds	SpT	Notes
AT 260	A	260				Data Card
AT 340	A	340				Data Card
Data Traveler	Par	127				
Data Traveler	Par	209				
Data Pak 170	P3	170				
Data Pak 260	P3	260				

KT Technology

Model	Type	Cap	Cyls	Hds	SpT	Notes
PHD 120	A	120				Hardcard
PHD 205	A	205				Hardcard
PHD 40	A	40				Hardcard
PHD 60	A	60				Hardcard
PHD 80	A	80				Hardcard

Kyocera

Model	Type	Cap	Cyls	Hds	SpT	Notes
KC 40GA	A	42	977	5	26	Try 537 x 4 x 17
KC 80GA	A	80	977	10	26	
KC 20A	M	21	616	4	17	
KC 20B	M	20	615	4	17	
KC 20C	M	21	615	4	17	
KC 30A	R	32	616	4	26	
KC 30B	R	30	615	4	26	
KC 80C	S	87	787	8	26	
KC 80GS	S	83	787	8	26	

KC 40GA

Single:	ST3 shut
Master:	ST2 shut
Slave:	ST2, ST3 open

LaCie Ltd

Makes external hard disks for Macs. Previously owned by Quantum, sold to Electronique d2 SA, France.

Model	Type	Cap	Cyls	Hds	SpT	Notes
Cirrus 650h	S	664				
Cirrus 1000Q	S	1050	2444	12	70	Quantum PD 1050
Cirrus 1200Q	S-2F	1200	1834	5	87	Quantum PD 1225
Joule 540Mb	S-2	540				Portable/Base
Joule 730Mb	S-2	730				Portable/Base
Joule 1080Mb	S-3	1080				Portable/Base
Joule 1400Mb	S-3	1400				Portable/Base
Joule 2100Mb	S-3	2100				
ZFP 105	S	105				
ZFP 20	S	20				
ZFP 200	S	200				
ZFP 40	S	40				
ZFP 80	S	80				
ZFP Plus 1000	S	1000				
ZFP Plus 400	S	332				
ZFP Plus 400	S	400				
ZFP Plus 600	S	600				
ZFP Plus 650	S	650				
ZFP100	S	100				

LANStor

Model	Type	Cap	Cyls	Hds	SpT	Notes
LAN 115		115	918	15	17	
LAN 140		140	1024	8	34	
LAN 180		180	1024	8	26	
LAN 64		64	1024	8	17	

LaPine

Out of business

Model	Type	Cap	Cyls	Hds	SpT	Notes
3062	M	10	306	4	17	
3065	M	10	306	4	17	
3512	M	10	306	4	17	
3522 Titan	M/R	10/16	306	4	17/26	
3532 Titan	M/R	21/32	615	4	17/26	
3533	M	20	615	4	17	
LT 10	M	10	615	2	17	
LT 100	M	10	615	2	17	
LT 20	M	21	615	4	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
LT 200	M	21	615	4	17	612 cyls?
LT 2000	M	20	614	4	17	
LX 200	M	20	615	4	17	
LX 2000	M	20	615	4	17	
Titan 10	M/R	10/16	615	2	17/26	
Titan 20	M/R	21/32	615	4	17/26	
Titan 30	M/R	20/32	615	4	17/26	
LT 30	R	33	615	4	26	
LT 300	R	32	615	4	26	616 cyls?
LT 4000	S	40				

Lexikon

see Olivetti

Model	Type	Cap	Cyls	Hds	SpT	Notes
HD 352	M	20	612	4	17	Set up by software
HD 674	M	35	820	5	17	
HDC 372	M	21	611	4	17	Hardcard
XM 5220/2	M	21	615(?)	4	17	Try 611 cyls

Liberty Systems

C=CartridgeAll Portable

Model	Type	Cap	Cyls	Hds	SpT	Notes
1080QAT	A	80	1024	9	17	Quantum?
1080Q	S	80	1024	9	17	Quantum?
11544S(P)	S	44				
11588S(P)	S	88				
1.2 GB-Q	S-2F	1200	1834	5	87	Quantum PD 1225
2040C	S	40				
22544SD	S	44 x 2				
22588SD	S	88 x 2				
3020C	S	20				
3020CT	S	20				
3040C(P)	S	40				
3040CT	S	40				
501080	S	1080	2866	8	92	Parallel/P3
50105Q(P)	S	105	1223	4	42	
50120C(P)	S	120	1818	2	60	
501300	S	1300				Parallel/P3
502100	S	2100				Parallel/P3
5052Q(P)	S	52	2438	2	70	
504200	S	4200				Parallel/P3
50730	S	730				Parallel/P3
70105Q	S	105	1223	4	42	
70170Q	S	170	2356	2	71	

Model	Type	Cap	Cyls	Hds	SpT	Notes
70210Q	S	210	3079	12	111	
702100	S	2100				Parallel/P3
70340M	S	340	2356	4	71	
7040Q	S	40				
704200	S	4200				Parallel/P3
70425Q	S	425				
7052Q	S	52	2438	2	70	
870 MB-T	S-2	862	1655	15	68	Toshiba MK 438FB

Longshine

Model	Type	Cap	Cyls	Hds	SpT	Notes
	P	124	979	6	41	

Loviel Computer Corp

Model	Type	Cap	Cyls	Hds	SpT	Notes
	S-2F	1200	1834	5	87	Quantum PD 1225

Mac/PC Data Enhancements Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
PD 1040	S	42				
PD 1085	S	84				
PD 1105	S	105				
PD 1120	S	120				
PD 1170	S	168				
PD 1210	S	210				
PD 3350	S	325				
PD 3670	S	650				
PD 61000	S	1030				

MacAvenue

Model	Type	Cap	Cyls	Hds	SpT	Notes
Protege 100Q	S	100				
Protege 20S	S	20				
Protege 20S	S	20				
Protege 40Q	S	40				
Protege 40Q	S	40				
Protege 40S	S	40				
Protege 40S	S	40				
Protege 80Q	S	80				
Protege 80Q	S	80				

Model	Type	Cap	Cyls	Hds	SpT	Notes
Protege 80S	S	80				
Protege 80S	S	80				

MacDirect

Model	Type	Cap	Cyls	Hds	SpT	Notes
MacDirect 2400	S	1957				Fujitsi M 2654S-512

MacProducts USA Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
Magic 105Q	S	101				
Magic 1.2 GB	S-2	1079	1658	15	85	Fujitsu M 2266S-512
Magic 150	S	152				
Magic 170Q	S	169				
Magic 20	S	21				
Magic 2.1GB	S-2F	1900	2573	15	96	ST 42100N
Magic 30	S	31				
Magic 300	S	300				
Magic 40Q	S	40				
Magic 46	S	65				
Magic 60	S	65				
Magic 600	S	584				
Magic 80Q	S	81				
Magic 91	S	92				

Magnetic Peripherals Inc (MPI)

See *CDC* who marketed drives under this name before forming Imprimis

Magtron

Model	Type	Cap	Cyls	Hds	SpT	Notes
3040A	A	40	850	2	46	
3080A	A	81	850	4	46	
3120A	A	130		4		
MT 4115E	E	115	1600	4	35	
MT 4140E	E	140	1600	5	35	
MT 4170E	E	170	1600	6	35	
MT 5400E	E	361	1632	8	54	
MT 5760E	E	677	1632	15	54	
MT 4115S	S	115	1600	4	35	
MT 4140S	S	140	1600	5	35	
MT 4170S	S	170	1600	6	35	

Model	Type	Cap	Cyls	Hds	SpT	Notes
MT 5400S	S	359	1623	8	54	
MT 5760S	S	673	1623	15	54	
MT 6120S	S	1200				

Market West Computer Group

Model	Type	Cap	Cyls	Hds	SpT	Notes
HC 8170E	E	150				

Mass Microsystems

Model	Type	Cap	Cyls	Hds	SpT	Notes
Hard Drive 130	P	130				
Hard Drive 170	P	170				
Hard Drive 265	P	265				
40 Hitchhiker	S	40				External, Mac
80 Hitchhiker	S	82				External, Mac
120P Diamond	S	117				Portable, Mac
210P Diamond	S	200				Internal
245i(V) Diamond	S-2	245				DD=Diamond
320i(V) Diamond	S-2	320				
510P Diamond	S	508				Portable, Mac
80P Diamond	S	79				
MD 1005	S-2F	1000				MD=MASSterDrive
MD 1600	S-2F	1600				Internal/External
MD 1630	S-2F	1630				Internal/External
MD 2010	S-2F	2010				Internal/External
MD 2100	S-2F	2100				Internal/External
MD 2780	S-2F	2800				Internal/External
MD 510	S-2F	510				
MASSter 6	S-2/P	1000				Reader/Writer
MASSter 7	S-2/P	2000				Reader/Writer

Master Disk

Model	Type	Cap	Cyls	Hds	SpT	Notes
DM 3142A	A	42				IBM?

Maximus

Model	Type	Cap	Cyls	Hds	SpT	Notes
El Dorado LX	M	60	820	6	17	
MaxiPro 20	M	20	782	2	17	3:1 interleave

Model	Type	Cap	Cyls	Hds	SpT	Notes
MaxiPro 40	M	40	782	4	17	
Premier 9000	R	71	1024	8	26	

Maxtor

Now owned by Hyundai; sells IDE drives to HP

For Maxtor (Colorado) see Miniscribe
For * or LXT/XT ESDI/SCSI models, ring Sequel 01734 509621; (408) 987 1000
For ** ring CNS on (303) 682 0090
For Hardcards ring Peripheral (408) 263 4043
For Passport XL ring Mountain Gate (702) 851 9393
For Optical Drives try Maxoptics, now owned by Kubota Corp
For Maxblast software (i.e. Disk Manager), set drive as Type 9, or 900 x 15 x 17

Model Numbering

87000A8 = 8000 series, 7000Mb, ATA with 8 data surfaces. **Suffixes** are: A=ATA, D=Ultra DMA or Diff SCSI, S=SCSI, E=ESDI, M=PCMCIA, P=128K cache, V=Value (*not* Visual, as in Audio-Visual), Q=64K cache (for European OEM), I=IBM, R=non-USA, L=Low Profile (1"), Y=nearly SCSI 2, H=High Perf.

7000 series discontinued 1996, SCSI & PCMCIA 1994 and ESDI 1991. LXTs replaced by MXTs 1993.

Model	Type	Cap	Cyls	Hds	SpT	Notes
250837	A	795	1621	16	63	PIO 4
25084A	A	80	569	16	18	Discontinued
251005	A	957	1945	16	63	PIO 4
25128A Apache	A	122	981	15	17	1092 x 4 x 30-60
251340A	A	1276	2594	16	63	PIO 4
25252A Apache	A	240	569	16	54	Try 1024 x 16 x 30
2585A Apache	A	82	981	10	17	1092 x 4 x 24-48
7040A	A	41	981	5	17	524x4x40
7060A	A	60	467	16	17	Try 1024 x 7 x 17
7080A	A	81	981	10	17	Try 832 x 6 x 33
71000A	A	1080	1946	16	63	
71050A	A	1006	2045	16	63	EIDE PIO3 Replaced by 71080A
71080A	A	1006	2045	16	63	Replaces 71050A
71084A	A	1036	2105	16	63	PIO 4
7120A	A	124	936	16	17	Try 1024 x 14 x 17
71260AV	A	1204	2448	16	63	EIDE Excalibur PIO 3
713A	A	113				Slimline
7130A	A	130	936	16	17	7120A in disguise
7131A	A	125	1002	8	32	2096 x 2 x 32
71336A(P)	A	1277	2595	16	63	EIDE PIO 4
7135AV	A	129	966	12	21	
71350AP	A	1292	2624	16	63	
71626AP	A	1554	3158	16	63	PIO 4
71670A(P)	A	1586	3224	16	63	EIDE

Model	Type	Cap	Cyls	Hds	SpT	Notes
71687AP	A	1614	3280	16	63	
7170A/AT/AI	A	163	984	10	34	Made for IBM—p/n 93F2360
7171A	A	165	866	15	26	
72004AP	A	1916	3893	16	63	PIO 4
72025AP	A	1937	3936	16	63	
7213A	A	203	683	16	38	1690 x 4 x 48-72
7245A	A	234	967	16	31	Try 944 x 14 x 40
72577AP	A	2459	4996	16	63	
7270AV	A	258	959	11	50	
72700AP	A	2583	5248	16	63	
7273A	A	261	1012	16	63	Old version 967 x 16 x 31
7290A	A	277	941	14	43	
7345A	A	329	790	15	57	2219 x 4
7405A	A	386	989	16	50	
7420AV	A	401	986	16	52	PIO 3
7425AV	A	407	1000	16	52	PIO 3
7540AV	A	515	1046	16	63	J22 for 1024x12x63 PIO 3
7541AV	A	518	1052	16	63	PIO 4
7546AV	A	522	1060	16	63	PIO 3 Old version 1024x16x63
7668A/AP	A	638	1297	16	63	PIO 4
7850AV	A	814	1654	16	63	
8051AT	A	41	982	5	17	Also 745 x 4 x 28
80875A2	A	837	1700	16	63	
81080A3	A	1034	2100	16	63	OEM
81081A2	A	1034	2100	16	63	
81275A3	A	1221	2480	16	63	OEM
81280A2	A	1280	2481	16	63	
81312A3	A	1254	2548	16	63	
81620A3	A	1600	3250	16	63	
81630A4	A	1559	3168	16	63	OEM
81750A4	A	1781	3400	16	63	
82100A4	A	2014	4092	16	63	
82160A4	A	2060	4185	16	63	
82160D2	A3	2160	4465	15	63	DiamondMax 2160
82187A5	A	2091	4248	16	63	
8225A	A	21	747	2	28	
82400A4	A	2317	4962	16	63	OEM
82559A4	A	2442	4962	16	63	OEM
82560A4	A	2442	4962	16	63	
82577A6	A	2560	4962	16	63	OEM
82580A5	A	2436	5004	16	63	
82625A6	A	2451	5100	16	63	
83062A7	A	2859	5948	16	63	
83200A5	A	2905	6296	15	63	OEM
83200A6	A	2905	6296	15	63	OEM
83200A8	A	3060	6218	16	63	OEM
83201A6	A	3060	6218	16	63	
83202A6	A	2905	6296	15	63	OEM

Model	Type	Cap	Cyls	Hds	SpT	Notes
83209A5	A	3060	6218	16	63	OEM
83240D3	A3	3240	6697	15	63	DiamondMax 2160
83500A8	A	3347	6800	16	63	
83840A6	A	3840	7443	16	63	
84000A6	A	4000	7763	16	63	OEM
84004A8	A	3818	7758	16	63	OEM
84200A8	A	4028	8184	16	63	OEM
84320A8	A	4410	8960	16	63	
8450A	A	43	745	4	28	
85120A8	A	4884	10585	15	63	
		5120	9924	16	63	
85121A8	A	4884	10585	15	63	OEM
82560A3	A3	2442	4962	16	63	
83240A(D)4	A3	3089	6277	16	63	
83500A4	A3	3339	7237	16	63	
84320A5	A3	3862	8370	15	63	
84320D4	A3	4320	8930	15	63	
85250A6	A3	5009	10856	15	63	
86480A8	A3	6179	13392	15	63	
86480D6	A3	6480	13395	15	63	DiamondMax
87000A8	A3	6679	14475	15	63	
88400D8	A	8400	16278	16	63	5200 RPM 256K 5W Diamond
90432D3	A	6400				
9070D6	A	7500				
90845D4	A	8400				
91000D8	A4	9529				Diamond Max + 2500
91024D4	A	10200				
91080D5	A	10800				
91303D6	A	13000				
91360D8	A4	12954				Diamond Max 3400
91536D6	A	15300				
91728D8	A	17200				
92048D8	A	20400				
Diamond Max 1750	A	1700				
Diamond Max 2880	A4	11000				2880 per platter
Diamond Max 3400	A4	12954				91360D8
Diamond Max 4320	A4	12100				91303D6 5400 RPM, but fast
Diamond Max 4320	A4	16100				91728D6
Diamond Max 6800	A4	27200				5400 RPM
Diamond Mx 84320D4	A4	4300				UDMA 66
Diamond Mx 88400D8	A4	8400				UDMA 66
Diamond Mx 90432D3	A4	6400				UDMA 66
Diamond Mx 90845D4	A4	8400				UDMA 66
Diamond Mx 91080D5	A4	10800				UDMA 66
Diamond Mx 91303D6	A4	13000				UDMA 66
Diamond Mx 91728D8	A4	17200				UDMA 66
Diamond Mx 92049Y4	A4	20000				UDMA 66 2Mb buffer 5400 RPM
Diamond Max	A	5100				

Model	Type	Cap	Cyls	Hds	SpT	Notes
Diamond Max + 2500	A4	9529				91000D8
Diamond Max + 5120	A4	20400				UDMA 66 7200 RPM
Diamond Max + 6800	A4	13000				
Dmnd Mx+ 54098U8	A4	40980				UDMA 66 7200 RPM
Dmnd Mx+ 9070D6	A	7500				UDMA 66 7200 RPM
Dmnd Mx+ 91000D8	A	9000				UDMA 66 7200 RPM
Dmnd Mx+ 91024D4	A	10200				UDMA 66 7200 RPM
Dmnd Mx+ 91536D6	A	15300				UDMA 66 7200 RPM
Dmnd Mx+ 92041U4	A4	20400				UDMA 66 5400 RPM
Dmnd Mx+ 92048D8	A	20400				UDMA 66 7200 RPM
Dmnd Mx+ 92732UB	A4	27300				UDMA 66 7200 RPM
LXT 100A	A	96	733	8	32	
LXT 200A	A	191	816	15	32	1320 x 7 x 33-53
LXT 213A	A	213	683	16	38	AKA 7213 from Arrow?
LXT 340A	A	322	654	16	63	1560 x 7 x 47-72
LXT 437A	A	437	842	16	63	
LXT 50A	A	48	733	4	32	
LXT 535A	A	510	1036	16	63	Actually 1560 x 11 x 47-72
MXT 340A(L)	A	340	654	16	63	
MXT 540A(L)	A	511	1050	16	63	Try 780 x 22 x 63
MXT 1240AL	A	1240		16	63	2512 x 15 x 44-85
VL20	A4	20000				
EXT 4125*	E					
EXT 4175*	E	234	1224	11	34	
EXT 4280E*	E	157	1224	7	34	
EXT 4380E*	E	319	1224	15	34	
XT 3130E**	E	112	1224	5	36	
XT 3170E	E	172	1224	9	36	
XT 3180E**	E	150	1224	7	36	
XT 3280E	E	269	1224	15	36	
XT 3380E	E	338	1224	15	36	35 SpT on older drives;H/sect
XT 4000E	E					
XT 4170E*	E	158	1224	7	36	
XT 4175E	E	150	1224	7	35	
XT 4230E*	E	203	1224	9	36	
XT 4280E	E	244	1224	11	36	
XT 4380E*	E	338	1224	15	36	
XT 81000E	E	890	1632	15	71	
XT 8380E(H)*	E	361	1632	8	52	
XT 8610E	E	541	1632	12	52	
XT 8760E(H)*	E	676	1632	15	52	
XT 8800E	E	695	1274	15	71	
XT 9380E**	E	322	1224	15	36	10 MHz
XT 9780E**	E	676				
XT 1050*	M	38	902	5	17	
XT 1065*	M/R	56/85	918	7	17/26	ATs—disable J1/2
XT 1085*	M/R	72/109	1024	8	17/26	
XT 1105*	M/R	88/134	918	11	17/26	1024x11x17 Phnx BIOS

Model	Type	Cap	Cyls	Hds	SpT	Notes
XT 1140*	M/R	120/204	918	15	17/26	
XT 1140E	M	131	1024	15	17	
XT 1160M	M	127	1024	15	17	
XT 1170	M		918	11	17	
XT 1190	M	150	1224		17	
XT 1240	M	73	1224	7	17	
XT 2085*	M	70	1224	7	17	ATs—disable J1/2
XT 2140*	M	117	1224	11	17	
XT 2190*	M/R	160/244	1224	15	17/26	
XT 3053**	M	44	1224	5	17	
XT 3085**	M	68	1224	7	17	
XT 4380	M	156	1224	15	17	
XT 8760	M	209	1632	15	17	
RHT-800HS	O	393/786				WORM
RXT-800HS	O	393/786				Write Only
RXT-HD	O	2500				Write Only
T3-1300	O	1300				
T4-1300	O	1300				
T4-2600	O	2600				
Tahiti II	O	652/1024				
Tahiti SD	O	652/1024				
Tahiti TMT-I	O	652/1024				
Tahiti TMT-II	O	652/1024				
MobileMAX Flash 1.0	P	.9				Flash
MobileMAX Flash 10.2	P	10				Flash
MobileMAX Flash 12.5	P	11				Flash
MobileMAX Flash 16.7	P	15				Flash
MobileMAX Flash 2	P	2				Flash
MobileMAX Flash 20.9	P	20				Flash
MobileMAX Flash 4.1	P					Flash
MXL 105	P3	100	810	15	17	Try 802 x 8 x 32
MXL 131	P3	125	1008	15	17	1534 x 4 x 28-50
MXL 171	P3	163	656	15	34	
MXL 262	P3	251	1008	15	34	
XT 1120R*	R	107	1024	8	26	
XT 1140R	R	183	918	15	26	
XT 1240R*	R	201	1024	15	26	
25128S Apache	S	128	1092	4	30-60	
25252S	S	252	1418	6	43-67	
2585S Apache	S	83	1092	4	24-48	
4000S	S					
7040S	S	41	1155	2	36	
7060S	S	65	1156	2	42	
7080S	S	81	1155	4	36	
7120S	S	130	1156	4	42	
7130S	S	130	1516	4	42	
7170S	S					
7213S(R) Chey	S	213	1698	4	42	

Model	Type	Cap	Cyls	Hds	SpT	Notes
7245S	S	245	1944	4	48-72	
7290S	S	290	1751	4	72-114	
7345S	S	345	2219	4	57-96	
7546S	S	546	2769	4	72-114	
8051S	S	45	793	4	28	Microcode 1222C+
		42	739	4	28	Microcode 1250C+
8425S	S	21	612	4	17	MFM
9380S	S	337	1218	15	36	
9780S	S	676	1661	15	53	
LXT 100S	S	96	733	8	32	
LXT 200S	S	207	1314	7	45	
LXT 213S	S	213	1560	7	34-56	AKA 7213 from Arrow?
LXT 213SY	S	213	1320	7	34-56	
LXT 340S(H)(Y)	S(-2)	340	1560	7	47-72	Discontinued
LXT 437S	S	437	1560	9		
LXT 50S	S	48	733	4	32	
LXT 535SY	S	535	1560	11	47-72	Discontinued
MXT 1240S	S-2F	1240	2512	15	44-85	
MXT 340S(L)	S-2	340				
MXT 540S(L)	S-2	546	2616	7	46-78	SL=slimline
MXT 4380S	S	338	1224	15	36	
MXT PQ-125	S	1000				
RXT 800S	S	786		2		WORM
XT 3130S**	S	112	1255	5	36	
XT 3170S	S	266	1224	9	48	
XT 3180S**	S	153	1255	7	36	
XT 3280S	S	415	1224	15	45	
XT 3380S	S	380	1224	15	36	
XT 4170S*	S	157	1224	7	36	
XT 4280S	S	244	1224	11	36	
XT 4380S*	S	332	1224	15	36	
XT 670S	S	670				
XT 8360S	S	360				
XT 8380S(H)*	S(-2)	360	1632	8	54	
XT 8702S	S	617	1490	15	54	
XT 8760S(H)*	S(-2)	676	1632	15	54	

25084A/25252A

Single:	J 301
Master:	J 301
Slave:	J301 out

25128A/2585A

Single:	J308
Master:	J308
Slave:	J308 out

7040A/7060A/7080A/7120A/7130A

Single:	J20/J19
Master:	J20
Slave:	J19

J17 sets model no: In=7080/7120

J14/13 should be out.

Try J20 the other way round, as some drives were made for IBM that way.

7131A**/7170A/7213A/7245A/7345A**/7546/7405

Single:	J20
Master:	J20
Slave:	J20 off (J19**)

Try J20 the other way round, as some drives were made for IBM that way.

7171A

Single:	J20
Master:	J20
Slave:	J20 off

J16=I/O CHRDY (on=enabled)
J17=ECC (on=4 byte; off=11 byte)
J18=Low power spin (on=enabled)
J19=Reserved
J22=Compatibility (on=enabled)
J23=Write cache (on=enabled)
J24=CS (on=enabled)

80875A, 81312A, 81750A, 82187A, 82625A, 83062A, 83500A

Single:	J50 On
Master:	J50 On
Slave:	J50 Off

CS enable J48 on
Cache disable J46 on
4092 cyls J42 on
42 is next to pwr connector
Set as type 9 in BIOS; should be 900/15/17.

85120A8/84000A6/83840A6/82560A4/81280A2

Single:	J50 On
Master:	J50 On
Slave:	J50 Off

CS=J48 (remove J50)

LXT200A/213A/340A/535A

Single:	1&2 out 5&6 out 7&8 out
Master:	1&2 out 5&6 out 7&8 in
Slave:	1&2 in 7&8 out

7850/7546/71050A/71260AV/7270AV/7273A/7420AV/72004/71670/71626/71336/71084/7541/7540/7420/7135

Single:	J20
Master:	J20
Slave:	J20 off

J21/25=Reserved
J22=1046 cyls (off) 1024 (on)
J23=Write cache (en=on)
J24=CS

DiamondMax

J50	Master/Slave
J48	Cable Select
J46	4092 cylinder limitation
J44	Reserved
J42	Reserved

540AL

Single:	1-2 out
Master:	1-2 out
Slave:	1-2 in
Write protect:	JP4 out

1240S/540S/340S

ID (J6)	*5-6*	*3-4*	*1-2*
0	O	O	O
1	O	O	J
2	O	J	O
3	O	J	J
4	J	O	O
5	J	O	J
6	J	J	O
7	J	J	J

Pins 7-8	parity; in=enabled.
Pins 9-10	motor start with pwr (0=wait)
JP 4	0=Write protect
JP 7	3-4 On=Single-ended. 1-2, 5-6, 7-8, 9-10, 11-12 On=Diff
JP 8	Leave jumped

7290S/7345S

ID	J307	308	309
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0

3130S/3180S

ID (601)	1-2	3-4	5-6
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	1

Secs/track	J12	J13
34	1	0
35	0	0
36	0	1

J 510, 21, 20, 14, 27, 2, 13, 24, 30, 29 = defaults.

Maxtor 4000E

JP1 (IN)	Factory testing
JP6 (IN)	IN = Remote spinup disabled OUT = Remote spinup enabled
DS1-DS7	Drive select (Default= 1)
JP14 (OUT)	IN= Write protected
JP16-JP29	Programable sector size
JP30 (IN)	Enables hard sector mode
JP31 (OUT)	Enables soft sector mode
JP32-35,38	Factory settings for head select
JP41	Factory test (not configurable)
JP42 (IN)	Factory testing
JP45	Conversion to short INDEX 1,2= Standard INDEX (70mS) 2,3= Short INDEX (3mS)

Jumper	Bytes/Sector
JP 16	1
JP 17	2
JP 18	4
JP 19	8
JP 20	16
JP 21	32

Jumper	Bytes/Sector
JP 22	64
JP 23	128
JP 24	256
JP 25	512
JP 26	1024
JP 27	2038
JP 28	4096
JP 29	8192

E.G. 20,940 bytes/track/36 sectors=581 b/sector
Install jumpers 25, 22, 18, 15

Maxtor 7245S/7213S

Jumper	Function
J301	Terminator Power
J302	Power Up Option
J303	Disable Parity
J304	Reserved
J305	Reserved
J306	Reserved
J307	Target ID Address (MSB)
J308	Target ID Address
J309	Target ID Address (LSB)

ID	J307	J308	J309
0	O	O	O
1	O	O	J
2	O	J	O
3	O	J	J
4	J	O	O
5	J	O	J
6	J	J	O
7	J	J	J

XT 8800E

Sec Size	Bytes/Sec	Jumpers
69	606	17,18,19,20,22,25,30
70	598	17,18,20,22,25,30
71	590	17,18,19,22,25,30

Drive select jumpers are DS1-DS7, by data cables. Terminating resistors are next to the drive select jumpers. Jumpers 16-30 are near the center of the circuit board. They are not all labeled, only 24 may be listed. UltraStor 12F and DTC-6282-24 work fairly well with this drive.

4000S series (4170/4280/4380)

ID	*JP37*	*JP-36*	*JP35*
0	O	O	O
1	O	O	1
2	O	1	O
3	O	1	1
4	1	O	O
5	1	O	1
6	1	1	O
7	1	1	1

Power Up	*JP14*	*JP38*	*Mode*
	O	O	ID sequence
	O	1	Wait for start
	1	1 or O	When pwr on

Term Power	JP41	1	From drive
	JP34	1	From Bus
	JP41/34	1	Both

JP18 is write protect. JP 40 is parity

Maxtor 7000 series

Jumper	*Pins*	*Function*
J601		Terminator Power
J60		Diagnostic (factory)
J604		Reserved
J605		Disable Parity
J602	1-2	Power-up Option
J602	3-4	Not Used
J602	5-6	Target ID Address (MSB)
J602	7-8	Target ID Address
J602	9-10	Target ID Address (LSB)

ID	*J602*	*J602*	*J602*
	5-6	*7-8*	*9-10*
0	O	O	O
1	O	O	J
2	O	J	O
3	O	J	J
4	J	O	O
5	J	O	J
6	J	J	O
7	J	J	J

LXT 200S/213SY/340/535

ID (J6)	*5-6*	*3-4*	*1-2*
0	O	O	O
1	O	O	J
2	O	J	O
3	O	J	J
4	J	O	O
5	J	O	J
6	J	J	O
7	J	J	J

Pins 7-8 are parity; in=enabled.
Pins 9-10 are motor start.

8760S(H)/8380SH

J2	*5*	*4*	*3*
7	1	1	1
6*	0	1	1
5	1	0	1
4	0	0	1
3	1	1	0
2	0	1	0
1	1	0	0
0	0	0	0

14 in	Spin when power applied
18 out	WP enabled
34 out	Term power from bus
38 out	Spin delay
40 in	Parity
41 in	Term power from drive

9380S

ID (601)	*1*	*3*	*5*
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5 1		0	1
6	1	1	0
7	1	1	1

Parity	602-2 On	
Term (701)	1	2
Local	1	0
Remote	0	1

Maxtor Panther

Model	Type	Cap	Cyls	Hds	SpT	Notes
P1-08E	E	696	1778	9	85	
P1-12E	E	1051	1216	15	85	
P1-13E	E	1160	1778	15	85	
P1-16E	E	1331	1778	19	85	
P1-17E	E	1470	1778	19	85	
P0-12S	S-2	1029	1632	15	82	Discontinued
P0 17S	S	1503	1778	19	82	Discontinued
P1-08S	S-2	664	1778	9	85	
P1-12S	S-2	989	1254	19	85	
P1-17S	S-2		1778	19	82	Discontinued
P2-08S	S-2	664	1778	7	85	
P2-12S	S-2	1065	1254	15	102	
P2-17S	S-2	1424	1778	15	85	
P1-12	SMDE	1065	1778	15	78	
P1-13	SMDE	1161	1776	15	85	

Maxtor Panther P0-12S

Jumper	*Description*
JP 2	In=Write Protected
	Out=Read and Write*
JP 5	In=Slave Sync. Termination*
JP 6	In=Master Sync. Termination
JP10	In=Term Power supplied by Host
JP11	In=Term Power supplied by Drive

J2 Pins:	1 & 2	Remote LED
	3 & 4	Parity enable=Off
	5 & 6	MSB Drive ID.Value =4
	7 & 8	Drive ID. Value =2
	9 & 10	LSB Drive ID. Value =1

For ID 6, Pins 5-6 and 7-8 should be jumpered. For ID 0, 5-6, 7-8 and 9-10. All others should are factory set and should not be changed.

Maxtor Panther P1-17S

JP 2	In=Write Protected	
	Out=Read and Write*	
JP 5	In=Slave Sync. Termination*	
JP 6	In=Master Sync. Termination	
JP10	In=Term Power supplied by Host	
JP11	In=Term Power supplied by Drive	
JP 13	In= Parity Disabled	
J2 Pins	1 & 2	MSB Drive ID. Value=4
	3 & 4	Drive ID. Value=2
	5 & 6	LSB Drive ID. Value=1

7 & 8	Write Protect. In=Enabled
9 & 10	Remote LED

JP1	*JP12*	
O	O	Start by ID Sequence
O	J	Start Motor after 11-13 seconds
J	O	Wait for Motor Start Command
J	J	Start motor when power applied

MDI

Micro Design International

Model	Type	Cap	Cyls	Hds	SpT	Notes
1000HD	S-2	1000				SCSI Express
2000HD	S-2	2000				SCSI Express
4000HD	S-2	4000				SCSI Express
5300HD	S-2	5300				
1200F	S	1200				Laserbank

Megadrive

Model	Type	Cap	Cyls	Hds	SpT	Notes
M1-120	S	105	1219	4		
M1-120	S	122	1818	2		
M1-240	S	245	1818	4		
M1-52	S	52	1219	2		
MH 1G	S	1050	1974	13		
MH 340	S	338	1100	9		
MH 425	S	426	1520	9		
MH 535	S	525	1476	9		
P 105	S	105	1019	6	33	
P 120	S	120	1123	5	33	
P 170	S	170	1123	7	33	
P 210	S	210	1156	7	33	
P 320	S	320	886	15	33	
P 42	S	42	834	3	33	
P 425	S	425	1512	9	33	
P 84	S	84	834	6	33	

Memorex

Model	Type	Cap	Cyls	Hds	SpT	Notes
306	M	6		4	17	
310	M	10		6	17	
313	M	13		6	17	
321	M/R	5/8	320	2	17/26	

Model	Type	Cap	Cyls	Hds	SpT	Notes
322	M/R	11/17	320	4	17/26	
323	M/R	15/25	320	6	17/26	
324	M/R	20/34	320	8	17/26	
450	M/R	10/16	612	2	17/26	
510	M	30		4	17	
510	M	50		6	17	
510	M	70		8	17	
512	M/R	25/38	961	3	17/26	
513	M/R	41/67	961	5	17/26	
514	M/R	58/76	961	7	17/26	
70323	M	16	320	6	17	

Memory International

Model	Type	Cap	Cyls	Hds	SpT	Notes
Pocketdrive	P3	170				
Pocketdrive	P3	260				

Memtech

Model	Type	Cap	Cyls	Hds	SpT	Notes
I2596	A	96	614	10	32	Solid State
PCB 902	P	2	32	4	32	Solid State
PCE 910	P	8	256	4	16	Solid State
PCF 912	P	4	128	4	16	Solid State
PCF 914	P	4	128	4	16	Solid State
PCF 932	P	32	2048	2	32	Solid State
SC 3524	S-2	432				Solid State
SC 3548	S-2	432				Solid State
SSD 903	S	4	128	4	16	Solid State
SSD 920	S	12				
SSD 924	S-2	24				Solid State

Micro Design International

See *MDI*

Microcomputer Memories

Model	Type	Cap	Cyls	Hds	SpT	Notes
M 112	M	10	306	4	17	
M 125	M	21	306	8	17	
M 212	M	10	306	4	17	
M 225	M	21	306	8	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
M 312	M	10	306	4	17	
M 325	M	21	306	8	17	

Micronet Computer Systems Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
EPS 100	S	100				
EPS 200	S	200				
EPS 40	S	40				
EPS 87	S	87				

MicroNet Technology Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
ADV 1000E(I)	S-2F	1000				I=Mac
ADV 2000E(I)	S-2	2000				I=Mac
AT 1000	S	1035				
AT 1010/RA	S-2F	1010				
AT 104/SP01	S	105				
AT 105	S	110				
AT 1300	S	1320				
AT 173	S	180				
AT 2060/RA	S-2F	2060				
AT 2070/RA	S-2F	2070				
AT 2120/W	S2FW	2050				
AT 303	S	323				
AT 330	S	330				
AT 40/SPO1	S	42				
AT 404	S	433				
AT 4050/RA	S-2F	4050				
AT 4060/RA	S-2F	4060				
AT 660	S	660				
AT 670	S	670				
AT 8640/RA	S-2F	8640				
CPK 100	S	103				
CPK 200	S	200				
CPK 40p	S	42				
DDM 1000	S-2	1000				
DDM 2000	S-2	2000				
DDM 2120W	S2FW	2120				
DDM230M0	S-2	230				
DDM 270R	S	270				
DDM 4050	S-2F	4050				
DDM 4100W	S2FW	4100				
MCi 40P	S	40				Mac (Conner)
MCi 80P	S	80				Mac (Maxtor)

Model	Type	Cap	Cyls	Hds	SpT	Notes
MS 105	S	110				
MS 173	S	180				
PS 105	S	110				
PS 173	S	180				
PS 404	S	433				
PS 660	S	660				
PS 670	S	670				
Q8i 2070	S-2F	2070				Mac
Q9i 2070	S-2F	2070				Mac
Q9i 4050	S-2F	4050				
Q9i 8640	S-2F	8640				
SB 1000	S	1011				
SB 1000N	S	1035				
SB 105	S	110				
SB 1300	S	1309				
SB 1300N	S	1334				
SB 173	S	180				
SB 303	S	312				
SB 330	S	331				
SB 330n	S	327	327			
SB 404	S	423				
SB 404n	S	433				
SB 644	S	644				
SB 644NPR	S	606				
SB 660	S	660				
SB 663n	S	663				
SB 669n	S	669				
SB 670	S	670				
SB 808NPR	S	808				
SB 8640	S-2F	8640				
SB 8670	S-2F	8670				
SBT 1288NP	S	1288				
SBT 1350	S	1350				
SBT 2000	S	2000				
SBT 2002NP	S	2022				
SBT 2600NP	S	2613				
SS 1010/RA	S-2F	1010				
SS 2060/RA	S-2F	2060				
SS 2070	S-2	2037				
SS 2120/W	S2FW	2050				
SS 4050	S-2	4050				
SS 4060/RA	S-2F	4060				
SS 4070	S-2F	4070				
SSW 2120	S2FW	2050				
SSW 4100	S2FW	4100				

Micropolis

Bought by Singapore Technologies in March 1995. Original company now trading as Stream Logic.

Model	Type	Cap	Cyls	Hds	SpT	Notes
1743-5	A	138	1140	5	48	
1744-6	A	165	1140	6	48	
1744-7	A	193	1140	7	48	
1745-8	A	220	1140	8	48	
1745-9	A	248	1140	9	48	
2105A-5	A	557	1085	16	63	1747 x 8 x 58-94
2108A	A	666	1745	10	63	
2112A-15	A	1050	2034	16	63	Try 837x30x77
2205AT-5	A	584	1050	16	63	
2210AT-9	A	976	1891	16	63	
2217AT	A	1626	3152	16	63	
4110A	A	1052	2048	16	63	Taurus
4525A Mustang	A	2500	4846	16	63	
Mustang	A	4000				
Mustang	A	5000				
1352	E	32	1024	2	36	
1352A	E	41	1024	3	36	
1353	E	75	1024	4	36	
1353A	E	94	1024	5	36	PS/2 60-071 equiv
1354	E	113	1024	6	36	
1354A	E	132	1024	7	36	PS/2 80-071 equiv
1355	E	151	1024	8	36	
1516-10S	E	666	1840	10	72	
1517-13	E	922	1925	13	72	
1517-14	E	981	1925	14	72	
1517-15	E	1051	1925	15	72	
1518-14	E	976	1925	14	72	
1518-15	E	1341	2104	15	83	
1538-15	E	910	1669	15	71	
1525-38	E	1000				
1554-07	E	158	1224	7	36	
1555-08	E	180	1224	8	36	
1555-09	E	202	1224	9	36	
1556-10	E	225	1224	10	36	
1556-11	E	247	1224	11	36	
1556-13	E	271	1224	13	36	
1557-12	E	270	1224	12	36	
1557-13	E	293	1224	13	36	
1557-14	E	310	1224	14	36	
1557-15	E	338	1224	15	36	
1558-14	E	315	1224	14	36	
1558-15	E	338	1224	15	36	
1560-8S	E	389	1632	8	54	
1564-07	E	315	1632	7	54	

Model	Type	Cap	Cyls	Hds	SpT	Notes
1565-08	E	361	1632	8	54	
1565-09	E	406	1632	9	54	
1566-10	E	451	1632	10	54	
1566-11	E	496	1632	11	54	
1567-12	E	541	1632	12	54	
1567-13	E	586	1632	13	54	
1567-14	E	831	1632	14	54	
1568-14	E	631	1632	14	54	
1568-15	E	676	1632	15	54	
1653-4	E	92	1249	4	36	
1653-5	E	115	1249	5	36	
1653-6	E	138	1249	6	36	
1653-7	E	161	1249	7	36	
1654-6	E	138	1249	6	36	
1654-7	E	161	1249	7	36	
1663-4	E	193	1780	4	54	
1663-5	E	242	1780	5	54	
1664-6	E	290	1780	6	54	
1664-7	E	344	1780	7	54	
1674-6	E	135	1249	6	36	
1674-7(HS)	E	158	1249	7	36	
1743-5	E	111	1140	5	38	
1201	M	9				
1202	M	26				
1203	M	44				
1221	M	8				
1222	M	26				
1223	M	44				
1302	M	20	830	3	17	
1303	M/R	34/55	830	5	17/26	RLL not certified
1304	M/R	41/66	830	6	17/26	RLL not certified
1323	M/R	36/55	1024	4	17/26	RLL not certified
1323A	M/R	45/66	1024	5	17/26	RLL not certified
1324	M/R	53/86	1024	6	17/26	RLL not certified
1324A	M/R	62/96	1024	7	17/26	RLL not certified
1325BR	M/R	71/109	1024	8	17/26	RLL not certified
1333	M	36	1024	4	17	RLL not certified
1333A	M/R	44	1024	5	17/26	PS/2 60-041 equiv
1334	M	53	1024	6	17	RLL not certified
1334A	M/R	62/91	1024	7	17/26	PS/2 60-041 equiv
1335	M	71	1024	8	17	RLL not certified
1353	M/R	34/65	1024	4	17/26	
1354	M/R	51/91	1024	6	17/26	
1355	M	68	1024	8	17	
1551	M	61	1024	7	17	
1554	M	115	1224	11	17	
1555	M	126	1224	12	17	
1556	M	136	1224	13	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
1557	M	146	1224	14	17	
1558	M	157	1224	15	17	
1548	M	43	1024	5	17	
1372A	S	52				
1373	S	73	1024	4	36	
1373A	S	91	1024	5	36	
1374	S	109	1024	6	36	
1374A	S	128	1024	7	36	
1374-6	S	135	1245	6	36	
1375	S	146	1024	8	36	
1528(D)-15	S-2	1342	2100	15	84	
1548(HS)-15	S-2F	1748	2099	15	84	
1571	S	160				
1574-07	S	154	1224	7	36	
1575-08	S	177	1224	8	36	
1575-09	S	199	1224	9	36	
1576-10	S	221	1224	10	36	
1576-11	S	243	1224	11	36	
1577-12	S	265	1224	12	36	
1577-13	S	287	1224	13	36	
1578-14	S	310	1224	14	36	
1578-15	S	332	1224	15	36	
1579	S	677	1919	13	54	
1585-8S	S	344	1628	8	54	
1586-11	S	486	1628	11	54	
1587-12	S	530	1628	12	54	
1587-13	S	575	1628	13	54	
1588-14	S	602	1632	14	54	
1588(D)(HS)15	S	668	1632	15	54	
1596-10S	S	645	1834	10	72	
1597-10S	S	498	1834	10	54	
1597-13	S	909	1919	13	72	
1598-14	S	936	1928	14	71	
1598(D)(HS)-15	S-2	1035	1928	15	71	
1624-17	S-2F	668	2112	7	65-110	
1670-4	S	90	1245	4	36	
1670-5	S	90				
1670-6	S	112				
1670-7	S	135				
1673-4	S	90	1249	4	36	
1673-5	S	112	1249	5	36	
1673-6	S	135	1249	6	36	
1673-7	S	156	1249	7	36	
1674-6	S	135	1249	6	36	
1674-7	S	157	1249	7	36	
1683-4	S	194	1777	4	54	
1683-5	S	242	1777	5	54	
1684-6	S	292	1777	6	54	

Model	Type	Cap	Cyls	Hds	SpT	Notes
1684-7(HS)	S	340	1777	7	54	
177-12	S	265	1220	12	36	
177-13	S	2387	1213	13	36	
1773-5	S	138	1140	5	48	
1774-6	S	160	1140	6	48	
1774-7	S	193	1140	7	48	
1775-8	S	220	1140	8	48	
1775-9	S	248	1140	9	48	
1908(D)(HS)-15	S-2F	1408	2089	15	71-94	
1924(D)(HS)-15	S-2	2100	2280	21	71-94	
1926-15	S-2	2158	2759	15		
1936-15	S-2F	3022	2759	21	110	
1991AV(W)	S2FW	9091	4461		Var	Scorpio 9 Audio Visual
2100	S-2F	512	2759	15	Var	
2105-08	S-2F	560	1747	8	58-94	
2108-10	S-2F	698	1747	10	58-94	
2112-15	S-2F	1050	1747	15	58-94	
2116	S-2F	1400				
2121	S-2F	1750				
2205-5	S-2F	584	2360	5		
2207-6	S-2F	700	2360	6		
2210-9	S-2F	1050	2360	9		
2217-15	S-2F	1750	2360	15		
3020	S-2F	512	2759	21	Var	
3243AV/S(W)	S2FW	4095	4124	19	Var	Capricorn 4 AV 7200 RPM
3391	S-2	4300	4811	11	76-125	Same as 4345
4110	S-2	1050				
4210	S-2	1001				7200 RPM
4221AV/S(W)	S2FW	1955	4150			Taurus 2 AV 7200 RPM
4300						Stinger 5400 RPM
4345NS	S-2	4300	4811	11	76-125	Tomahawk – same as 3391
4421	S-2	2150				Aries 2
FH-3-777	S	688				GigaFile
FH-31200	S	1062				GigaFile
MIC 3391WS	S(UW)	9100				7200 RPM
Microdisk 1000	S-2	1100				
Microdisk 1030	S	1036	1922	15	71	
Microdisk 1050	S-2	1100				
Microdisk 1340	S	1340	2094	15	84	
Microdisk 1700	S-2	1700				
Microdisk 1750	S	1748	2089	15	83-131	
Microdisk 1760	S-2	1700				
Microdisk 2100	S-2	2100	2280	21	71-94	Microplis 1924
Microdisk 3020	S-2	3000				
Microdisk 340	S	340	1774	7	54	
Microdisk 4100	S-2	1100				
Microdisk 670	S	667	1632	15	54	
Raidion 2x340	S	340	1776	7	54	

Model	Type	Cap	Cyls	Hds	SpT	Notes
Raidion 2x670	S-2F	670	2099	7	65-110	
Raidion 2x1030	S	1030	1922	15	71	
Raidion 2x1340	S	1340	2094	15	84	
Raidion 2x1750	S-2F	1750	2096	15	83-131	
Raidion 2x2100	S-2F	2100	2280	21	71-94	
Raidion 680	S	680	1776	7	54	
Raidion 1340	S-2F	1300	2099	7	65-110	
Raidion 2060	S	2100	1922	15	71	
Raidion 2680	S	2600	2094	15	84	
Raidion 3500	S	3500	2096	15	83-131	
Raidion 4200	S	4200	2280	21	71-94	
RM 340	S	340	1776	7	54	Raidion Module
RM 670	S-2F	670	2099	7	65-110	Raidion Module
RM 680	S	340				
RM 1030	S-2	1030	1922	15	71	Raidion Module
RM 1340	S-2	1340	2094	15	84	Raidion Module
RM 1750	S-2F	1750	2096	15	83-131	Raidion Module
RM 2100	S-2F	2100	2280	21	71-94	Raidion Module
Tomahawk						See MIC series

Micropolis 1300/1320/1330 (MFM)

DS1, 2, 3	Drive Select
W1	Write fault latch—remove for ATs
W2, W7, W8	Always installed

4525A Mustang

Single	D
Master	D, C
Slave	None

1350/1518/1538/1558/1568/1650/1664 (ESDI)

ID	*DA3*	*DA2*	*DA1*
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

W5 Spindle control (out for ATs)
W1 Sectoring mode (out for ATs—hard)

Sect size

W4	*W3*	*W2*	*1650*	*1518 1558*	*1538*	*1568 1664*
0	0	0	35	82	68	53
0	0	1*	36	83	71	54

1624

ID	*ID2*	*ID1*	*ID0*
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

W1	Terminator power from drive
W2	Term power from host via pin 26
W31	With above, drive does itself/bus.
J2 7,8	Spindle control; Out=auto start (*)
J2 13,14	Bus Parity; Out=drive generated
J2 11,12	WP; Out=not write protected

22xx

ID	ID2	ID1	ID0
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

1370

ID	ID2	ID1	ID0
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

Terminator pwr	W1	W2
From drive	1	0
From host	0	1

W3 Spindle: Out for ATs (start at power on).
W18 Parity check. Out=enabled (can be W9).

1528/1578/1588/1598

As for 1370, except:

W11 Drive supplies terminator power to the bus. In for ATs.
W5 Spindle control: Out for ATs (spindle starts at power on). In=wait for comd.
W4 Parity check. Out=enabled.
W28 Ground -In for ATs.

1548/1908/1924

W1 In=drive provides terminator power.
W2 In=Term power from host (with W12 provides term power to bus as well).
W11 Frame Ground (out for ATs).
J2 7 & 8 out=drive starts spindle at pwr on.
11 & 12 out=drive not write protected.
13 & 14 out=parity check enabled.

135x/1558-15

ID	DA1	DA2	DA3
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

W1 Hard/soft sector (in=soft)
W2/W3/W4 Bytes/sector (out=35)
W5 Spindle control

2112-15

ID1 Address 1
ID2 Address 2
ID3 Address 3
PTY Parity Checking
WP Write Protect
SP0 Spin Up with Start Unit Command
SP1 Spin Up delay disabled
Do not install SPIN0 and SPIN1.
W4 LED enable
W3 Drive provides bus term power
W2 Off=Term power provided by host
W1 Off=Drive provides local term power
W10 Off=Slave Sync term enabled
W11 Off=Master Sync term disabled

3391/4345

Front view, board down

1-2 Remote LED
3-4 ID0
5-6 ID1
7-8 ID2
9-10 ID3 (wide drives)
11-12 SP0
13-14 SP1
15-16 WP
17-18 Parity
19-20 No pins (key)
21-22 Reserved
23-24 Reserved
25-26 No pins (key)
27-28 Term enabled
29-30 W1 (Term power)
31-32 W2 (Term power)
33-34 W3 (Term power)
35-36 Reserved (fault LED in 4345)

Microscience

Out of business.

Model	Type	Cap	Cyls	Hds	SpT	Notes
HH 7040-00	A	46	855	3	36	
HH 7070-00	A	76	855	5	40	
HH 7070-20	A	86	960	5	35	
HH 7100-00	A	107	855	7	35	
HH 7100-20	A	120	960	7	35	
HH 7200-00	A	201	992	9	44	
HH 7400	A	304	1904	8	ZBR	
HH 8040-00/20	A	42	977	5	17	RLL?
HH 8040-50/58	A	52	855	7	17	
HH 8040-60/62	A	62	1024	7	17	
HH 8040-65/68	A	65	603	4	53	
HH 8080-00	A	85	884	4	17	
HH 8200	A	152	1904	4	ZBR	
FH 21200	E	1062	1921	15	72	
FH 21600	E	1350				
FH 2414	E	367	1658	8	54	
FH 2777	E	688	1658	15	54	
FH 3777E	E	1200				
HH 2012	E	19	306	4	31	
HH 2085	E	106	1024	5	31	
HH 2120	E	119	1024	7	33	1022 x 7 x 34 in ALR 120
HH 2160	E	161	1276	7	35	
HH 5040-00	E	47	855	3	35	
HH 5070-00	E	73	855	5	35	
HH 5070-20	E	82	959	5	35	
HH 5100-00	E	110	855	7	36	
HH 5100-20	E	124	960	7	36	
HH 5160-00	E	174	1270	7	40	
HH 7100	E	105	855	7	36	
Easy 20	H	25	612	4	17	
Easy 30	H	38	612	4	26	
HH 1040	M	40				
HH 1050	M	44	1024	5	17	
HH 1075	M	61	1024	7	17	
HH 1090	M	80	1314	7	17	
HH 1314	M	76	1314	7	17	
HH 2012	M	10	306	4	17	
HH 312	M/R	10/16	306	4	17/26	
HH 315	M/R	10/16	306	4	17/26	
HH 325	M/R	21/32	612	4	17/26	
HH 4050	M	44	1024	5	17	
HH 4070	M	61	1024	7	17	
HH 612	M/R	11/16	306	4	17/26	

Model	Type	Cap	Cyls	Hds	SpT	Notes
HH 612C	M	10	612	4	17	
HH 625	M	21	612	4	17	
HH 712	M/R	10/16	612	2	17/26	
HH 725	M/R	21/32	612	4	17/26	
HH 825	M	21	612	4	17	
MS 10E	M	10	656	2	17	
MS 15E	M	15	522	4	17	
MS 20E	M	20	656	4	17	
MS 30E	M	30	656	6	17	
MS 5B	M	5	336	2	17	
HH 1060	R	67	1024	5	26	
HH 1080	R	68	1024	5	26	SCSI?
HH 1095	R	94	1024	7	26	
HH 1120	R	122	1314	7	26	
HH 330	R	32	612	4	26	
HH 338	R	32	612	4	26	
HH 4060	R	67	1024	5	26	
HH 4090	R	94	1024	7	26	
HH 7100	R	110	855	7	26	
HH 8040	R?	41	1024	2	40	
HH 738	R	32	612	4	26	
HH 830	R	32	615	4	26	
FH 277S	S	777				
FH 31200	S	1062	1921	15	72	
FH 31600	S	1350				
FH 3414	S	367	1658	8	54	
FH 3777	S	688	1658	15	54	
FH 377S	S	1200				
HH 1080	S					
HH 3120	S	122	1314	7	26	
HH 3160	S	171	1314	7	37	
HH 6100	S	107	855	7	36	
HH 6100-20	S	120	960	7	35	
HH 7040	S	47	855	3		
HH 7100	S	110	855	7		

Microscience 7100-20

	J1	*J4*
Single:	0	0
Master:	1	0
Slave:	0	1

1xxx

1-4	Drive select
5-10	Terminations

2xxx

SW1	1	On= 33 secs/track Off=35
	2	On =Write Protect
SW2	1-7	Drive select
	8	On=Soft sectored Off=Hard sectored
	9/1	Terminations
SW3	All	Terminations

4xxx

DS0-DS3 Drive select

5xxx

Drive	*3-4*	*5-6*	*7-8*
1	on	off	off
2	off	on	off
3	on	on	off
4	off	off	on
5	on	off	on
6	off	on	on
7	on	on	on

Secs/Tk	*9-10*	*11-12*
33	on	on
34	off	on
35	on	off
36	off	off

Jumper 13-14 On=Write protect

6xxx

ID	*1*	*2*	*3*
0	off	off	off
1	on	off	off
2	off	on	off
3	on	on	off
4	off	off	on
5	on	off	on
6	off	on	on
7	on	on	on

7xxx

Single:	1,2,7-8 off
Master:	1-2 on
Slave:	7-8 on

Pins 3-6 are not used

8xxx

Single:	No jumper
Master:	No jumper
Slave:	7-8 on

Microse

Model	Type	Cap	Cyls	Hds	SpT	Notes
MM 1050	M	44	1024	5	17	

Micro Solutions

Model	Type	Cap	Cyls	Hds	SpT	Notes
152010	Par	1200				Backpack
152020	Par	1600				
152850	Par	850				Backpack
HD 100	Par	100				Backpack
HD 200	Par	200				Backpack
HD 300	Par	300				Backpack
HD 40	Par	40				Backpack

Microstorage

Model	Type	Cap	Cyls	Hds	SpT	Notes
MS 212R	M/R	10/15	306	4	17/26	

Microtech International Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
Polaris 1000	A	1000				
Polaris 500i	A	500				
Polaris 700	A	700				
Eclipse 1000	S	1000				
Eclipse 200	S	200				
Eclipse 320	S	320				
Eclipse 400	S	400				
Eclipse 650	S	650				
Europa 100(ic)	S	100				Mac (Quantum)
Europa 20(ic)	S	21				Mac (Seagate)
Europa 40	S	40				
Europa 50(ic)	S	50				Mac (Quantum)
Europa 80	S	80				
MicroLynx 1000	S	1030				
MicroLynx 2000	S	2010				

Model	Type	Cap	Cyls	Hds	SpT	Notes
MicroLynx 4000	S	4000				
N 40(i)	S	40				
N 650(i)	S	650				
N 100(i)	S	101				
N 120(i)	S	120				
N 1200(i)	S	1200				
N 150(i)	S	152				
N 170(i)	S	170				
N 200(i)	S	200				
N 320(i)	S	326				
N 400(i)	S	400				
N 80(i)	S	81				
PocketPac 320	S	323				
PocketPac 500	S	500				
Polaris 1000	S	1030				
Polaris 1400	S	1340				
Polaris 2000	S	2010				
Polaris 270	S	256				
Polaris 2700	S	2700				
Polaris 350	S	349				
Polaris 4000	S	4000				
Polaris 500	S	525				
Polaris 700	S	698				
Polaris 9000	S	9000				
RoadRunner 230	S	228				
RoadRunner 250	S	245				
RoadRunner 320	S	323				
RoadRunner 500	S	500				

Microtek

Division of Tandon.
Mindflight Technology

Model	Type	Cap	Cyls	Hds	SpT	Notes
HP 1000 PIC	Par	1000				
HP 1080 PIC	Par	1080				
HP 1500 PIC	Par	1500				
PL 500 PIC	Par	1000				

MiniMicro

Model	Type	Cap	Cyls	Hds	SpT	Notes
MMHD 2040R	R	42	820	4	26	Rebadged Samsung SHD 2040

Miniscribe

Now Maxtor (Colorado)
*CNS (Computer Network Services)

Model	Type	Cap	Cyls	Hds	SpT	Notes
7040A	A	43	981	5	17	Try 585 x 4 x 36
7060A	A	65	925	8	17	
7080A	A	85	981	10	17	Try 585 x 8 x 36
7120A	A	130	936	16	17	
8051AT	A	43	745	4	28	Try 981 x 5 x 26
8057A	A	50	750	5	26	
8225A(T)(1)	A	21	805	2	28	Try 615 x 4 x 17
8225XT	A	21	805	2	26	XT; AT=747 cyls
8425XT	A	21	615	4	17	XT
8438XT	A	32	615	4	26	XT
8450AT	A	43	745	4	28	
8450(E)(F)(XT)	A	42	805	4	26	XT
3085E	E	72	1270	3		
3130E*	E	112	1250	5	35	10 MHz
3180E*	E	157	1250	7	35	
6085E	E	72	1024	4	36	
6128E	E	104	1024	8	26	
6170E	E	130	1024	8	34	
9000E	E	329	1224	15	36	
9230E	E	177	1224	9	32	
9380E*	E	338	1224	15	35	
9424E	E	360	1661	8	32	
9780E*	E	676	1661	15	53	15 MHz
1006	M	5	306	2	17	
1012	M	11	306	4	17	OEM for IBM
2006	M	5	306	2	17	
2012	M	11	306	4	17	
2425P	M	20	615	4	17	
3006	M	5	306	2	17	
3012	M	11	612	2	17	Very slow!
3051	M	42	306	5	17	
3052	M	45	1024	5	17	
3053*	M	44	1024	5	17	
3085*	M	71	1170	7	17	
3130	M	54	1250	5	17	
3180	M	75	1250	7	17	
3212(+)	M/R	11/16	612	2	17/26	+ version MFM
3412	M	11	306	4	17	
3425(+)(P)	M/R	21/31	615	4	17/26	+ version MFM
3650(F)	M	42	809	6	17	852 cyls; formats 842
3838	M	20				
4006	M	5	306	2	17	
4010	M	8	480	2	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
4012	M	20	480	4	17	
4020	M	17	480	4	17	
5330	M	25	480	6	17	
5338	M	31	612	6	17	
5440	M	33	480	8	17	
5451	M	42	612	8	17	
6032	M/R	27/40	1024	3	17/26	
6053	M/R	45/68	1024	5	17/26	
6074	M	60	1024	7	17	
6079	M/R	44/68	1024	5	17/26	
6085	M	71	1024	8	17	
6212	M/R	10/16	615	2	17/26	
7426	M/R	21/32	612	4	17/26	
80SC-MFM	M	21	615	4	17	Poss SCSI + MFM recording
8051A	M	25	745	4	17	
8212	M/R	11/16	615	2	17/26	
8412	M/R	11/16	306	4	17/26	
8425(F)(XT)	M/R	21/32	615	4	17/26	
3128	R	108.1	1170	7	26	
3438(F)(+)(P)	R	32	615	4	26	
3450A	R	39	745	4	26	
3650R	R	64	809	6	26	
3675	R	65	809	6	26	
6079	R	68	1024	5	26	
6128	R	109	1024	8	26	
80SC-RLL	R	32	615	4	26	Poss SCSI + RLL recording
8051	R	62	981	5	26	
8225	R	20	771	2	26	
8225XT	R	20	805	2	26	
8432	R	32	615	4	26	
8434F	R	32	615	4	26	
8438(F)	R	32.7	615	4	26	WPC 128
8450(C)	R	40.6	771	4	26	WPC 128
8450XT	R	41	805	4	26	
3085S	S	72	1256	3	35	
3130S*	S	115	1255	5	35	
3180(S)(M)*	S	154	1255	7	36	M=Mac
3425S	S	21	612	4	17	MFM recording
7040S	S	40	1155	2	36	
7060S	S	65	1155	2	42	1516 cyls?
7080S	S	81	1155	4	36	
7120S	S	131	1155	2	85	1516 cyls?
8048S	S	40				
8051S	S	43	739	4	28	
8225S	S	20	805	2	26	
8425S(A)	S	21	612	4	17	MFM recording. A=Apple
8450S	S	40	804	4	26	
9000S	S	347	1220	15	32	

Model	Type	Cap	Cyls	Hds	SpT	Notes
9230	S	203	1224	9	32	
9380(S)(M)*	S	325	1218	15	36	M=Mac
9424S	S	355	1661	8	32	
9780S*	S	668	1661	15	53	

8051AT

Single:	None
Master:	J4 5-6
Slave:	J4 1-2

J4 3-4 for BIOSes unable to support 1:1.

8438

Drive No	*J1*	*J2*	*J3*	*J4*
1	close	open	open	open
2	open	close	open	open
3	open	open	close	open
4	open	open	open	close

Miniscribe model nos

1st digit

3:	Half height
6:	Full height
8:	3.5"

Miniscribe 3130E/3180E

Terminators	*Drive Select Jumpers*			
RP-4, RP-17	Drive	1	2	3
	1	O	J	O
	2	O	J	O
	3	J	J	O

J-14, J-20, J-21, J-24, J-27, J-29, J-30, J-510 must be installed. J-9, J-10, J-11, J-23 uninstalled.

Sector configuration

J-19	*J-12*	*J-13*	*Bytes/sec*	*SpT*
J	J	J	Soft Sec Mode	
O	J	O	512	34
O	O	J	512	36
O	O	O	512	35

*9380S Parity Enable (J-602). The first pair is undefined. The second defines parity (Off=Parity enabled).

Term Power. First pr controls power supplied by target. Second controls power from elsewhere.

Miniscribe 9380E

Sector Configuration

J-19	*J-12*	*J-13*	*Bytes/sec*	*SpT*
J	J	J	Soft sec mode	
O	J	O	530	34
O	O	J	512	36
O	O	O	512	35

ID

J-16	*1*	*2*	*3*
1	J	O	O
2	O	J	O
3	J	J	O

Miniscribe 3130S/3180S/9380S*

ID J601	*1,2*	*3,4*	*5,6*
0	O	O	O
1	O	O	J
2	O	J	O
3	O	J	J
4	J	O	O
5	J	O	J
6	J	J	J

SpT	*J-12*	*J-13*
34	J	O
35	O	O
36	O	J

	J701-1	*J701-2*
Local term power	J	O
Remote termpower	O	J

Ministor Peripherals Corp

Model	Type	Cap	Cyls	Hds	SpT	Notes
MP 1080A-XL	A	1080				EIDE, ATA
MP 1100A-XL	A	1080				EIDE, ATA
MP 128A	A	128	822	8	38	
MP 130A	A	130	846	8	38	
MP 170A	A	85	1076	4		
MP 256A	A	128	1280	2		
MP 32A	A	32				
MP 42A	A	42	547	4	38	
MP 510A	A	510				EIDE, ATA
MP 540A-SL	A	540				EIDE, ATA

Model	Type	Cap	Cyls	Hds	SpT	Notes
MP 550A-XL	A	541				EIDE, ATA
MP 64A	A	64	862	4	38	
MP 680A	A	680				EIDE, ATA
MP 810A-XL	A	810				EIDE, ATA
MP 825A-XL	A	812				EIDE, ATA
MP 85A	A	85	547	4	38	
MP 128P	P3	128	822	8	38	
MP 130	P3	130	846	8	38	
MP 130/260P3	P3	131	1325	4		
MP 170/340P3	P3	179	1446	4		
MP 170P	P	85	1076	4		
MP 263/526P3	P3	261				
MP 42P	P3	42	547	4	38	
MP 64P	P3	64	862	4	38	
MP 85P	P3	85	547	4	38	
MP 88P3	P3	89				

Mirror Technologies Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
M 595	S	595				
M 650	S	650				
M 100i	S	96				
M 105i	S	105				
M 130i	S	130				
M 180i	S	180				
M 20i	S	21				
M 30i	S	32				
M 325	S	325				
M 40i	S	40				
M 45s/si	S	45				
M 80i	S	80				
M 90i	S	90				
MP 105i	S	105				
MP 200i	S	194				
MP 290	S	290				
MP 40i	S	42				
MP 80	S	84				

Mitsubishi

No longer producing hard drives

Model	Type	Cap	Cyls	Hds	SpT	Notes
MR 5310E	E	101	977	5	41	
MR 321	M	10	615	2	17	
MR 322	M	20	615	4	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
MR 335	M	54	743	8	17	
MR 52	M	21	612	4	17	
MR 521	M	10	612	2	17	615 cyls?
MR 522	M/R	21/31	612	4	17/26	615 cyls?
MR 533	M/R	24	971	3	17/26	
MR 535	M/R	42/65	981	6	17/26	Also 977 x 5 x 17
MR 548	M	89	1225	8	17	
MR 535R	R	65	977	5	26	
MR 5310S	S	101	977	5	41	
MR 535S	S	65	977	5	26	
MR 537S	S	76	977	5	26	
M 4870	SMD	247	1024	12	40	

Mitsumi

Model	Type	Cap	Cyls	Hds	SpT	Notes
HD 2509AA	A	92	1024	4	44	
HD 2513AA	A	130	977	8	32	
HD 309AA	A	90	928	6	17	
HD 313AA	A	130	963	8	17	
HD 354VA	A	40	615	4	17	
M 106	M	5	306	2	17	
M 112	M	10	306	4	17	
M 125	M	21	306	8	17	
M 206	M	5	306	2	17	
M 212	M	10	306	4	17	
M 225	M	21	306	8	17	
M 306	M	5	306	2	17	
M 312	M	10	306	4	17	
M 325	M	21	306	8	17	
HD 309AC	S	90	928	6	17	
HD 313AC	S	128	964	7	39	
HD 354VC	S	40	940	8	17	

MKE

Subcontractor for Quantum

MMI

Micro Memories Inc. Out of business.

Model	Type	Cap	Cyls	Hds	SpT	Notes
M 106	M/R	5/8	306	2	17/26	
M 112	M/R	10/16	306	4	17/26	
M 125	M/R	21/32	306	8	17/26	

Model	Type	Cap	Cyls	Hds	SpT	Notes
M 206	M/R	5/8	306	2	17/26	
M 212	M/R	10/16	306	4	17/26	
M 225	M/R	21/32	306	8	17/26	
M 306	M/R	5/8	306	2	17/26	
M 312	M/R	10/16	306	4	17/26	
M 325	M/R	21/32	306	8	17/26	

Morton Management Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
GigaBox 1000	E	1000				
Gigabox 160	E	160				
GigaBox 330	E	330				
Gigabox 680	E	680				
GigaBox Jr 1000	E	1000				
Gigabox Jr 160	E	160				
Gigabox Jr 680	E	680				
GigaBox 1000	S	1000				
GigaBox 160	S	160				
GigaBox 330	S	330				
Gigabox 680	S	680				
GigaBox Jr 1000	S	1000				
GigaBox Jr 160	S	160				
GigaBox Jr 330	S	330				

Mountain Gate

Model	Type	Cap	Cyls	Hds	SpT	Notes
XL 1080	S-2	1080	2874	8	64-107	
XL 127	S-2	127	1745	2	52-91	
XL 170	S-2	170	2337	2	52-91	
XL 270	S-2	270	2740	2	62-125	
XL 340	S-2	342	5493	4	52-91	
XL 540	S-2	541	2740	4	62-125	

MPI

See *Magnetic Peripherals* (MPI)

Myrica

Bought Rodime (Singapore)

Model	Type	Cap	Cyls	Hds	SpT	Notes
RO3259A	A	210	990	15	28	Rodime 3259A

NCL America

Brand Tech Connection?

Model	Type	Cap	Cyls	Hds	SpT	Notes
9170A	A	150	582	14	36	
9121A	A	107	1166	5	36	
9220A	A	200	1209	9	36	
8170E	E	136	1024	8	34	
9170E	E	150	1072	7	41	
9121E	E	107	1166	5	36	
9124E	E	102	1166	5	36	
9220E	E	200	1209	9	36	
8085	M	68	1024	8	17	
8170	M	136	1024	8	34	
8128	R	124	1024	8	31	
8170S	S	136	1024	8	34	
9170S	S	150	1072	7	41	XT
9121S	S	107	1166	5	36	
9220S	S	200	1209	9	36	XT

NCR

Now a division of AT&T.

Model	Type	Cap	Cyls	Hds	SpT	Notes
6801 STD10717	A	45	868	3	34	
6801 STD11017	A	104	776	8	33	
6801 STD11217	A	42	1047	2	40	
6801 STD14746	E	121	969	7	35	10 MHz
6801 STD10317	M	53	872	7	17	
6801 STD14646	M	21	615	4	17	
6801 STD14746	M	71	1024	8	17	
6091-5101	S	332	1898	9	38	
6091-5301	S	652	1244	16	64	
6928						

NEC

081 993 8111 (508) 264 8000
Versas (800) 632 4525 Ready (800) 632 4054 Powermate (800) 632 4565 www.nec.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
AC 160	A	62	1024	7	17	Rebadged WD Caviar
AB 01204	A	120	762	8	39	158-50395-304 CP 30104
158-050395-304	A	120	901	5	53	Quantum LPS 120AT
D 1711	A	43	977	5	17	
D 1731	A	85	977	10	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
D 1741	A	125	508	11	44	
D 3556	A	100				
D 3711	A	173	335	16	63	
D 3713	A	345	670	16	63	
D 3715	A	270	524	16	63	
D 3717	A	540	1048	16	63	
D 3723	A	365	708	16	63	
D 3724	A	427	827	16	63	
D 3725-301/351/501	A	730	1416	16	63	
D 3726	A	854	1654	16	63	
D 3727	A	1083	2100	16	63	
D 3735	A	44	733	7	17	Try also 537 x 4 x 41
D 3741	A	44	733	7	17	Actually 423 x 8 x 26
D 3743	A	540	1048	16	63	
D 3745-301/351	A	1080	2096	16	63	
D 3747	A	1620	3144	16	63	
D 3755	A	105	625	8	41	
D 3756	A	105	625	8	41	
D 3761	A	114	915	7	36	Conner Compaq type 45
D 3765	A	176	1486	4	58	Try 743 x 8 x 58
D 3766	A	245	723	13	51	
D 3771	A	220	1367	5	63	
D 3772	A	331	1468	7	63	
D 3781	A	426	1468	9	63	Try 734 x 18 x 63
D 3855	A	105	1251	4	41	
D 4540	A	540	963	28	41	Conner CFA 540A?
DSE 1340A	A	1340	2600	16	63	
DSE 1700A	A	1700	3306	16	63	
DSE 2010A	A	2010	3900	16	63	
DSE 2100A	A	2100	4092	16	63	
DSE 2550A	A	2550	4960	16	63	
OP 220 4002	A	127	980	15	17	Seagate ST 9144A
D 3661	E	118	915	7	35	10Mhz-Try 913 cyls
D 5652	E	135	823	10	35	10 Mhz
D 5655	E	140	1224	7	64	Powermate 256 bytes/sec
D 5662	E	300	1224	15	64	10 Mhz 256 bytes/sec
D 5665	E	153				
D 5682	E	665	1024	16	63	Physical 1633 x 15 x 54 15 Mhz
D 2346	IPI-2	400				
D 2366	IPI-2	800	23			
D 2367	IPI-2					
D 2377	IPI-2	1400	27			
D 2387	IPI-2	2100	1371	30	98	514 b/sec
D 5392	IPI-2	1300	615	16	17	
D 5682/DA521	IPI-2	665	1633	15	54	
D 3122	M	21	642	4	32	256 bytes/sector
D 3126H	M/R	21/32	615	4	17/26	
D 3142	M	42	642	8	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
D 3146(H)	M	40	615	8	17	
D 5114	M	6	310	2	17	
D 5120	M	20	612	4	17	
D 5124	M	11	310	4	17	ST 412
D 5126(H)	M/R	21/32	615	4	17/26	ST 412 Not in XTs
D 5128	M	20	615	4	17	
D 5142	M	10	310	4	17	
D 5146(H)	M/R	40/62	615	8	17/26	Not in XTs/Xebec 1210 ST 412
D 5224	M	20	309	8	17	
D 5244	M	21	310	8	17	
D 5452	M	67	823	10	32	
D 1711	P	42	977	5	17	
D 1731	P	85	977	10	17	
EPP 340-	Par	340				
EPP 540	Par	540				
D 3127	R	31	615	4	26	
D 5127(H)	R	32	615	4	26	5126 tested as RLL
D 5147(H)	R	62	615	8	26	Aka LR 56913
D 2384S	S-2	384				Solid State
D 2462	S	800		23		
D 2463	S	1100		27		
D 2473	S	1400		27		
D 3035	S	56				
D 3811	S	170	335	16	63	
D 3813	S	340	670	16	63	
D 3815	S	270	524	16	63	
D 3817	S	540	1048	16	63	
D 3823	S	365	708	16	63	
D 3825	S	730	1416	16	63	
D 3827	S	1083	2100	16	63	
D 3835	S	45	1074	2	41	
D 3841	S	45	400	8	25	Mac compatible
D 3843	S-2	540	1048	16	63	
D 3845	S-2	1080	2096	16	63	
D 3847	S-2F	1620	3144	16	63	
D 3855	S	105	1251	4	41	
D 3856	S	105	1251	4	41	
D 3861	S	115	915	7	35	Mac compatible
D 3865	S-2	176	1486	4	58	
D 3871	S	220	1367	5	63	
D 3872	S	331	1468	7	63	
D 3881	S-2	425	1464	9	63	
D 3896	S-2	2160	3928	9		
D 5852	S	147	823	10	35	Mac compatible
D 5862	S	330	1224	15	35	Mac compatible
D 5882	S	678	1630	15	54	Mac compatible
D 5892	SSync	1400	1675	19	86	
D 5894	S	1400	1680	19	86	5400 RPM

Model	Type	Cap	Cyls	Hds	SpT	Notes
D 589X	S	2180	2610	19	86	
DSE 1340S	S	1340	2600	16	63	
DSE 1700S	S	1700	3306	16	63	
DSE 2010S	S	2010	3900	16	63	
DSE 2100S	S	2100	4092	16	63	
DSE 2550S	S	2550	4960	16	63	
SD 020S	S	20				Solid State
SD 040S	S	40				Solid State
SD 120S	S	125				Solid State
D 2247	SMD	82		10		
D 2257	SMDE	167		10		MFM
D 2268H	SMDE	337				MFM
D 2352	SMD	520				
D 2362	SMD	800	23			
D 2363	SMD	1100	1024	27	71	
D 2366	SMD	800		23		RLL
D 2373	SMDE	1220	1024	27	86	
D 2377	SMD	1415		27		RLL
D 2462	SMD	800		23		RLL
D 2463	SMD	1130		27		RLL
D 2467	SMD	1130		27		RLL
D 5682/DA501	SMD	665		15		
D 5592	SMD	1300				7200 RPM

NEC Drive Numbering

2nd Digit
1=MFM
6=ESDI
7=IDE
8=SCSI

D 3735

Single:	11 closed
	12 open
Master:	11,12 closed

D3723/3724/3725/3727/3713/3715/3717/3747/3743/3745/DSE 1340A/1700A/2010A/2100A/2550A

Single:	Sw 1-1 On
Master:	Sw 1-1 On
Slave:	Sw 1-1 Off

CD=Sw 1-2
3-4 always off
Don't use J4

D 3755/3756/3641

Single:	12/13 Off
Master:	12 On
Slave:	12/13 On

Pwr Save Off: 17 On
ECC 11 bit: 15 off (on=4 bit)

D 3761

Master:	MST, TRS closed
Slave:	SLV, TRS closed

Compaq: FC closed, 776 x 8 x 33

D 3661

DS	Drive Select
S on	Hard Sector
36 s/t	SCNT S, 2, 0 on
35 s/t	SCNT S, 2 on
34 s/t	SCNT S, 1, 0 on

Switches sometimes upside down!

D3811/3813/3815/3817/3823/3825/3827/3843/3845/3827/DSE 1340S/1700S/2010S/2100S/2550S

Sw 1-1	Always off
Sw 1-2	Start comd-on=use
Sw 1-3	Parity-on=check

J2-1	ID 2
J2-2	ID 1
J2-3	ID 0
J2-5	Parity
J2-6	Spindle sync
J9-14	ground

	J2-3	*J2-2*	*J2-1*
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

If using pins, turn switches off
Don't use J4

D 3835/3855/3856

1-1	Off
1-2	Off Start dr
1-3	On Parity on
1-4	ID 2
1-5	ID 1
1-6	ID 0

D 5655

DS	Drive Select
S on	Hard Sector
36 s/t	C, 5, 2 on
34 s/t	C, 5, 1 on

For PS/2, jmp D on Pwa G8ATA/G8ATE must be installed. Switches sometimes upside down!

D 5662

DS	Drive Select
S on	Hard Sector
36 s/t	C, 5, 2 on
34 s/t	C, 5, 1 on

Switches sometimes upside down!

D 5682

DS	Drive Select
S on	Hard Sector
54 s/t	C, 5, 4, 2, 1 on
53 s/t	C, 5, 4, 2 on
34 s/t	SCNT S, 1, 0 on

Switches sometimes upside down!

NEI

See NPL (Nippon)

Newbury Data

Maxtor under licence

Model	Type	Cap	Cyls	Hds	SpT	Notes
ND 100A	A	96	733	8	32	
ND 200A	A	207	816	15	32	
ND 213A	A	213	683	16	63	
ND 340AT	A	340	654	16	63	
ND 3490AT	A	430	1585	9	43	

Model	Type	Cap	Cyls	Hds	SpT	Notes
ND 535AT	A	535	1024	16	63	
ND 540AT	A	546				
ND 8380E	E	361	1632	8	54	
ND 8610E	E	541	1632	12	54	
ND 8760E	E	677	1632	15	54	
NDR 4170	E	194	1224	7	45	
NDR 4175	E	150	1224	7	36	
NDR 4230E	E	203	1224	9	36	
NDR 4380	E	323	1224	15	36	
NDR 1065	M	55	918	7	17	ATs—disable J1/2
NDR 1085	M	71	1024	8	17	
NDR 1105	M	87	918	11	17	
NDR 1140	M	120	918	15	17	
NDR 2085	M	75	1224	7	17	ATs—disable J1/2
NDR 2140	M	111	918	15	17	1224 x 11 x 17?
NDR 2190	M	160	1224	15	17	Victor BIOS settings
NDR 320	M	21	615	4	17	612 cyls—Victor BIOS
NDR 340 Penny	M	42	615	8	17	Removeable
NDR 360	M	42	615	8	17	
NDR 505	M	5	306	2	32	
ND 1120R	R	105	1024	8	25	
ND 1240R	R	97	1024	15	25	
ND 100S	S	96	733	8	32	
ND 1240S(D)	S-2	1240	2389	15		
ND 200S	S	201	1320	7		
ND 213S(D)	S	213	1310	7		
ND 340S(D)	S	340	1546	7		
ND 3490S(D)	S	430	1585	9	43	
ND 535S	S	535	1546	11		
ND 540S	S	546				
ND 4170S	S	158	1224	7	36	
ND 437S	S	437	1560	9		
ND 8380S	S	360	1632	8	54	
NDR 3170S	S	140	1224	9	26	
NDR 3280S	S	233	1224	15	26	
NDR 3380S	S	320	1224	15	34	
NDR 4380S	S	314	1224	15	34	
PI 17(D)S	S	1503	1778	19	90	
PO 12	S	1051	1795	15	17	

New Media Corp

Model	Type	Cap	Cyls	Hds	SpT	Notes
Anycom 170	P	170				
Anycom 260	P	260				
NMC 00372	P3	42				
NMC 00373	P3	105				

Model	Type	Cap	Cyls	Hds	SpT	Notes
NMC 00396	P3	170				
Note Disk 105	P3	105				
Note Disk 170	P3	170				
Note Disk 260	P3	260				

N/Hance Systems

Model	Type	Cap	Cyls	Hds	SpT	Notes
HCS-pcs150	S	150				
HCS-pcs150	S	150				
HCS-pcs2700e	S	662				
HCS-pcs300	S	300				
HCS-pcs300	S	300				
HCS-pcs700	S	662				
HCS-ps2150E	S	150				
HCS-PS2300e	S	300				
Sun 70e	S	71				Sun
Sun 50e	S	150				Sun

Northgate

Model	Type	Cap	Cyls	Hds	SpT	Notes
Turbo	R	42	809	6	26	

NPL

Nippon. Out of business?

Model	Type	Cap	Cyls	Hds	SpT	Notes
NP 02-13	M	10	306	4	17	320 cyls?
NP 02-26A(S)	M	21	640	4	17	
NP 02-52A	M	43	640	8	17	
NP 03-13	M	10	306	4	17	
NP 03-20	M	15	306	6	17	
NP 03-38	M	30	612	6	17	
NP 03-6	M	5	306	2	17	
NP 04-13T	M	10	320	4	17	
NP 04-14C	M	23	650	4	17	
NP 04-20T	M	15	306	6	17	
NP 04-26F	M	21	320	8	17	
NP 04-36	M	29	699	5	17	
NP 04-50	M	41	699	7	17	
NP 04-55	M	44	754	7	17	
NP 04-85	M	69	754	11	17	
NP 05-105	M	10	320	4	17	
RD 3127	M	10	612	2	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
RD 3255	M	20	612	4	17	
RD 4064	M	5	306	2	17	
RD 4127	M	10	306	4	17	
RD 4191	M	15	306	6	17	
RD 4255	M	20	306	8	17	
RD 4362	M	30	612	6	17	
NP 03-13	R	16	306	4	26	
NP 02-26S	S	54	640	4	42	

Okidata

Hard drive division bought by International Technologies.

Model	Type	Cap	Cyls	Hds	SpT	Notes
OD 526	M/R	21/31	612	4	17/26	640 cyls?
OD 540	M/R	33/50	480	6	17/26	640 cyls?

Olivetti

Olivetti—OPE See also Lexikon

Model	Type	Cap	Cyls	Hds	SpT	Notes
HD 352	M	20	612	4	17	
HD 362	M	20	612	4	17	
HD 416	M		819	2	17	
HD 512-1	M	5		2	17	
HD 512-2	M	13		4	17	
HD 512-3	M	21		6	17	
HD 561-1	M	3	180	2	17	
HD 561-2	M	6	180	4	17	
HD 561-3	M	9	180	6	17	
HD 562-11	M	3	180	2	17	
HD 562-12	M	6	180	4	17	
HD 562-13	M	9	180	6	17	
HD 563-1	M	6		2	17	
HD 563-2	M	12		4	17	
HD 563-3	M	20		6	17	
HD 661	M	20			17	
HD 662/11	M	10	612	2	17	
HD 662/12	M	21	612	4	17	
HD 670-12	M	20	612	4	17	
HD 674	M	41	820	6	17	
SM 5220/2	M	20	612	4	17	
XM 221	M	21	615	4	17	
XM 3220	M	20	612	4	17	
XM 5210/1	M	10	612	2	17	306 x 4 x 17?
XM 5210/2	M	10	612	2	17	615 cyls? 306x4x17?
XM 5220/2	M	20	612	4	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
XM 5221/2	M	20	615	4	17	
XM 5540	M	42	825	6	17	
XM 563-12	M	10	612	2	17	

Optima Technology

Model	Type	Cap	Cyls	Hds	SpT	Notes
A 1301	A	137	1024	8	32	
A 1801	A	172	1024	8	41	
A 401	A	43	981	4	21	
A 901	A	86	981	8	21	
Minipak A1801	A	172	1024	8	41	
Minipak A2601	A	262	1012	12	42	
Minipak A3601	A	344	1024	12	54	
Minipak A801D	A	80				
Minipak A8091	A	90	977	8	22	
Concorde 1050	S	1050		15		
Concorde 1350	S	1352				
Concorde 2100	S-2F	2129	2624	19	83	ST 42400N
Concorde 600M	S	600				
Concorde 635	S	640		14		
Concorde 9000	S-2	9000				
Diskovery 100	S	100				
Diskovery 1000	S-2	1040				
Diskovery 130	S	137	1024	8	32	IS = internal for Mac
Diskovery 1400	S	400				
Diskovery 1800	S2FW	1760				
Diskovery 200	S	200				IS = internal for Mac
Diskovery 2100	S-2	2040				
Diskovery 260	S	2 x 130				Dual, Mac, Internal
Diskovery 310	S	310				
Diskovery 325	S	321				I version internal
Diskovery 40	S	45	998	4	22	
Diskovery 400	S	2 x 200				Dual, Mac, Internal
Diskovery 4100	S-2	4100				
Diskovery 420	S	416		8		I version internal
Diskovery 45R	S	45				Removeable
Diskovery 500	S-2F	520				
Disk'y IM260	S	260				
Disk'y IM400	S	440				
Disk'y IM620	S	2x310				Dual, Mac, Internal
Disk'y IS130	S	130				
Disk'y IS200	S	200				
Disk'y IS200	S	200				
Disk'y 80IM	S	2 x 40				Dual, Mac, Internal
Minipak 100	S	104		4		
Minipak 1000	S-2F	1050	2570	14	57	DEC DSP 3105

Model	Type	Cap	Cyls	Hds	SpT	Notes
Minipak 130(I)	S	130				I version internal
Minipak 1600	S	1600				
Minipak 200(I)	S	209		8		I version internal
Minipak 2100	S-2F	2040				
Minipak 240	S	248				
Minipak 300	S	320				
Minipak 310(I)	S	306				I version internal
Minipak 40(I)	S	40				I version internal
Minipak 4100	S-2F	4095				
Minipak 500	S-2	511				

Orca Technology

Out of business

Model	Type	Cap	Cyls	Hds	SpT	Notes
OT 301-1	A	335				
OT 304-1	A	430				
OT 320A	A	370		9		
OT 400A	A	470		9		
OT 760E	E	760	1564	15		Priam ID 700E
OT 320S	S	370		9		
OT 400S	S	470		9		
OT 507S	S	676	1632	15	34	
OT 510S	S	1073	1928	15	73	
OT 512S	S	1063	1924	15	72	
OT 513S	S	1130	1911			
OT 760S	S	760	1564	15		Priam ID 700S

Osicom Technologies Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
OsiCard 20	H	21				
OsiCard 30	H	33				
OsiCard 40	H	42				
OsiCard 8438	H	32	615	4	26	Miniscribe 8438
Macbest 100	S	91				
Macbest 150	S	150				
Macbest 30 ISE	S	33				
Macbest 300	S	300				
Macbest 40I SE	S	43				
Macbest 600	S	600				
Macbest 65	S	65				
Macbest 85	S	85				
Macbest-E 100	S	91				
Macbest-E 20	S	21				
Macbest-E 30	S	33				

Model	Type	Cap	Cyls	Hds	SpT	Notes
Macbest-E 40	S	43				
Macbest-E 65	S	65				
Macbest-E 85	S	85				

Otari

Bought Disctron. Sold to Rotating Memory Services

Model	Type	Cap	Cyls	Hds	SpT	Notes
C 214	M	10	306	4	17	
C 226	M	21	612	4	17	
C 503	M	3	153	2	17	
C 504	M	4	215	2	17	
C 506	M	5	153	4	17	
C 507	M	5	306	2	17	
C 509	M	8	215	4	17	
C 512	M	11	153	8	17	
C 513	M	11	215	6	17	
C 514	M	10	306	4	17	
C 518	M	15	215	7	17	
C 519	M	15	306	6	17	
C 525	M	20	306	8	17	
C 526	M	21	306	8	17	

Pacific Microelectronics Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
PM HDE 1200	S	1200				NeXT, Sun
PM HDE 330	S	330				NeXT, Sun
PM HDE 660	S	660				NeXT, Sun

Pacific/Magtron

Model	Type	Cap	Cyls	Hds	SpT	Notes
MT 3040	A	40				
MT 3050	A	50	1062	2	46	
MT 3080A	A	80				
MT 3100	A	100	1062	4	46	
MT 3120A	A	130				
MT 4115E	E	115	1600	4	35	
MT 4140E	E	140	1600	5	35	
MT 4170E	E	170	1600	6	35	
MT 5760E	E	677	1632	15	54	
MT 4115S	S	115	1600	4	35	
MT 4140S	S	140	1600	5	35	
MT 4170S	S	170	1600	6	35	

Model	Type	Cap	Cyls	Hds	SpT	Notes
MT 5760S	S	677	1632	15	54	
MT 6120S	S	1050				

PACKinTELL Electronics USA

Out of business?

Model	Type	Cap	Cyls	Hds	SpT	Notes
SX 47	A	47				
SX 43	M	43				

Panasonic

Model	Type	Cap	Cyls	Hds	SpT	Notes
RD 210AA	A	210				
JU 116	M	21	615	4	17	
JU 128	M	44	633	7	17	
JU 1381	S	40				
JU 1391	S	80				
LF 3000E	S	128				
LF 3002	S	128				
LF 5010E	S	470				
LF 5012	S	470				
LF 7010E	S	500				
LF 7012	S	500				
LF 9000E	S	326				
LF 90002	S	326				

Paragon

Model	Type	Cap	Cyls	Hds	SpT	Notes
PCQ ELO 2013	A	1300	2633	16	63	
PCQ ELO 2014	A	1400				MK 1401MAN?
PCQ ELO 2021	A	2160				ST 31621A?
PCQ ELO 2030	A	3080				MK 3003MAN?

Peripheral Land Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
Infinity 88 Tbo	S	88				
Infinity Opt	S	118				
Infinity Opt	S	650				
Mach One 100	S	96				Mac
Mach One 200	S	192				Mac
Mach One 30	S	32				Mac

Model	Type	Cap	Cyls	Hds	SpT	Notes
Mach One 40	S	45				Mac
Mach One 400	S	400				Mac
Mach One 60	S	60				Mac
MiniArray 040	S	2000				DEC DSP 3105
MiniArray 2 Gb	S	1550	1747	15	58-94	Micropolis 2112. External
PL 1.2 Turbo	S	1200				
PL 1.35 Turbo	S	1350				
PL 100 Turbo	S	105		4		
PL 20 Turbo	S	22				
PL 200 Turbo	S	210		7		
PL 2.1GB Turbo	S-2F	2129	2624	19	83	ST 42400N
PL 250 Turbo	S	251				Mac
PL 30 Turbo	S	32				Mac
PL 300 Turbo	S	300				Mac
PL 320 Turbo	S	320		14		
PL 383 Turbo	S	383				Mac
PL 400 Turbo	S	404				
PL 40 Turbo	S	42				
PL 415 Turbo	S	415				
PL 50 Turbo	S	49				Mac
PL 600 Turbo	S	613				Mac
PL 635 Turbo	S	645				
PL 645 Turbo	S	645				
PL 650 Turbo	S	645				Mac

Peripheral Systems Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
PSI 380	S	361				
PSI 536	S	323				
PSI 760	S	677				

Perstor Systems Inc

Out of business?

Model	Type	Cap	Cyls	Hds	SpT	Notes
StorMor 150		150				ST 506
StorMor 300		300				ST 506
StorMor 600		600				ST 506
StorMor 80		80				ST 506

PLI

See *Peripheral Land Inc*

Plus 5

Model	Type	Cap	Cyls	Hds	SpT	Notes
HD 113	S	113				
HDC 105	S	105				
HDC 45	S	45				
HDE 113	S	113				
HDE 377	S	377				
HDP 211	S	211				
HDP 83	S	83				
RD 44E	S	44				
RDP 44	S	44				

Plus Development Corp

Makers of Plus Hardcards. Now owned by Quantum

Model	Type	Cap	Cyls	Hds	SpT	Notes
Impulse 105AT	A	105	755	16	17	
Impulse 120AT	A	120	814	9	32	
Impulse 170AT	A	168	968	10	34	
Impulse 210AT	A	209	873	13	36	
Impulse 330AT	A	331		7	38	
Impulse 40AT	A	42	965	5	17	Try 834 x 3 x ?
Impulse 425AT	A	426	1021	16	51	
Impulse 52AT	A	52	751	8	17	
Impulse 80AT	A	84	965	10	17	
Impulse 80ATLP	A	86	616	16	17	
Hardcard 20	H(A)	20	612	4	17	8-bit IDE MFM 3:1
Hardcard 40	H(A)	40	612	8	17	8-bit IDE MFM 3:1
Hardcard2 40	H(A)	40	925	5	17	16-bit RLL
Hardcard2 80	H(A)	80	925	10	17	16-bit RLL
Hardcard2 105	H(A)	105	806	15	17	16-bit S-2 XL
Hardcard2XL 50	H(A)	52	601	10	17	16-bit S-2 1:1
Hardcard 80	H	81				16-bit S-2 1:1
Passport 20	H	21				1:1
Passport 40	H	43				1:1
Impulse 105S	S-2	105	1019	6		
Impulse 105SLP	S-2	105	609	8		
Impulse 120S	S-2	120	1123	5	42	
Impulse 170S	S	168	1123	7	48	
Impulse 210S	S	210	1156	7	39-59	
Impulse 330S	S	331		7	78	
Impulse 40S	S	42	834	3	28	
Impulse 425S	S	426	1520	9	44-78	
Impulse 52S/LP	S	52	1219	2		
Impulse 80S	S	84	834	6	35	
Impulse 80S/LP	S-2	86		4		

Prairetek Corp

Out of business

Model	Type	Cap	Cyls	Hds	SpT	Notes
PT 120	A	21	615	2	34	XT/AT
PT 140	A	40	1024	2	38	
PT 220A	A	21	612	4	17	
PT 240	A	42	615	4	34	NEC Prospeed
PT 242A	A	43	615	4	34	XT/AT
PT 282A	A	82	1024	4	39	
PT 220S	S	21	612	4	17	
PT 242S	S	43	615	4	34	
PT 282S	S	82	1024	4	39	

Premier Computer Innovations Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
PD 40281	A	40	977	5	17	
P D2070R	R	20				
P D4070R	R	40				
P S30R	R	33		2		
P S50R	R	49		2		
P 103ES/IS	S	103				Mac
P 20EM	S	20				Mac
P 20IM	S	20				Mac
P 20S	S	22		2		
P 30S	S	32		2		
P 401S	S	40				Mac
P 50EM	S	49				Mac
P 50IM	S	49				Mac
P 601M	S	60				Mac
P 60ES	S	60				Mac
P 801S	S	80				Mac
P 8028S	S	80				
P 80ES	S	80				Mac
PD 6028S	S	60				
PS 5040S	S	48				
PS 50S	S	49		2		

Priam/Vertex

Division of Sequel. Partially purchased by Atasi in 1990.
ID=Internal Disk ED=External Disk

Model	Type	Cap	Cyls	Hds	SpT	Notes
ID 200L-1(C,P)	A	200	1316	9	33	
3708	A	49	745	4	28	

Model	Type	Cap	Cyls	Hds	SpT	Notes
3804	A	65	981	5	26	
3804M	A	40	745	4	26	
ID 120-EX	E	121	1024	7	33	
ID 160H	E	156	1225	7	36	
ID 340H(-U)	E	340	1218	7	36	
ID 660H(-U)	E	660	1632	15	54	
ID 700E	E	701	1564	15		Orca 760E
ID/ED 100	E		1156	7		
ID/ED 120	E	121	1017	7	34	
ID/ED 130	E		1024	15	34	
ID/ED 150	E	159	1268	7	34	
ID/ED 160EC,E	E	157	1218	7	36	Logical 376 x 16 x 51
ID/ED 160PS71	E	155	1195	7	36	Logical 148 x 64 x 32
ID/ED 230	E		1218	15	36	
ID/ED 250EC,E	E	247	1218	11	36	Logical 591 x 16 x 51
ID/ED 250PS71	E	243	1195	11	36	Logical 232 x 64 x 32
ID/ED 330EC	E	337	1218	15	36	Logical 806 x 16 x 51
ID/ED 330PS71	E	331	1195	15	36	Logical 316 x 64 x 32
ID/ED 75	E		1156	5		
P 617	E	153	1225	7	36	
P 628	E	241	1225	11	36	
P 638	E(S?)	329	1225	15	36	
P 676	E	677	1632	15	54	
ID 100AT	M	103	1156	7	17	
ID 160A	M	62	1166	5	17	
ID 185A	M	73	1166	7	17	
ID 20	M	20	987	3	17	
ID 330	M	338				
ID/ED 40PC,W1	M	42	981	5	17	X2 Interleave 6 V 150
ID/ED 45 ATD2	M	45	1018	5	17	Based on V160
ID/ED 45PS002	M	45	1017	5	17	002 M30, 021 for M50
ID/ED 60 PCX2	M	60	981	7	17	X2 Interleave 6 V 170
ID/ED 62 ATD2	M	62	1018	7	17	
ID/ED 62 PS002	M	62	1017	7	17	02 M30, 021 M50
ID/ED 120	M	26	987	3	17	
ID/ED 130AT	M/R	133/244	1018	15	17/25	
ID/ED 130PS2	M	133	1218	15	17	PS/2 Model 30
ID/ED 130PS21	M	133	1017	15	17	021 M50, 041 others
P 1050	M	45	1024	5	17	
P 502	M	45	755	7	17	
P 503	M	71		8	17	
P 504	M	45	755	7	17	
P 505	M	111		12	17	
P 514	M/R	117/180	1224	11	17/25	
P 519	M/R	133/244	1224	15	17/25	
P 623	M	70	752	11	17	
P 630	M	156	1224	15	17	
S 14	M/R	117/179	1224	11	17/25	

Model	Type	Cap	Cyls	Hds	SpT	Notes
S 15	M/R	160/244	1224	15	17/25	
S 19	M	152	1224	15	17	
V 130	M/R	25/39	987	3	17/25	
V 150/ID 40	M/R	42/65	987	5	17/25	
V 170/ID 60	M/R	60/91	987	7	17/25	
V 185	M/R	71/108	1166	7	17/25	
V 519	M/R	160	1224	15	17	
3504	R	44	820	4	25	
3504M	R	57	771	4	25	
3704	R	58	793	4	35	
ID/ED 75RC,RF	R	74	1156	5	25	Logical 578 x 10 x 25
ID/ED 100RC	R	103	1156	7	25	Logical 578 x 14 x 25
ID/ED 230RC	R	233	1214	15	25	Logical 612 x 30 x 25
ID/ED 240R	R	243	1220	15	26	
V 130R	R	39	987	3	25	
V 150	R	151	987	5	25	
V 160	R	74	1166	5	25	
V 170R	R	92	987	7	25	
V 185	R	103	1166	7	25	
ID/ED 160	S	158	1218	7	36	
ID/ED 160PSSX	S	158	1225	7	36	
ID/ED 250	S	248	1218	11	36	
ID/ED 250-PS	S	244	1225	15	36	
ID/ED 250-SX	S	248	1225	11	36	
ID/ED 330	S	338	1218	15	36	
ID/ED 330PSSX	S	339	1225	15	36	
ID/ED 660	S	675	1628	15	54	
ID 700S	S	668	1564	15		Orca 760S
P 3708	S	86	838	6	35	
P 717	S	164	1225	7	36	
P 728	S	257	1225	11	36	
P 738	S	352	1225	15	36	
P 776	S	677	1632	15	54	
P 806	S	192	1023	11	35	
P 807	S	292	1552	11	35	MFM recording
P 808	S	433	1422	12	52	
P 3450	SMD	33	525	5	26	
P 7050	SMD	67	1049	5	26	
P 803	SMD	73	850	5	35	MFM recording

Procom Technology

Model	Type	Cap	Cyls	Hds	SpT	Notes
Atom AT 1300	A	1350				
Atom AT 340	A	340				
Atom AT 500	A	524				
Atom AT 700	A	700				

Model	Type	Cap	Cyls	Hds	SpT	Notes
Atom AT 800	A	810				
Bravopaq 120	A	124	1024	14	17	
Bravopaq 40	A	42	977	5	17	
HIDEDRIVE AT 120	A	121	683	8	38	
HIDEDRIVE 20	A	21	615	4	17	Hardcard
HIDEDRIVE 30	A	33	615	4	26	Hardcard
HIDEDRIVE 48	A	48	615	6	26	Hardcard
HIDEDRIVE AT 80	A	84	526	8	39	
PAT 100	A	100	535	14	29	
PAT 40	A	42	805	4	26	
PHD 20	A	20	615	4	17	
PHD 30	A	33	615	4	26	
PHD 45	A	48	608	6	26	
PHD 48	A	49	615	6	26	773 x 7 x 17?
PHD 5045	A	45	773	7	17	
PI 120	A	121	1524	4	39	
PI 140	A	44	820	4	26	
PI 80	A	84	1053	4	39	
PIRA 100	A	110	531	14	29	776 x 8 x 33?
PIRA 120	A	124	1024	15	17	
PIRA 200	A	210	951	12	36	
PIRA 40	A	42	977	5	17	
PIRA 50-120	A	120	1024	15	17	
PIRA 50-200	A	212	683	16	38	954 x 12 x 36?
PIRA 50-270	A	270				
PIRA 50-340	A	340				
PIRA 50-420	A	420				
PIRA 50-80	A	87	1024	14	17	
PIRA 55-120	A	120				
PIRA 55-200	A	212				
PIRA 55-270	A	270				
PIRA 55-340	A	340				
PIRA 55-420	A	420				
PIRA 55-500	A	500				
Propaq 100	A	105	776	8	33	
Propaq 1201	A	121	1524	4	39	
Propaq 120-19	A	124	1105	7	33	1024 x 14 x 17?
Propaq 185-15	A	189	977	9	42	1023 x 12 x 33?
Propaq 200	A	212	683	16	38	
Propaq 40	A	42	523	4	40	805 x 4 x 26?
Propaq 80i	A	80	1053	4	39	
PR IDE 1200	A	1200				
PR IDE 340i	A	340				
PR IDE 500i	A	510				
PR IDE 800	A	800				
Hiper 145	E	150	1024	8	36	
Hiper 155	E	383	966	9	36	
Hiper 330	E	337	1224	15	36	

Model	Type	Cap	Cyls	Hds	SpT	Notes
Hiper 380	E	383	755	16	63	
Hiper II/65	E	65	925	9	17	
Hiper II/155	E	157	150	64	32	
Hiper II/380	E	383	365	64	32	
PHD 20	M	20	615	4	17	
PHD 2520	M	21	615	4	17	
PHD 2545	M	45	733	7	17	
PHD 3020	M	21	615	4	17	
HideDrive 30	M	21	615	4	17	
HideDrive 48	M	45	733	7	17	
Hiper 20	M	21	615	4	17	
HideDrive 30	R	33	615	4	26	
Hiper 30	R	32	615	4	26	
Hiper 48	R	48	615	6	26	
Classic 100	S	100				Mac (Quantum)
Classic 20	S	20				Mac (Seagate)
Classic 30	S	30				Mac (Seagate)
Classic 45	S	45				Mac (Seagate)
Classic 50	S	50				Mac (Quantum)
HiPerf 100	S	102				
HiPerf 20	S	20				
HiPerf 200	S	200				
HiPerf 30	S	30				
HiPerf 320	S	320				
HiPerf 45	S	45				
HiPerf 650	S	650				
HiPerf 80	S	80				
LCsi 100	S	100				
LCsi 50	S	50				
MC 1003	S	1060				
MD 20	S	21	21	64	32	
MD 200	S	208	200	32	32	
MD 2003	S-2F	2030				
MD 2013	S-2F	2030				
MD 2103(W)	S2FW	2100				
MD 30	S	30	30	64	32	
MD 320	S	337	317	64	32	
MD 420	S	433	415	64	32	
MD 4303(W)	S2FW	4300				
MD 45	S	46	45	64	32	
MD 544	S	544				
MD 80	S	83	80	64	32	
M IIsi	S	200				
MTD 1000	S	1000	989	64	32	
MTD 1900	S-2F	1900				
MTD 2000	S-2F	2000				External Mac
MTD 320-10	S	337	317	64	32	
MTD 585	S	601	573	64	32	

Model	Type	Cap	Cyls	Hds	SpT	Notes
MTD 650	S	676	650	64	32	
MTD 9000	S-2F	9100				
QD 1900	S-2F	1900				
QD 2000	S-2F	2000				Internal Mac
Si 100	S	104	102	64	32	
Si 1000/S5	S	1037		64	32	
Si 1003	S	1060				
Si 200/PS3	S	209	200	64	32	
Si 2003	S-2F	2030				
Si 2103(W)	S2FW	2100				
Si 320-10	S	320	317	64	32	
Si 320H	S	320	339	64	32	
Si 420h	S	435	415	64	32	
Si 4303(W)	S2FW	4300				
Si 45	S	48	45	64	32	
Si 544	S	544				
Si 585/S5	S	601	415	64	32	
Si 650	S	662	632	64	32	
Si 80	S	83	80	64	32	
Si 9000(W)	S2FW	9100				

PTI

Peripheral Technology

Model	Type	Cap	Cyls	Hds	SpT	Notes
PT 238A	A	32	615	4	26	
PT 251A	A	43	820	4	26	
PT 357A	A	48	615	6	26	
PT 376A	A	64	820	6	26	
PT 4102A	A	86	820	8	26	
PT 225	M/R	21/32	615	4	17/26	
PT 234	M	28	820	4	17	
PT 325	M	20	615	4	17	
PT 338	M/R	32/49	615	6	17/26	
PT 351	M	42	820	6	17	
PT 468	M	57	820	8	17	
PT 238R	R	32	615	4	26	
PT 251R	R	43	820	4	26	
PT 257R	R	30	615	6	26	
PT 325R	R	20	615	4	26	
PT 338R	R	30	615	6	26	
PT 357R	R	48	615	6	26	
PT 376R	R	64	820	6	26	
PT 4102R	R	86	820	8	26	
PL 100 Turbo	S	105		4		
PL 200 Turbo	S	210		7		
PL 32 Turbo	S	320		14		

Model	Type	Cap	Cyls	Hds	SpT	Notes
PT 238S	S	52	615	4	42	
PT 251S	S	43	820	4	26	
PT 357S	S	48	615	6	26	
PT 376S	S	64	820	6	26	
PT 4102S	S	87	820	8	26	

Quadram

Model	Type	Cap	Cyls	Hds	SpT	Notes
Q 520	M		512	4	17	
Q 530	M		512	6	17	
Q 540	M		512	8	17	

Quantum

Drive manufacture subcontracted to MKE. DSP drives made by Digital.

Sun Parameters

CTRL may use the value SCSI; ACYL value is always 2; PCYL=NCYL+2
7200 RPM drives need v4.1.3 or higher. Solaris supports 7200.

Drive ID

First five characters of second group on bar code, such as CY12A. Numbers are capacity, last letter decode:

A	IDE
S	SCSI, 50-pin, single-ended
W	SCSI Wide, 68 pin, single-ended
D	SCSI Wide, 68 pin, single-ended
J	SCSI SCA, 80 pin

First letter decode:

AT	Atlas	**BF**	Bigfoot	**CP**	Capella	**CY**	Bigfoot CY
DA	Daytona	**EM**	Empire	**EN**	Pro LPS	**EP**	Pro LPS 1800
EU	Europa	**FB**	Fireball	**GM**	Pro LPS	**GP**	Grand Prix
HN	Atlas II	**LT**	Lightning	**MU**	Pro 425	**MV**	Maverick
RR	LPS	**SA**	Saturn VP	**SE**	Fireball SE	**SG**	Pioneer SG
SR	Sirocco	**ST**	Fireball ST	**TB**	LPS	**TM**	Fireball TM
TR	Trailblazer	**TX**	Bigfoot TX	**VK**	Viking		

Model	Type	Cap	Cyls	Hds	SpT	Notes
Bigfoot 1.0AT	A	1080	2100	16	63	5.25"
Bigfoot 1.2AT	A2F	1286	2492	16	63	5.25"
Bigfoot 1.7AT	A2	1700	3744	16	63	5.25"
Bigfoot 2.1AT	A2F	2110	4092	16	63	5.25"
Bigfoot 2.5AT	A2F	2577	4994	16	63	5.25"

Model	Type	Cap	Cyls	Hds	SpT	Notes
Bigfoot 3.5AT	A2F	3500	6232	16	63	5.25"
Bigfoot CY 2.1AT	A2F	2111	4092	16	63	5.25"
Bigfoot CY 4.3AT	A2F	4320	8960	15	63	5.25"
Bigfoot CY 6.4AT	A2F	6480	13346	15	63	5.25"
Bigfoot TS	A4	17900				
Bigfoot TX 4.0	A2F	4018	8306	15	63	5.25"
Bigfoot TX 6.0	A2F	6028	12459	15	63	5.25"
Bigfoot TX 8.0	A2F	8037	15574	16	63	5.25"
Bigfoot TX 12.0	A4	11480	23361	16	63	5.25"
Daytona 127AT	A	127	677	9	41	
Daytona 170AT	A	170	538	10	62	
Daytona 256AT	A	256	723	11	63	
Daytona 341AT	A	341	1011	15	44	
Daytona 514AT	A	514	997	16	63	
ELS 127AT	A	127	919	16	17	1536 x 3 x 42-67
ELS 170AT	A	170	1011	15	22	
ELS 40AT	A	42	966	5	17	
ELS 42AT	A	42	968	5	17	1536 x 1 x 42-67
ELS 85AT	A	85	977	10	17	832 x 6 x 33 HP D 2329
Europa 1080AT	A2F	1080	2362	15	60	2.5"
Europa 540AT	A2F	540	1579	15	60	2.5"
Europa 810AT	A2F	810	1771	15	60	2.5"
Fireball 2100AT	A2	2012	4092	16	63	
Fireball II 1080AT	A2F	1089	2112	16	63	Normal
			528	64	63	LBA
			1056	32	63	Large
Fireball II 1280AT	A2	1281	2484	16	63	
Fireball II 540AT	A2	544	1056	16	63	
Fireball II 640AT	A2	642	1244	16	63	
Fireball CR 127	A3	12700				
Fireball CR 13.0	A3	12700				5400 RPM
Fireball CR 84	A3	8400				
Fireball CX 20A011	A4	20400				5400 RPM
Fireball EL 2.5	A2	2500	5300	15	63	
Fireball EL 5.1	A2	5100	10602	15	63	
Fireball EL 7.6	A2	7600	15907	15	63	
Fireball EL 10.2	A4	9772	19885	16	63	
Fireball EX 3.2	A2	3200	6256	16	63	
Fireball EX 5.1	A2	5100	10602	16	63	
Fireball EX 6.4	A2	6400	133328	16	63	
Fireball EX 10.2	A2	10200	19885	16	63	
Fireball EX 12700	A2	12700	24704	16	63	
Fireball KX Ultra	A4	27300				7200 RPM
Fireball LCT 08	A4	26000		16		5400 RPM U66
Fireball LCT 10	A4	30000		16		5400 RPM U66
Fireball + KA	A3	18200				7200 RPM Fast
Fireball + KX 10A00A	A4	10270				7200 RPM
Fireball SE 2.1	A(U)	2151	4092	16	63	

Model	Type	Cap	Cyls	Hds	SpT	Notes
Fireball SE 3.2	A(U)	3228	6256	16	63	
Fireball SE 4.3	A(U)	4310	14848	9	63	
Fireball SE 6.4	A(U)	6448	13328	16	63	
Fireball SE 8.4	A(U)	8455	16383	16	63	
Fireball ST 1.6	A	1614	3128	16	63	5400 RPM
Fireball ST 2.1	A	2111	4092	16	63	5400 RPM
Fireball ST 3.2	A	3228	6256	16	63	5400 RPM
Fireball ST 4.3	A	4310	14848	9	63	5400 RPM
Fireball ST 6.4	A	6448	13328	15	63	5400 RPM
Fireball TM 1.0	A	1089.9	2112	16	63	4500 RPM
Fireball TM 1.2	A	1281	2484	16	63	4500 RPM
Fireball TM 1.7	A	1707	3309	16	63	4500 RPM
Fireball TM 2.1	A2	2111	4092	16	63	4500 RPM
Fireball TM 2.5	A	2564	4969	16	63	4500 RPM
Fireball TM 3.2	A2	3216	6232	16	63	5.25" Tempest 4500 RPM
Fireball TM 3.8	A2	3860	7480	16	63	4500 RPM
GEM 160A	A	168	968	10	34	ProDrive
GEM 80A	A	84	991	10	17	ProDrive
GEM 24A012	A	240	723	13	51	
GO 40AT	A	43	821	6	17	Laptops
GO 60AT	A	65	526	9	26	Laptops
GO 80AT	A	86	991	10	17	Also 1024 x 4 x 17
GO 120AT	A	127	731	13	26	Laptops
GO 160AT	A	169	968	10	34	
GO GLS 127AT	A	127	677	9	41	
GO GLS 170AT	A	170	538	10	62	
GO GLS 256AT	A	256	723	11	63	
GO GLS 85AT	A	85	722	10	23	
GO GLS 341AT	A	341	1011	15	44	
GO GLS 541AT	A	541	997	16	63	
GO GRS 60AT	A	60	526	9	26	
GO GRS 80AT	A	84	966	5	34	Laptops
GO GRS 120AT	A	127	1024	9	26	
GO GRS 160AT	A	169	966	10	34	Laptops
GO QG80	A	84	991	10	17	
IMP 52AT	A	52	751	8	17	
IMP 425AT	A	425	1021	16	51	
Lightning 270AT	A	270	944	14	40	
Lightning 365AT	A	366	976	12	61	
Lightning 540AT	A	541	1120	16	59	
Lightning 730AT	A	731	1416	16	63	
LPS 105AT	A	105	755	16	17	1219 x 4 x 35-49
LPS 120AT PD	A	122	901	5	53	760 x 8 x 39—see 127AT
LPS 127AT	A	128	919	16	17	Try 760 x 8 x 39
LPS 170AT	A	170	1011	15	22	
LPS 210AT	A	210	723	15	38	
LPS 240AT PD	A	245	723	13	51	
LPS 270AT	A	270	944	14	40	Maverick

Model	Type	Cap	Cyls	Hds	SpT	Notes
LPS 330AT	A	331	1011	15	44	
LPS 340AT	A	343	1011	15	44	
LPS 420AT	A	420	1010	16	51	
LPS 450AT	A	450	931	15	63	2096 x 6 x 44-96
LPS 52AT	A	52	751	8	17	
LPS 525AT PD	A	525	1017	16	63	
LPS 540AT	A	540	1120	16	59	1024 cyls for SCO Unix/AST
LPS 80AT	A	85	616	16	17	
LPS 85AT	A	80	977	5	17	
Maverick 270AT	A	270	944	14	40	IBM 06H4152
Maverick 540AT	A	541	1049	16	63	
PD 120AT	A	120	814	9	32	
PD 170AT	A	168	968	10	34	
PD 210AT	A	209	873	13	36	
PD 425(I)AT	A	426	1021	16	51	
Pioneer SG 1.0	A	1082	2097	16	63	
Pioneer SG 2.1	A	2111	4092	16	63	
Pro 105AT	A	105	755	16	17	
Pro 120AT	A	120	814	9	32	1123 x 5 x 48
Pro 1225AT	A	1225	2448	14	70	
Pro 127AT	A	127	814	9	32	
Pro 170AT	A	168	968	10	34	1123 x 7 x 48
Pro 210AT	A	210	873	13	36	1156 x 7 x 39-59
Pro 240AT	A	245	723	13	51	
Pro 270AT	A	270	944	14	40	Mac LC630
Pro 330AT	A	336	1011	15	44	
Pro 40AT	A	42	965	5	17	834 x 3 x 28
Pro 425(i)AT	A	426	1021	16	51	
Pro 52AT/S	A	52	751	8	17	
Pro 80AT	A	84	965	10	17	834 x 6 x 28
Pro 85AT	A	85	611	16	17	
QM 20256DYA	A	256	723	11	63	2.5”
QM 20341DYA	A	341	1011	15	44	2.5”
QM 20541DYA	A	541	997	16	63	2.5”
QM 20540EUA	A	540	1120	16	59	2.5”
QM 20810EUA	A	810				2.5”
QM 21080EUA	A	1089	2112	16	63	2.5”
QM 30850TRA	A	850	1647	16	63	
QM 31080FBA	A	1089	2112	16	63	
Scirocco 1700	A2	1713	3309	16	63	
Scirocco 2550	A2	2573	4969	16	63	
Trailblazer 420AT	A	421	1010	16	51	
Trailblazer 635AT	A	637	1234	16	63	
Trailblazer 850AT	A	850	1647	16	63	Normal
			823	32	63	LBA/Large
Pro 100E	E	103				
Pro 145E	E	145	1123	7	36	
EZ 127	H	127	919	16	17	16-bit

Model	Type	Cap	Cyls	Hds	SpT	Notes
EZ 240	H	245	723	13	51	16-bit
EZ 42	H	42	977	5	17	16-bit
EZ 85	H	85	977	10	17	16-bit
HCIIXL105	H	105	806	15	17	16-bit
HCIIXL50	H	52	601	10	17	
Q 510	M/R	9/13	512	2	17/26	
Q 520	M/R	15/27	512	4	17/26	Not in XTs or Xebec 1210
Q 530	M/R	25/41	512	6	17/26	Not in XTs or Xebec 1210
Q 540	M/R	36/54	512	8	17/26	Not in XTs or Xebec 1210
Q 2010	R	8	512	2	32	
Q 2020	R	16	512	4	32	
Q 2030	R	25	512	6	32	
Q 2040	R	33	512	8	32	
Q 2080	R	67	1172	7	32	
Q 250	R	53	823	4	26	
Q 280	R	80	823	6	26	
Atlas	see XP series (down a bit)					
240S	S	240				Rebadged as DEC RZ 24L-E
40S	S	43	834	3	35	
80S	S	71	834	5	35	
1050S	S	1000				
1080S	S	1080		8		
1225S	S	1200				
Capella	see VP series (down a bit)					
Daytona 127S	S-2	127	1704	2	54-92	
Daytona 170S	S-2	170	1704	3	54-92	
Daytona 256S	S-2	256	1704	4	54-92	
Daytona 341S	S-2	341	1704	6	54-92	
Daytona 514S	S-2	491				4500 RPM
Daytona 541S	S-2	541	1704	8	54-92	
DSP 3053L	S-2F	535	8100	4	59-119	
DSP 3107L	S2FW	1070	3100	8	59-119	
DSP 3133L	S2FW	1340	3100	10	59-119	
DSP 3210L	S2FW	2150	3042	16	59-119	
ELS 127S	S	127	1541	3	54	Sun 3600 RPM
			1536	3	27	HP
ELS 170S	S	170	1544	4	54	3600 RPM
			1542	4	54	Sun
ELS 42S	S	42	1528	1	17	
ELS 455S	S	455				
ELS 85S	S	85	1537	2	54	3600 RPM
			1535	2	54	Sun
Empire 1080S	S-3F	1080	2864	16	46	Sun 5400 RPM
			2866	8	46	HP
Empire 1400S	S-2F	1440	1988	24	86	Sun 5400 RPM
			1019	22	61	HP
Empire 2100S	S-3F	2100	1988	24	86	Sun 5400 RPM
			1990	24	43	HP

Model	Type	Cap	Cyls	Hds	SpT	Notes
Empire 540S	S-3F	540	1431	16	46	Sun 5400 RPM
			1433	8	46	HP
Empire II	see VP series (down a bit)					
ESP 3013	S-2	134				Solid State
ESP 3026	S-2	268				Solid State
ESP 5011	S-2F	118				Solid State
ESP 5047	S-2F	475				Solid State
ESP 5095	S-2F	950				Solid State
ESP 510	S-2F	107				Solid State
ESP 530	S-2F	267				Solid State
ESP 540	S-2F	428				Solid State
ESP 580	S-2F	856				Solid State
Fireball 1080S	S-3F	1080	2864	16	46	Sun 5400 RPM
Fireball 1280S	S-3F	1282	4133	4	139	Sun 5400 RPM
Fireball 2.1	S-3F	2100				
Fireball 540S	S-3F	544	1431	16	46	Sun 5400 RPM
Fireball 640S	S-3F	640	4133	2	139	Sun 5400 RPM
Fireball SE 2.1	S-3	2151				
Fireball SE 3.2	S-3	3228				
Fireball SE 4.3	S-3	4310				
Fireball SE 6.4	S-3	6448				
Fireball SE 8.4	S-3	8455				
Fireball ST 2.1	S-3	2111				5400 RPM
Fireball ST 3.2	S-3	3228				5400 RPM
Fireball ST 4.3	S-3	4310				5400 RPM
Fireball ST 6.4	S-3	6448				5400 RPM
Fireball TM 1.2	S-3	1281				4500 RPM
Fireball TM 2.1	S-3	2111				4500 RPM
Fireball TM 3200S	S-3	3216	6810	6	104-232	4500 RPM
GEM 160S	S	168				Prodrive
GEM 80S	S	84	834	6	35	Prodrive
GO 40S	S-2	43	870	2	39-58	Laptops
GO 60S	S	65	1097	2	44-68	Laptops
GO 80S	S	85	834	6	35	Laptops
GO 120S	S	130	1069	4	56	Laptops 3600
GO GLS 85S	S-2	85	1395	2	44-75	
GO GLS 127S	S-2	127	1395	3	44-75	
GO GLS 170S	S-2	170	1395	4	44-75	
GO GLS 256S	S-2	256	1395	6	44-75	
GO GRS 80S	S	84	1376	2	45-73	
GO GRS 160S	S	169	1415	4	58	3600 RPM
Grand Prix						See XP Series
Impulse 210	S	210		7		
Impulse 425S	S	455		9		
Impulse 52S	S	52		2		
Impulse 525S	S	525				
Impulse 80	S	80		4		
KN 18L011	SU160	18200				Atlas IV

Model	Type	Cap	Cyls	Hds	SpT	Notes
Lightning 365S	S-2F	365	3763	2	64-128	
Lightning 540S	S-2F	541	3763	3	64-128	
Lightning 730S	S-2F	732	3763	4	64-128	
LPS 105S	SSync	105	1221	4	42	Sun 3600 RPM
LPS 105SMAC	SSync	105	1219	4	41	Mac compatible
LPS 105SPS2D	S	105	1019	6	32	PS/2 Upgrade
LPS 1050S	S-2	1050	2446	12	70	
LPS 1080S	S3FW	1080	2866	8	92	Emp 2897x8x91
LPS 120S(PS2)	SSync	122	1987	2	60	Sun 4300 RPM
			829	6	24	HP
LPS 1225S	S-2	1225	2448	14	69	
LPS 127S	S	128	1601	2	78	Sun 3600 RPM
LPS 1400S	S3FW	1400	2038	22	61	Emp 3079x8x111
LPS 1440S	S-3F	1440	3100	8	74-135	Empire
LPS 170S	S	171	871	8	48	Sun 3600 RPM
LPS 2100S	S3FW	2100	3079	12	111	Empire
LPS 2160S	S-3F	2160	3100	12	74-135	Empire
LPS 240S(PS2)	SSync	245	1995	4	60	Sun 4300 RPM
			901	7	38	HP
LPS 270S	S	271	1650	8	40	Sun 4500 RPM
			2740	2	48	HP
LPS 330S	S	331		7		
LPS 340S	S	343	871	16	48	Sun 3600 RPM
LPS 425S	S	426		9		
LPS 450S	S-2F	450	2096	6	44-96	
LPS 52S(PS2D)	SSync	52	2444	6	70	Sun 4500 RPM
LPS 525S	S-2	525	2444	6	70	Sun 4500 RPM
			1895	9	30	HP
LPS 540S	S	541	1650	8	80	Sun 4500 RPM
			2740	4	48	HP
LPS 540ES	S3FW	541	2897	8	91	Sun
			1433	8	92	HP
LPS 80(S)(T)	SSync	85	834	4	34	
Lightning 365S	S-2F	365	1355	6	88	Sun 4500 RPM
Lightning 540S	S-2F	540	2296	6	48	Sun 4500 RPM
Lightning 730S	S-2F	730	2709	6	88	Sun 4500 RPM
Maverick 270S	S	271	1652	8	40	
Maverick 540S	S	540	2897	4	91	Sun 5400 RPM
			1433	8	92	HP
Passport XL105	S	105	1219	4		XL Removable
Passport XL120	S	120	1800	2		Removable
Passport XL127	S-2	127				Removable
Passport XL170	S-2	170				Removable
Passport XL240	S	240	1800	4		Removable
Passport XL42	S-2	42	1219			Removable
Passport XL50	S	52	1219	2		Removable
Passport XL525	S-2					Removable
Passport XL85	S-2	85				Removable

Model	Type	Cap	Cyls	Hds	SpT	Notes
PD 1050S	S	1050	2444	12	70	Sun 4500 RPM
			2075	13	38	HP
PD 120S	SSync	120	1114	5	42	Sun 3600 RPM
PD 1225S(D)	S-2F	1200	1834	5	87	Sun 4500 RPM
			2958	9	45	HP
PD 170S	SSync	168	1117	7	42	Sun 3600 RPM
PD 1800S	S	1800	2337	6	94	Sun 4500 RPM
			2339	16	47	HP
PD 210S	SSync	210	1189	7	49	Sun 3600 RPM
			1167	7	25	HP
PD 2100S	S		1889	25	87	Yukon
PD 40S	S	42	834	3	28	
PD 425S(i)	S	426	1540	9	60	Sun 3600 RPM
			1527	9	30	HP
PD 700S	S	700	2441	8	70	Sun 4500 RPM
			1989	8	43	
PD 80S	S	84	834	6	35	
Pro 105S	S	105	1019	6	28-35	
Pro 1050S(D)	S-2F	1050	2448	12	70	
Pro 120S	S	120	1123	5	48	
Pro 1225S	S-2	1225	2448	14	70	
Pro 160S	S	168				
Pro 170S	S	168	1123	7	48	
Pro 1800S	S-2	1800	2959	14	59-99	
Pro 210S	S	210	1156	7	39-59	
Pro 240	S-2F	245		6		
Pro 330S	S	331		7	78	
Pro 40S	S	42	834	3	28	
Pro 425i,PS2D	S-2F	426	1542	9	60	3600 RPM
Pro 450	S-2	450		6		
Pro 525S	S	525	2448	6	44-92	
Pro 700S(D)	S	700	2441	8	42-92	
Pro 80S	S	84	834	6	35	
Pro 85S	S	85				
Q 160	S	160	823	12	31	815 cyls? 35 secs?
Q 250	S	53	823	4	31	815 cyls? 35 secs?
Q 280	S	77	823	6	31	815 cyls? 35 secs?
QM 20341DYS	S-2	341				
QM 20514DYS	S-2	514				
QM 30730LTS	S-2	730				
QM 30850TRS	S-2	850				
QM 31080FBS	S-2	1000				
QM 39100PX-LW	S-U2	8500				
Saturn	see VP3 series (down a bit)					
TN 36L011	SU160	36400				Atlas 10K
Trailblazer 420S	S	425	1334	10	62	Sun 4500 RPM
Trailblazer 850S	S	810	2674	10	62	Sun 4500 RPM
VP 31080	S-2F	1085	3432	5		Saturn

Model	Type	Cap	Cyls	Hds	SpT	Notes
VP 31110S	S2FW	1110	4172	4	129	Capella 1 Gb Sun
VP 32170S	S-2F	2170	3432	10		Saturn
VP 32181S	S-3	2180		5		Vik 2.1/Empire II
VP 32210S	S2FW	2102	4172	8	129	Capella 2 Gb Sun
VP 34360S	S-3	4360		10		Vik 4.3/Empire II
VP 39100S	S-3	9100		20		Empire II
XP 31070s	S2FW	1080	3832	5	71-138	Atlas
XP 3125S	S-2F	2150				
XP 32140	S3FW	2140		10	<118	Grand Prix 2140
XP 32150S	S2FW	2050	3850	10	109	Atlas 2150 Sun
XP 32151S	S3FW	2152	3561	10	118	Grand Prix 2150 Sun 7200
XP 32181	S-3	2181		5	Var	Atlas
XP 34280	S3FW	4280		20	<118	Grand Prix 4280
XP 34300S	S2FW	4101	3850	20	109	Atlas 4300 Sun
XP 34301S	S3FW	4306	3561	20	118	Grand Prix 4300 Sun 7200
XP 34361	S-3	4360		10	Var	Atlas
XP 34550	S-3	4550	5812	10	108-180	Atlas II
XP 39100	S-3	9100		20	Var	Atlas II 7200 RPM 17.6W
XP 4280S	S-2F	4280				
2010	S1000	8	512	2	17	MFM
2020	S1000	17	512	4	17	MFM
2030	S1000	25	512	6	17	MFM
2040	S1000	34	512	8	17	MFM

Most Quantum ATA Drives

Single:	DS
Master:	DS/SP/SS*
Slave:	None

*Try without SP/SS with some Quantum drives.
CS for cable selection (Mstr if pin 20 grounded).

425iAT/540AT/525 PRO 120/170/210

with Quantum 50-210

Master: DS
Slave: None

with Quantum 40-80

Master: DS/SS
Slave: SS (TM)

with 3rd party drive

Master: DS SP
Slave: SP

ELS 170AT

Restoring boot sector

```
DEBUG
A
MOV AX,330
MOV CX,1
MOV DX,80
MOV BX,3800
MOV ES,BX
MOV BX,0
INT 13
INT 3
<Cge  retn>
G=100
Q Reboot
```

Most Quantum SCSI drives

ID	*A2*	*A1*	*A0*
1	0	0	0
2	0	0	1
3	0	1	0
4	0	1	1
5	1	0	1
6	1	1	0
7	1	1	1

Do not use if J5 is used for ID.

Maverick/Lightning/Empire

As above, but Empire:

TE	Terminator Enable
EP	Enable Parity
WS	Wait/Spin
J13	Terminator Power

Atlas XP series

ID	*5-6*	*3-4*	*1-2*
1	0	0	0
2	0	0	1
3	0	1	0
4	0	1	1
5	1	0	1
6	1	1	0
7	1	1	1

7	FLT Out L LED
8	Key (No pin)
9	Out LED (BSY)
10	Spindle Synch
11	LED +5v Out
12	N/A
13	Spin delay
14	Spin delay
15	AC Low L
16	Logic Ground L
17	WP
18	WP
19	Spin synch
20	Logic Ground L

Grand Prix XP series

ID	*A2*	*A1*	*A0*
1	0	0	0
2	0	0	1
3	0	1	0
4	0	1	1
5	1	0	1
6	1	1	0
7	1	1	1

A3	ID does not work on 50-pin SE/Diff
TE on	Terminator Enable
EP on	Enable Parity
WS on	Wait/Spin enable
DS on	Delay Spin enable
J2 on	Terminator Power from drive

DSP 3053L/3107L/3133L/XP 34300

ID	*5-6*	*3-4*	*1-2*
1	0	0	0
2	0	0	1
3	0	1	0
4	0	1	1
5	1	0	1
6	1	1	0
7	1	1	1

GO drive SCSI ID

J2	*7*	*6*	*5*
0	0	0	0
1	0	0	1
3	0	1	0
4	0	1	1
5	1	0	1
6	1	1	0
7	1	1	1

Pro 525S

1	0	0	0
2	0	0	1
3	0	1	0
4	0	1	1
5	1	0	1
6*	1	1	0
7	1	1	1

TE on	Terminator Enable
EP on	Enable Parity
WS on	Wait/Spin enable
S4 on	Spindle synch active (Rev 2)
J13 on	Terminator Power from host (Rev 2)

Qubie

Model	Type	Cap	Cyls	Hds	SpT	Notes
HH 612C	M	21	615	4	17	in Olivetti M24

Qume

Model	Type	Cap	Cyls	Hds	SpT	Notes
R 200	?					
R 300	?					

RACET Computers Ltd

Model	Type	Cap	Cyls	Hds	SpT	Notes
Admin 350x1	E	650				External
Admin 350x2	E	1200				External
Admin 650x1	E	676				External
Admin 350x1	S	650				
Admin 350x1	S	676				
Admin 350x2	S	1200				
GigaSTOR	S	5300				
PCMS SA185	S	185				
PCMS SA190	S	190				
PCMS SA338	S	338				
PCMS SA600	S	600				
SA 350	S	350				
SA 357	S	357				
SA 657	S	657				
SA 673	S	673				

RARE Systems

DEC

Model	Type	Cap	Cyls	Hds	SpT	Notes
RS 3105	S-2F	1050	2570	14	57	
RS 3160	S2FW	1600	2599	16	53-107	
RS 5200	S-2F	2100	2620	21	71	
RS 5350	S-2F	3500	3035	25	80-120	

Relax Technology Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
960 MB	S-2	1079	1658	15	85	Fujitsu M 2266S-512

Model	Type	Cap	Cyls	Hds	SpT	Notes
Hard Plus 100	S	102				
Hard Plus 1200	S	960				
Hard Plus 180	S	180				
Hard Plus 300	S	288				
Hard Plus 350	S	347				
Hard Plus 600	S	632				
Hard Plus 650	S	654				
Mac Int 100	S	102				
Mac Int 1200	S	960				
Mac Int 180	S	176				
Mac Int 30	S	32				
Mac Int 300	S	288				
Mac Int 350	S	347				
Mac Int 46	S	47				
Mac Int 600	S	632				
Mac Int 650	S	654				
Vista 100	S	102				
Vista 1200	S	960				
Vista 180	S	176				
Vista 30	S	32				

Ricoh

DMA

Model	Type	Cap	Cyls	Hds	SpT	Notes
RH 5130	M/R	10/15	612	2	17/26	
RH 5260	M	10	615	2	17	Removeable
RH 5261	S	25	612	2	17	MFM recording
RH 5500	S	50	1285	2	76	Cartridge
RS 9150AR	S	47	1285	2	76	Cartridge

Rotating Memory Systems

Merged with Data Peripherals to form Disctron—later sold to Otari, sold to Rotating Memory Services

Model	Type	Cap	Cyls	Hds	SpT	Notes
SS 40AT	A	42				Cartridge
SS 85AT	A	83				
SS 180-E	E	177				Cartridge
SS 20	M	21				Cartridge
SS 40	M	42				Cartridge
SS 85	M	83				Cartridge
SS 100-S	S	100				Cartridge
SS 140-S	S	142				Cartridge
SS 20-S	S	21				Cartridge
SS 200-S	S	207				Cartridge

Model	Type	Cap	Cyls	Hds	SpT	Notes
SS 320S	S	320				Cartridge
SS 400S	S	42				Cartridge
SS 80S	S	84				Cartridge

Rotating Memory Services

Repair company which bought Otari, which was discontinued.

Model	Type	Cap	Cyls	Hds	SpT	Notes
RMS 214	M	10	306	4	17	
RMS 503	M/R	3/4	153	2	17/26	
RMS 504	M	4	215	2	17	
RMS 506	M	5	153	4	17	
RMS 507	M	5	306	2	17	
RMS 509	M	8	216	4	17	WPC 108
RMS 512	M	11	153	8	17	
RMS 513	M	11	215	6	17	
RMS 514	M	10	306	4	17	
RMS 518	M	15	215	8	17	
RMS 519	M	15	306	6	17	
RMS 525	M	20		8	17	
RMS 526	M	21	306	8	17	

Rodime Ltd

Out of business Aug 1991. Bought by Conner

Model	Type	Cap	Cyls	Hds	SpT	Notes
RO 128A	A	106	868	7	34	
RO 3055A	A	46	872	6	17	
RO 3058A	A	45	868	3	34	
RO 3059A	A	42	217	15	28	
RO 3071A	A	61	1217	2	48	
RO 3088A	A	75	868	5	34	
RO 3089A	A	82	325	16	28	
RO 3095A	A	82	923	5	34	
RO 3099A(P)	A	80	373	15	28	Try 515 x 8 x 17
RO 3121A	A	122		4		
RO 3128A	A	106	868	7	34	
RO 3129A	A	106	492	15	28	
RO 3130T	A	105	1053	7	28	
RO 3135A	A	112	923	7	34	
RO 3139A(P)	A	114	523	15	28	
RO 3151A	A	122	1217	4	39	
RO 3199A	A	163	1216	4	66	
RO 3209A	A	163	759	15	28	
RO 3259A(P)	A	210	990	15	28	
RO 5075E	E	65	1224	3	35	

Model	Type	Cap	Cyls	Hds	SpT	Notes
RO 5125E	E	106	1224	5	34	
RO 5180E	E	150	1224	7	34	
RO 100	M					
RO 101	M/R	3/5	192	2	17/26	
RO 102	M/R	7/11	192	4	17/26	
RO 103	M/R	10/15	192	6	17/26	
RO 104	M/R	14/21	192	8	17/26	
RO 200	M	11	320	4	17	
RO 201	M/R	5/8	320	2	17/26	321 cyls?
RO 201E	M/R	11/16	640	2	17/26	
RO 202	M/R	11/16	321	4	17/26	
RO 202E	M/R	22/31	640	4	17/26	
RO 203	M/R	17/26	320	6	17/26	
RO 203E	M/R	33/47	640	6	17/26	
RO 2031	M	16	320	6	17	
RO 204	M/R	22/34	320	8	17/26	321 cyls?
RO 204E	M/R	45/63	640	8	17/26	
RO 206	M	40	320	8	17	
RO 208	M	53	320	8	17	
RO 2301	M	16	320	6	17	
RO 251	M	5	306	2	17	
RO 252(F)	M	10	306	4	17	
RO 3000A-XLA	M	42	992	5	17	
RO 3045	M/R	38/58	872	5	17/26	
RO 3055	M/R	45/69	872	6	17/26	972 cyls? (Oli)
RO 3065	M	53	872	7	17	
RO 350	M	10	306	4	17	
RO 351	M	5	306	2	17	
RO 352	M/R	11/16	306	4	17/26	
RO 365	M	21	615	4	17	
RO 412	M	34	1024	4	17	
RO 413	M	51	1024	6	17	
RO 414	M	68	1024	8	17	
RO 5040	M	32	1224	3	17	
RO 5065	M	63	1224	5	17	
RO 5090	M	75	1224	7	17	
RO 652	M	20	306	4	17	
RO 200RX	R	20				
RO 3000A-XL	R	43	992	5	17	
RO 3000A-NAT	R	43	625	5	26	
RO 3060R	R	50	750	5	26	
RO 3075R	R	60	750	6	26	
RO 3085R	R	67	750	7	26	
RO 352	R	16	306	4	26	
RO 5090R	R	109	1224	7	26	
RO 5095R	R	81	1224	5	26	
RO 5130R	R	114	1224	7	26	
RO 3040S	S	32	872	3		

Model	Type	Cap	Cyls	Hds	SpT	Notes
RO 3057S	S	72	680	5	42	
RO 3058T	S	45	868	3	34	
RO 3059T	S	42	1216	2	34	
RO 3070S	S	70	756	4	45	
RO 3080S	S	38				
RO 3085S	S	70	750	7	26	
RO 3088T	S	75	868	5	34	
RO 3089T	S	82	1216	3	44	
RO 3090T	S	75	1053	5	28	
RO 3128T	S	106	868	7	34	
RO 3129T	S	106	1090	5	38	
RO 3130S	S	106	1047	7	28	
RO 3139S	S-2	113	1148	5	38	
RO 3258T	S	216	1235	9	38	
RO 3259S	S-2	210	1189	9	38	
RO 3259T	S	210	1216	9	34	
RO 3331S	S-2	331	1497	7	62	
RO 3426S	S-2	426	1497	9	62	
RO 3540S	S	540	1568	11		
RO 5000S	S	146	1233	7	33	
RO 5040S	S	38	1224	3	42	
RO 5075S	S	76	969	5	31	
RO 5125S-102/1F2	S	106	1219	5	34	
RO 5178S	S	149	1219	7	34	
RO 5180S-102/1F2	S	149	1219	7	34	
RO 651	S	10	306	2	34	
RO 652(A)	S	21	306	4	33	MFM recording
RO 652B	S	26	306	4	42	
RO 751	S	10	306	2	34	
RO 752A	S	25	306	4	42	MFM recording
RO 8074	SMDE	667	1646	11		

RO 3259A

Master: LK4 LK1

Rodime Systems

Model	Type	Cap	Cyls	Hds	SpT	Notes
Cobra 110AT	A	110		4		Compaq
Cobra 210AT	A	210	1216	9		Compaq
Cobra 40AT	A	42	1170	2	36	Compaq
Cobra 80AT	A	84	1159	4	36	Compaq
20 Plus	S	20			33	Mac, External
45 Plus	S	40			34	Mac, External
100RX	S	100				Mac
450RX	S	40				Mac

Model	Type	Cap	Cyls	Hds	SpT	Notes
Classic 20	S	20				Mac
Classic 40	S	40				Mac
Classic 80	S	80				Mac
Cobra 1000e	S	1000				Mac, External
Cobra 100e	S	100	868	7		Mac, External
Cobra 100i	S	100	868	7		Mac, Internal
Cobra 110e	S	105		4		Mac, External
Cobra 210e	S	210	1216	9		Mac, External
Cobra 210i	S	210	1216	9		Mac, Internal
Cobra 330e	S	330				Mac, External
Cobra 45e	S	40	868	3		Mac, External
Cobra 45i	S	40	868	3		Mac, Internal
Cobra 50il	S	50				Mac
Cobra 650e	S	650				Mac, External
Cobra 70e	S	70	868	5		Mac, External
Cobra 70I	S	70	868	5		Mac, Internal

Ruby Systems Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
StarDrv 100 DN	S	100				Mac
StarDrv 100 DX	S	100				Mac
StarDrv 130 DN	S	130				Mac
StarDrv 130 DX	S	130				Mac
StarDrv 170 DN	S	168				Mac
StarDrv 170 DX	S	168				Mac
StarDrv 40D N	S	40				Mac
StarDrv 40D X	S	40				Mac
StarDrv 90D N	S	88				Mac
StarDrv 90D X	S	88				Mac

Samsung

www.samsung.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
PLS 30544A	A	540	1047	16	63	
PLS 30854A	A2	850	1647	16	63	
PLS 31084A	A2	1080	2100	16	63	
PLS 31264A	A	1273	3844	6	72-132	Physical
PLS 31274A	A2	1213	2478	16	63	
SHB 30560	A	560				Apollo
SHB 3272A	A	545		4		Apollo
SHC 3061A	A	60	966	5	26	
SHC 3101A	A	101	748	8	33	
SHD 2041B	A	41	820	4	28	Try 900 x 6 x 17
SHD 2081A	A	80	1300	2	60	

Model	Type	Cap	Cyls	Hds	SpT	Notes
SHD 30280A	A	280	869	10	63	
SHD 30420A	A	420	856	16	63	
SHD 30560A	A	561	1086	16	63	
SHD 3061A	A	61	993	7	17	
SHD 3062A	A	120	927	15	17	
SHD 3101A	A	105	754	16	17	Try 776 x 8 x 33
SHD 3121A	A	125	615	16	25	
SHD 3122A	A	240	937	15	35	
SHD 3171A	A	170	968	8	45	
SHD 3172A	A	357	968	16	45	
SHD 3211A	A	213	1002	8	52	
SHD 3212A	A	426	1002	16	52	
SP 0914D	A4	9108	17648	16	63	
SP 1366D	A4	13658	26464	16	63	
SP 1828D	A4	18216	35296	16	63	
STG 31271A	A2	1280				
STG 31601A	A2	1600				
SV 0211A	A4	2112	4092	15	63	
SV 0322A	A4	3200	11024	9	63	
SV 0431D	A4	4311	8912	15	63	
SV 0432A/D	A4	4311	8912	15	63	
SV 0643A/D	A4	6448	13328	15	63	
SV 0644A	A4	6402	13232	15	63	
SV 0682D	A4	6851	14160	15	63	
SV 0842D	A4	8455	16383	16	63	
SV 0844A/D	A4	8455	16383	16	63	
SV 1022D	A4	10204	19773	16	63	
SV 1023D	A4	10276	19912	16	63	
SV 1025A	A4	10200	19765	16	63	
SV 1296A/D	A4	12922	25038	16	63	
SV 1363D	A4	13672	26493	16	63	
SV 1364D	A4	13702	26550	16	63	
SV 1533D	A4	15307	29660	16	63	
SV 1705D	A4	17127	33187	16	63	
SV 1824D	A4	18230	35324	16	63	
SV 2044D	A4	20409	39546	16	63	5400 RPM
SV 2046D	A4	20553	39824	16	63	
TBR 31080A	A2	1080	2112	16	63	Quantum Trailblazer?
VG 33402A	A	3400	6591	16	63	
VG 36483A	A4	6177				
WN 310820A	A	1030	2093	16	63	
WN 321620A	A	2060	4186	16	63	
WN 32163A	A	2100	4136	16	63	
WNH 31601A	A	1600	3121	16	63	
WU 32553A	A	2540	4924	16	63	
WU 33205A	A	3240	6280	16	63	
SHD 2030	M	27	820	4	17	
SHD 2020	R	21	820	2	26	

Model	Type	Cap	Cyls	Hds	SpT	Notes
SHD 2021	R	23	820	2	28	
SHD 2040	R	42	820	4	26	
SHD 2041	R	47	820	4	28	
SHD 3101A	R	105	641	8	40	
PLS 30854S	S	850				
PLS 31084S	S	1080	2093	16	63	
PLS 31274S	S-2	1273	3844	5	72-132	
SHD 3202	S	212	1376	7	43	
SHD 3210S	S	212	1376	7	43	
SHD 3272S	S-2F	545		4		

SHD 30280A/30420A/30560A

Single:	C/D In
Master:	C/D, DsP In
Slave:	C/D, DsP out

3101A/3061A/3062A

Single:	CD,ACT On
Master:	CD,DSP On
Slave:	None

3121A/3122A

Single:	CD
Master:	CD,DSP
Slave:	None

PLS 31274A/30854A, Wuxxxx3A

Single:	C/D
Master:	C/D
Slave:	None

WA, VGxxxx2A

Single:	Master
Master:	Master
Slave:	Slave

VG, VA, SV, SW, Wuxxxx5A

Single:	MA
Master:	MA
Slave:	SL

Saratoga

See *Areal* and *Disctec*

Saturae Corp

Model	Type	Cap	Cyls	Hds	SpT	Notes
Edge 1000r	S-2F	1050	2570	14	57	DEC DSP 3105
ProLine 1910hz	S	2000	2255	19	76-96	HP C 3010

Seagate

www.seagate.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
ST 1057A	A	53	1024	6	17	Try 940 x 3 x 34
ST 1090A	A	79	536	10	29	CDC 94354-90
ST 1102A	A	85	1024	10	17	ST 1144 Family
ST 1111A	A	99	538	10	36	CDC 94354-111
ST 1126A	A	111	536	14	29	CDC 94354-126
ST 1133A	A	117	636	10	36	CDC 94354-133
ST 1144A	A	131	1001	15	17	Also 1024 x 14 x 17
ST 1156A	A	138	536	14	36	CDC 94354-155
ST 1162A	A	143	804	12	29	CDC 94354-160
ST 1186A	A	164	636	14	36	CDC 94354-186
ST 1201A	A	177	804	12	36	CDC 94354-200
ST 1239A	A	211	954	12	36	CDC 94354-239
ST 125A (-1)	A	21	615	4	17	404 x 4 x 26
ST 1274A	A	23	407	4	26	
ST 138A (-1)	A	32	615	6	17	604 x 4 x 26
ST 1400A	A	332	1018	12	53	ST 1480 Family
ST 1401A	A	344	726	15	61	ST 1480 Family
ST 1480A	A	426	895	15	62	1475 x 9 x 54-85
ST 157A (-1)	A	43	733	7	17	Try 1024 x 5 x 17
ST 2140A	A	140				
ST 2247A	A	226	536	16	55	
ST 2274A	A	241	536	16	55	CDC 94244-274
ST 2383A	A	338	737	16	56	CDC 94244-383
ST 2384A	A	330				
ST 2660A	A	540	1057	16	63R	
ST 274A	A	65	940	8	17	CDC 94204-65/74
ST 280A	A	71	516	10	27	CDC 94204-71/81
ST 3025A	A	21	808	2	26	1616 x 1 x 26
ST 3051A	A	43	820	6	17	ST 3144 Family
ST 3057A	A	40	1024	8	17	940 x 3 x 34
ST 3096A	A	89	1024	10	17	Try 836 x 8 x 26 ST3144 Family
ST 31010A	A2	1082	524	64	63	

Model	Type	Cap	Cyls	Hds	SpT	Notes
ST 31012A	A	1082	524	64	63	
ST 310230A	A4	10200				UDMA 66
ST 310240AG	A4	10200	16383	16	63	Medalist
ST 31060A	A	1065	516	64	63	
ST 31081A	A2	1081	2097	16	63	Cabo 1080 CFS 1081A
			524	64	63	Large
ST 31082A	A	1082	524	64	63	
ST 3120A	A	106	1024	12	17	ST 3144 Family
ST 31210A	A	1080	611	64	63	
ST 31220A	A	1080	2099	16	63	Medalist 1080
			524	64	63	Large
ST 3123A	A	106	1024	12	17	Try 905 x 9 x 25
ST 31270A	A	1200	2485	16	63	621 x 64 x 63 Large
ST 31274A	A	1279	619	64	63	
ST 31275A	A	1275	619	64	63	
ST 31276A	A2	1276	2482	16	63	Cabo 1276
			620	64	63	Large
ST 31277A	A2	1281	620	64	63	
ST 313021A	A4	13000				UDMA 66
ST 313640A	A4	13600				UDMA 66
ST 3144A	A	130	1001	15	17	ST 3144 Family
ST 3145A	A	130	1001	15	17	
ST 31621A	A2	1621	786	64	63	Cabo 1621
ST 31640A	A	1640	3150	16	63	787 x 64 x 63 Large
ST 31720A	A	1720	3305	16	63	
			826	64	63	Large
ST 31721A	A2	1704	825	64	63	
ST 31722A	A	1704	825	64	63	
ST 317221A	A4	17200				5400 RPM U66
ST 317242A	A4	17200				5400 RPM UDMA 66
ST 3195A	A	170	981	10	34	
ST 3211A	A	213	685	16	38	
ST 32110A	A	2111	1023	64	63	
ST 32120A	A2	2111	1023	64	63	
ST 32122A	A	2113	1023	64	63	
ST 32132A	A3	2113	4096	16	63	
			1023	64	63	Large
ST 32140A	A2	2140	4096	16	63	Med 2140
			1024	64	63	Large
ST 32161A	A	2147	1023	64	63	
ST 3240A	A	210	1010	12	34	
ST 3243A	A	214	1024	12	34	Try 683 x 16 x 38
ST 325A (/X)	A	21	615	4	17	697 x 2 x 30 AT/XT
ST 3250A	A	213	1024	12	34	Medalist 210xe
ST 32520A	A	2530	611	128	63	
ST 32530A	A2	2530	611	128	63	Medalist 2530
ST 32531A	A2	2557	619	128	63	
ST 32532A	A	2557	619	128	63	

Model	Type	Cap	Cyls	Hds	SpT	Notes
ST 3270A	A	271	600	14	63	
ST 3271A	A	265	977	10	53	
ST 328040A	A4	28500				UDMA 66
ST 3283A	A	245	978	14	35	ST 3550 Family
ST 3290A	A	260	1001	15	34	
ST 3291A	A	272	761	14	50	
ST 3295A	A	260	761	14	50	Medalist 275xe
ST 33220A	A	3227	781	128	63	
ST 33221A	A	3227	781	128	63	
ST 33230A	A2	3227	781	128	63	
ST 33232A	A	3227	781	128	63	
ST 33240A	A	3200	781	128	63	Large
ST 33440A	A	3400				Medalist 3340 Fast ATA-2
ST 3385A	A	340	767	14	62	
ST 3390A	A	340	768	14	62	Superseded by ST 3391A
ST 3391A	A	341	768	14	62	Supersedes ST 3390A
ST 3420A	A	427	826	16	63	
ST 3425A	A	425	839	16	62	
ST 34250A	A2F	4250				Medalist 4250
ST 34321A	A	4303	555	240	63	
ST 34340A	A2	4303	555	240	63	
ST 34342A	A3	4300	555	240	63	4500 RPM Medalist
ST 34520A	A	4500	588	240	63	
ST 3491A	A	428	899	15	62	Medalist 420xe
ST 3500A	A	426	895	15	62	ST 3550 Family
ST 35040A	A2	5008	647	240	63	
ST 351A (/X)	A	42	820	6	17	AT/XT Also 980 x 5 x 17
ST 35130A	A		661	240	63	
ST 3541A	A	540	524	32	63	Cabo
ST 352A (/X)	A	43	980	5	17	AT/XT Try 977 x 5 x 17
ST 3543A	A	542	525	32	63	
ST 3544A	A	541	524	32	63	
ST 3550A	A	452	1018	14	62	Medalist 455
ST 3600A	A	528	1024	16	63	1872 x 7 x 53-88
ST 3630A	A2F	631	1223	16	63	Medalist 630
			611	32	63	Large
ST 3635A	A	635	619	32	63	
ST 3636A	A	640	620	32	63	
ST 36423A	A4	6448	13328	15	63	Medalist 6423
ST 36450A	A	6400	833	240	63	Large
ST 36451A	A	6400	833	240	63	Upgraded to ST 36530A
ST 36530A	A	6400	841	240	63	Upgraded ST 36451A 7200 RPM
ST 36531A	A	6400	840	240	63	Replaces ST 36451A 128K cache
ST 36540A	A		840	240	63	
ST 3655A	A	527	1024	16	63	Medalist 350
ST 3660A	A	540	1057	16	63	Medalist 545xe
			699	32	63	Large
ST 3780A	A	722	1399	16	63	Medalist 720

Model	Type	Cap	Cyls	Hds	SpT	Notes
			699	32	63	Large
ST 38420A	A4	8400				UDMA 66
ST 3850A	A2F	850	1648	16	63	Medalist
			824	32	63	Large
ST 3851A	A	851	825	32	63	Cabo
ST 3852A	A		826	32	63	
ST 3853A	A		826	32	63	
ST 38641A	A4	8197	1023	256	63	
ST 39140A	A4	8683	1023	256	63	
ST 500A	A	426	895	15	62	
ST 51080A	A	1034	2100	16	63	Mode 4 Medalist SL
			525	64	63	Large
ST 51270A	A2F	1223	2485	16	63	Medalist SL
			621	64	63	Large
ST 52160A	A		1023	64	63	
ST 52520A	A	2560	4978	16	63	Medalist
			621	128	63	Large
ST 5540A	A	517	1050	16	63	
			525	32	63	Large
ST 5660A	A	545	1057	16	63	Decathlon 545
			528	32	63	
ST 5850A	A	854	1656	16	63	Try 828 x 32 x 63
			828	32	63	
ST 5851A	A	1034	828	32	63	
ST 7050A	A	42	976	4	21	
ST 9025A	A	21	1024	4	17	Try 654 x 2 x 32
ST 9038A	A	32		2		
ST 9051A	A	42	820	6	17	Try 654 x 4 x 32
ST 9052A	A	42	980	5	17	ST 9144 Family
ST 9077A	A	64	669	11	17	
ST 9080A	A	64	823	4	38	ST 9235 Family
ST 9096A	A	85	980	10	17	ST 9144 Family
ST 9100A(G)	A	85	748	14	16	ST 9295 Family
ST 91080A	A3	1083	525	64	63	
ST 91350AG	A3	1350	654	64	63	
ST 9140A(G)	A	127	980	15	17	
ST 91420A	A3	1441	694	64	63	
ST 91430AG	A3	1449	702	64	63	
ST 9144A(G)	A	127	980	15	17	Laptops
ST 9145A(G)	A	127	980	15	17	
ST 9150AG	A	131	419	13	47	Marathon 130sl
			873	16	24	Large
ST 91685AG	A	1680	814	64	63	
ST 9190A(G)	A	171	873	16	24	Marathon 170sl
ST 9195A(G)	A	170	800	13	32	
ST 92080A	A	64	823	4	38	
ST 92120AG	A		1050	64	63	
ST 92130AG	A3	2163	523	128	63	

Model	Type	Cap	Cyls	Hds	SpT	Notes
ST 92255AG	A	2250	545	128	63	
ST 9235A(G)	A	209	985	13	32	Laptops
ST 9240AG	A	210	988	8	52	Marathon 210sl
ST 9295AG	A	261	569	15	60	
ST 9300AG	A	262	569	15	60	Marathon 260sl
ST 93230AG	A		788	128	63	
ST 9342A	A	345	667	16	63	
ST 9352A	A	350	905	12	63	
ST 9385AG	A	340	934	14	51	Marathon 340
ST 94030AG	A		993	128	63	
ST 9420AG	A	421	988	16	52	
ST 9422A	A	421	818	16	63	
ST 9546AG	A	520	523	32	63	
ST 9550AG	A	455	942	16	59	Marathon 455
ST 9655AG	A	524	1016	16	63	Marathon 520
ST 9810AG	A	811	786	32	63	
ST 9816AG	A2	810	1571	16	63	2.5” Marathon 810
			785	32	63	Large
ST 9840AG	A3	840	814	32	63	
ST 1111E	E	99	1072	5	36	CDC 94356-111
ST 1156E	E	138	1072	7	36	CDC 94356-155
ST 1182E	E	161	972	9	36	
ST 1201E	E	178	1072	9	36	CDC 94356-200
ST 2106E	E	89	1024	5	34	10 Mhz CDC 94216-106
ST 2160E	E	85	1024	5	34	
ST 2182E	E	160	1453	4	54	15 Mhz CDC 94246-182
ST 2383E	E	338	1747	7	54	15 Mhz CDC 94246-383
ST 41650E	E	1420	2107	15	Z	
ST 4182E	E	152	969	9	34	10 Mhz CDC 94166-182
ST 4192E	E	169	1147	8	36	
ST 4383E	E	319	1412	13	34	10 Mhz CDC 94186-383
ST 4384E	E	319	1224	15	34	10 Mhz CDC 94186-383H
ST 4442E	E	368	1412	15	34	10 Mhz CDC 94186-442
ST 4766E	E	664	1632	15	53	15 Mhz CDC 94196-766
ST 4767ES	E	676	1399	15	63	24 Mhz
ST 4769ES	E	631	1552	15	53	24 Mhz
ST 41201K	I	1200	2101	17	Z	CDC 97509-12G
ST 41800K	I	1800	2627	26	138	
ST 43200K	I2	3385	2627	20	161-240	
ST 6515K	I	576	711	24		
ST 6516K	I	516	711	24		
ST 6545K	I	516	711	24		
ST 8100K	I	100	1-992	1-32	1-256	Solid State
ST 81154K	I	1154	1635	14	197	CDC 97229-1150
ST 81236K	I	1056	1635	15	83	CDC 97209-12G
ST 8134K	I	134	1-992	1-32	1-256	Solid State
ST 8135K	I	134	1-992	1-32	1-256	Solid State
ST 8167K	I	167	1-992	1-32	1-256	Solid State

Model	Type	Cap	Cyls	Hds	SpT	Notes
ST 8201K	I	201	1-992	1-32	1-256	Solid State
ST 82030K	I	2030	2120	19	83	
ST 82105K	I	2105	2611	16	78	CDC 97289-21G
ST 82272K	I					CDC 97200-23G
ST 82368K	I	2368	2611	18	86	CDC 97299-23G
ST 82500K	I	2140	2611	19	83	CDC 97209-25G
ST 8268K	I	288	1-992	1-32	1-256	Solid State
ST 83050	I	3050	2655	18	212	
ST 83220K	I	3220	2655	19	106	
ST 833K	I	33	1-992	1-32	1-256	Solid State
ST 8335K	I	335	1-992	1-32	1-256	Solid State
ST 8402K	I	402	1-992	1-32	1-256	Solid State
ST 867K	I	67	1-992	1-32	1-256	Solid State
ST 868K	I	67	1-992	1-32	1-256	Solid State
ST 8851K	I	727	1381	15	Z	CDC 97209-850
SG 10B	M	10	305	4	17	
SG 15C	M	15	305	6	17	
SG 5A	M	5	152	4	17	
SG 5B	M	5	305	2	17	
ST 1100	M	83	1072	9	17	CDC 94355-100
ST 124	M	21	615	4	17	
ST 125 (-1)	M/R	21/32	615	4	17/26	
ST 138 (-1)	M	32	615	6	17	
ST 151	M/R	42/65	977	5	17/26	
ST 206	M	5	306	2	17	
ST 212	M/R	10/16	306	4	17/26	
ST 213	M/R	10/16	615	2	17/26	
ST 225	M	21	615	4	17	
ST 238	M	21	615	4	17	
ST 251 (-1)	M	42	820	6	17	
ST 252	M	42	820	6	17	
ST 253	M	43	989	5	17	CDC 94205-51
ST 3212	M	10	612	2	17	
ST 4026	M/R	21/32	615	4	17/26	High Performance
ST 4030	M	31	733	5	17	
ST 4037	M	30	733	5	17	
ST 4038 (M)	M/R	31/48	733	5	17/26	High Performance
ST 4051	M/R	42/65	977	5	17/26	High Performance
ST 4053	M	44	1024	5	17	IBM PS/280
ST 406	M/R	5/8	306	2	17/26	
ST 4068	M	72	925	9	17	
ST 4085(p)	M	71	1024	8	17	CDC 94155-85
ST 4086(p)	M	72	925	9	17	CDC 94155-86
ST 4096	M/R	80/122	1024	9	17/26	High Performance
ST 4097(p)	M	80	1024	9	17	CDC 94155-96(p)
ST 412	M/R	10/16	306	4	17/26	Rebadged as IBM for XT
ST 419	M/R	15/24	306	6	17/26	
ST 425	M	21	306	8	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
ST 506	M/R	5/8	153	4	17/26	Unbuffered seek
ST 706	M	5	306	2	17	
ST 7050P	P3	43	580	9	16	ST 7000 family
ST 71P(5)	P2	1.8				Solid State Flashdrive
ST 710P(A)(5)	P2	10				Solid State Flashdrive
ST 720P(A)(5)	P2	21				Solid State Flashdrive
ST 72P(A)(5)	P2	3				Solid State Flashdrive
ST 740P(A)(5)	P2	42				Solid State Flashdrive
ST 75P(A)(5)	P2	5				Solid State Flashdrive
ST 910AC	P2	10				Solid State Flashdrive
ST 92AC	P2	3				Solid State Flashdrive
ST 920AC	P2	21				Solid State Flashdrive
ST 95AC	P2	5				Solid State Flashdrive
ST 1106R	R	91	977	7	26	
ST 1150R	R	128	1072	9	26	CDC 94355-150
ST 1156R	R	138	1072	7	36	CDC 94355-156
ST 137R	R	33	615	4	26	
ST 138R (-1)	R	32	615	4	26	
ST 157R (-1)	R	49	615	6	26	
ST 225R	R	21	667	2	31	
ST 238R	R	32	615	4	26	
ST 250R	R	42	667	4	31	
ST 251R	R	43	820	4	26	
ST 277R (-1)	R	65	820	6	26	ST 251 Family
ST 278R	R	65	820	6	26	
ST 279R	R	65	989	5	26	CDC 94205-77
ST 4077R	R	65	1024	5	26	
ST 4135R	R	115	960	9	26	CDC 94155-135
ST 4144R	R	122	1024	9	26	ST 4096 Family
ST 7075	R	65				
ST 7095	R	80				
ST 1057N	S-2	49	1021	3	Z	
ST 1090N	S	79	1068	5	29	CDC 94351-90
ST 1096N	S	84	906	7	26	ST 1144 Family
ST 1102N	S-2	84	965	5	34	
ST 1111N	S	99	1068	5	36	CDC 94351-111
ST 11200N(D)	S-2F	1054	1872	15	73	GCC UltraDrive 1000S
ST 11201N(D)	S-2F	1054	1872	15	73	ST 11200 Family
ST 1126N	S	107	1068	7	29	CDC 94351-126
ST 1133N	S	113	1268	5	36	CDC 94351-133S
ST 1133NS	S	113	1068	5	36	CDC 94351-133S
ST 1144N	S-2	126	2048	7	Z	
ST 1156N(S)	S-2	138	1068	7	36	CDC 94351-155 (S)
ST 1162N	S	138	1068	9	29	CDC 94351-160
ST 11700N(D)	S-2F	1430	2626	13	57-99	ST 12400 Family
ST 11701N(D)	S2FW	1430	2626	13	57-99	ST 12400 Family
ST 11750N(D)	S-2F	1437	2756	11	62-97	Barracuda
ST 11751N(D)	S2FW	1437	2756	11	Z	

Model	Type	Cap	Cyls	Hds	SpT	Notes
ST 118202LW	S-U	18200	6962	24	213	Cheetah
ST 118273(LNW)	S-U	18200	7501	20	237	Barracuda
ST 1186N(S)	S-2	160	1268	7	36	CDC 94351-186(S)
ST 11900N(W)	S-2F	1700	2621	15	83	
ST 11901N	S	1700	2621	15		
ST 11950N(W)	S-2F	1689	2706	15	81	Barracuda
ST 11951N	S-2F	1689	2706	15		Barracuda
ST 1201N(S)	S-2	172	1068	9	35	CDC 94351-200(S)
ST 1239N(S)	S-2	211	1268	9	36	CDC 94351-230(S)
ST 12400N(DW)	S-2F	2100	2621	19	83	
ST 12401N	S-2F	2100	2626	19	83	ST 12400 Family
ST 12450N(DW)	S2FW	1781	2710	9	149	D model no termination
ST 125N(-1)	S	21	407	4	26	
ST 12550N(D)	S-2F	2100	2707	19	81	Barracuda; 7200 RPM
ST 12551N(D)	S2FW	2100	2756	19	62-97	Barracuda 2
ST 138N(-1)	S	32	615	4	26	
ST 1400N	S-2	331	1476	7	62	ST 1480 family
ST 1401N	S-2	338	1100	9	66	ST 1480 Family
ST 14207(N)(W)	S-2F	4295	3999	20	104	
ST 14209(N)(W)	S-3	4295	3999	20	104	
ST 1480N(D,V)	S-2	426	1476	9	62	
ST 1481N(D)	S-2F	426	1476	9	62	ST 1480 Family
ST 150176LW	S-U2	50100				Barracuda 50 7200 RPM
ST 15150N(W)	S2FW	4094	3711	21	107	Barracuda 4 A/V 7200 RPM
ST 15230N	S-2F	4094	3992	19	110	A/V 5400 RPM
ST 157N(-1)	S	49	615	6	26	
ST 1581N(D)	S-2F	525	1476	9	77	ST 1480 Family
ST 177N	S	60	921	5	26	I version made for IBM
ST 1830N	S-2F	702	1325	13	79	
ST 19101N	S-3	9100	6256	16	170	Cheetah 10,033 RPM 20 W
ST 19171N(W)	S2FW	9100	5274	20	168	Barracuda 9 7200 RPM
ST 1950N	S-2F	803	1575	13	76	
ST 1980N(D)	S-2F	860	1730	13	74	ST 11200 Family
ST 2106N(M)	S	91	1022	5	36	CDC 94211-106 M=Mac
ST 2125N(V,M)	S	107	1544	3	45	94211-125 V=Novell
ST 2209N(V,M)	S	179	1544	5	45	CDC 94221-209
ST 224N	S	22	615	2	26	
ST 225N	S	21	615	4	17	
ST 2383N(M)	S	332	1261	7	74	CDC 94241-383 M=Mac
ST 250N	S	45	667	4	17	
ST 2502N(V,M)	S	435	1755	7	69	CDC 94241-502
ST 251N	S	43	820	4	26	818 cyls?
ST 251N-1	S	43	630	4	34	
ST 277N	S	65	820	6	26	ST 251 Family
ST 277N-1	S	65	628	6	34	ST 251 Family
ST 296N	S	84	820	6	34	ST 251 Family
ST 3025N	S-2	21	1616	1	26	
ST 3057N	S-2	49	940	3	34	

Model	Type	Cap	Cyls	Hds	SpT	Notes
ST 3096N	S-2	40	610	3	35	
ST 31051N(W)	S2FW	1060	4176	4	123	Hawk
ST 31055N	S-3	1060	4176	4	123	
ST 31060N	S-2F	1062	2757	8	94	
ST 31080N (WC)	S-2F	1080	3658	6	96	WC = CFP 1080E
ST 31200N(D,C)	S	1063	2700	9	84	
ST 31230N(W)	S-2F	1010	3992	5	103	Hawk 5400 RPM
ST 31231N	S-2F	1060	3992	5	103	
ST 31250N	S-2F	1020	3711	5	107	Barracuda 2LP
ST 3136403LWV	S-U2	36400				Cheetah 36 10000 RPM
ST 3144N	S-2	126	1652	3	ZBR	
ST 318203LW	S-U2	18200				Cheetah 18LP 10,016 RPM
ST 318275SLW	S	8600				7200 RPM
ST 31930N	S-2F	1700	3898	7	121	
ST 32105N	S-2F	2148	3948	10	106	
ST 32107N	S-2F	2147	3999	10	104	
ST 32109N	S-2F	2148	3999	10	104	
ST 32151N(W)	S2FW	2145	4176	8	125	Hawk
ST 32155N	S-3	2047	4176	8	125	Hawk 2 XL
ST 32171N(W)	S-3	2150	5178	5	163	Barracuda 4LP
ST 32271N	S-3	2260	5178	5	170	
ST 32272N	S-3	3250	6311	4	175	
ST 32430N(W)	S-2F	2147	3992	9	116	A/V
ST 325N	S	21	654	2	32	
ST 32550N(W)	S2FW	2041	3510	11	108	Barracuda 4LP A/V 68 pin 7200
ST 3283N	S-2F	248	1689	5	57	ST 3550 Family
ST 3285N	S	249	1689	3	57	
ST 3390N	S	344	2676	3	83	
ST 34217	S-3					Cozume 1
ST 34371N(W)	S-3	4320	5178	10	164	Barracuda 4LP
ST 34501N	S-3	4550	6526	8	170	Also 9100 Mb Cheetah
ST 34502LW	S		6962	6	212	
ST 34520(N)(W)	S		9006	4	246	
ST 34555(N)(W)	S		6311	8	176	
ST 34571N	S-3	4550	5178	10	171	
ST 34572N	S-3	6500	6311	8	176	
ST 34573(N)(W)	S		7501	5	237	
ST 3500N(D)	S-2F	426	1547	7	76	
ST 3550N	S-2F	456	2126	5	83	
ST 3600N	S-2F	525	1872	7	76	Try 1872 x 7 x 79
ST 3610N(D)	S-2F	535	1872	7	79	ST 3600 Family
ST 3620N(N,C)	S-2F	551	2700	5	78	
ST 36530(L)(N)(W)	S		9006	6	234	
ST 3655N	S	545	2393	5	89	
ST 39102LW	S-U2	9100	6962	12	212	Cheetah
ST 319103LW	S	8600				Cheetah 10025 RPM
ST 39140(N)(W)	S		9006	8	246	
ST 39173LW	S-U2	9100	7520	5	236	Barracuda

Model	Type	Cap	Cyls	Hds	SpT	Notes
ST 39173(N)(W)	S		7501	10	237	
ST 39175LW	S	8600				Barracuda 7200 RPM
ST 4051N	S	103	977	5	42	
ST 4077N	S	87	1024	5	26	
ST 4096N	S	84	1147	4	42	
ST 410800N(W)	S-2F	8669	4925	14	133	A/V Elite 9 5400 RPM
ST 41200NDVM	S-2	1035	1931	15	71	94601-12G/Tricord SD 1200
ST 41250N	S	1550	2098	17	74	
ST 4144N	S	122	1024	9	26	
ST 41520N(D)	S-2	1352	2098	17	74	CDC 97501-12G
ST 41600N	S	1370	2098	17	74	CDC 97501-16G
ST 41601N(D)	S-2F	1370	2098	17	74	CDC 97501-16G
ST 41650N(D)	S-2	1415	2107	15	87	
ST 41651N(D)	S-2F	1415	2107	15	87	
ST 4182N(M)	S	155	969	9	35	CDC 94161-182 M=Mac
ST 4192N	S	168	1147	8	36	
ST 42000N(D)	S	1792	2624	16	83	
ST 42100N(D)	S-2F	1900	2573	15	96	
ST 42101N	S2FW	1900	2573	15	96	
ST 423451N	S-2F	23400	6876	28	237	Elite 23
ST 42400N(D)	S-2F	2129	2624	19	83	FWB Hammer 2000FMF
ST 43400N(D)	S-2F	2916	2735	21	99	
ST 43401N(D)	S2FW	2916	2735	21	99	
ST 43402N(D)	S2FW	2916	2735	21	99	
ST 4350N(M)	S	307	1412	9	46	94171-350/M M=Mac
ST 4356N	S	311	1430	9	Z	
ST 4376NDMV	S	330	1549	9	45	94171-376/M M=Mac
ST 4385N(DM)	S	330	791	15	55	94181-385H/Tricord SD 385
ST 446452	S		9996	28	328	
ST 4702N(DM)	S	601	1546	15	50	94181-702/Tricord SD 702
ST 4766N(DM)	S	676	1632	15	54	CDC 94191-766 M=Mac
ST 4767N(DM)	S-2	665	1356	15	63	94601-767H/M M=Mac
ST 51080N	S-2F	1080	4826	4	109	Physical A/V Med 1080
ST 52160WC(N)	S-3	2170	6536	4	161	
ST 5660N	S-2F	545	3002	4	88	
ST 5767ND	S	676	1356	15		
ST 81236N	S	1049	1635	15	83	CDC 97201-12G
ST 82500N	S	2140	2611	19	Z	CDC 97201-25G
ST 8368N	S	316	1217	10	60	CDC 97201-368
ST 8500N	S	378	1217	10	82	CDC 97201-500
ST 8741N	S	637	1635	15	Z	CDC 97201-736
ST 8851N	S	851	1381	15	Z	CDC 97201-850
ST 9096N	S-2	85		4		
ST 9144N	S-2	128	1024	16	63	
ST 9235N	S	209	985	13	32	
ST 9252N	S	252	1339	6	61	
ST 9259N	S	251				Never produced
ST 41097J	SMD	1097	2101	17	Z	

Model	Type	Cap	Cyls	Hds	SpT	Notes
ST 41201J	SMD	1200	2101	17	Z	CDC 97500-12G
ST 6165J	SMD	165	823	10	Z	CDC 97150-160
ST 6315J	SMDE	315	823	19	Z	CDC 97150-300
ST 6344J	SMDE	344	711	24	Z	CDC 97150-340
ST 6515J	SMDE	344	711	24	Z	CDC 97150-500
ST 6516J	SMD	344	711	24	Z	CDC 97150-500
ST 683J	SMD	83	823	5	Z	CDC 97100-80
ST 81123J	SMDE	1123	1635	15	76	CDC 97200-1123
ST 81236J	SMDE	1056	1635	15	83	CDC 97200-12G
ST 82030J	SMD	2030	2120	19	83	
ST 82038J	SMD	2038	2611	19	68	
ST 82272J	SMDE	2272	2611	19	86	CDC 97200-270
ST 82500J	SMDE	2140	2611	19	83	CDC 97200-25G
ST 83073J	SMD	3073	2655	19		
ST 8368J	SMDE	316	1217	10	60	CDC 97200-368
ST 8500J	SMDE	378	1217	10	82	CDC 97200-500
ST 8741J	SMDE	736	1635	15	60	CDC 97200-736
ST 8851J	SMDE	851	1381	15	82	CDC 97200-850

Seagate Drive Nos

1st — Form factor

1	3.5" HH
2	5" HH
3	3.5" 1"
4	5" FH
6	9"
7	1.8"
8	8"
9	2.5"

2nd/3rd — Unformatted Capacity

Letter	*Interface*
A	ATA
AG	ATA +Shock
C	SCSI Wide
D	Differential SCSI
E	ESDI
J	SMD/SME-E
K	IPI-2
N	Narrow SCSI
NM	SCSI Mac
NV	SCSI NetWare
P	PCMCIA
R	RLL
S	Synchronous SCSI
W	Wide SCSI
X	XT IDE
0	Standard Access
1	Faster Access

Power requirements

On early Elite drives, +5 should not fall below +4.85.

ST 3600A, 3500A

Single:	J5-A in
Master:	J5-B in
Slave:	J5-AB out

With 2x3 style J6 on right side near rear

A=vertical (pins 9&10).
B=horizontal (8&10)

With 2x2 style J6 on right side near rear

A=1-2
B=3-4

1-2 are at rear of drive

ST 1090A, 1111A, 1126A, 133A, 1156A, 1162A, 1186A, 1201A, 1239A

Single:	1 open
Master:	1 open, 3 closed
Slave:	1 closed

ST125A, 138A, 157A

0=open, 1=closed. Read from left, look at back with board down.

	6-pin jumpers	*10-pin*
Single:	1-2	3-4
Master:	1-2, 3-4	3-4, 5-6
Slave:	3-4	None

ST 274A/280A

Jumper nearest AT cable on for Master, off for slave. For 280A, leave other jumper alone if non-C model*. For C model*, other jumper on indicates No Slave, off means Slave present. *There are two models. If you do not have a C after the model no, you can only connect two similar 94204-xx drives. Otherwise you can mix.

ST 3295A, 3660A, 3250A, 3291A, 3391A, 3491A, 3240A

Single:	None (5-6, 7-8 off)
Master:	As above if slave is ATA compatible
	1-2 on if slave without -DASP signal
	5-6 on if slave non-ATA
Slave:	7-8 on (to ATA compatible master)

Cable select is 3-4 (default)

ST 3123A, 3145A, 3195A, 3243A, 3290A

Single:	1-2, 3-4 open
Master:	1-2 open
	3-4 closed
Slave:	1-2 closed

1-2 are at the back

ST 31081A

Single:	1-2
Master:	1-2
Slave:	None
CS	5-6

ST 31276A/32132A

Single:	5-6
Master:	5-6*
Slave:	None

CS: 3-4

32132A - 3-4, 5-6

ST 1057A, 1102A, 1144A

Single:	3-4 closed
Master:	3-4 closed
	5-6 closed
Slave:	3-4 open

1-2 nearest data cable

ST 3051A, 3096A, 3120A, 3144A

Single:	3-4
Master:	3-4, 5-6
Slave:	3-4 open

1-2 are at the back

ST 325A/X, ST 351A/X, ST 352A/X

Pins on side, 1-2 towards front

12-pin version

Single:	1-2, 11-12
Master:	1-2, 3-4, 11-12
Slave:	5-7, 11-12

XT Mode:	7-8
40 Mb:	1-2
30 Mb:	3-4
20 Mb:	1-2, 3-4

18-pin version

Single:	3-4, 11-12, 17-18
Master:	3-4, 5-6, 11-12, 17-18
Slave:	7-8, 11-12, 17-18

XT Mode:	9-10
40 Mb:	3-4
30 Mb:	5-6
20 Mb:	3-4, 5-6

ST 2274A, 2383A

Single:	A, B, E
Master	A, B
Slave:	A (B start delay 20 sec from mstr start).

A is nearest power connector

ST1400A, 1480A

With 2x2 style J6 on right side near rear

Single:	J5 Cin
Master:	J5 C, D in
Slave:	J5 C open

With 2x3 style J6 on right side near rear

A=vertical (pins 9&10).
B=horizontal (8&10)

Single:	J5-A in
Master:	J5-B in
Slave:	J5-AB out

ST 3283A, 3385A, 3390A, 3550A, 3655A

Single:	None
Master:	Pin next to mini pwr closed.
Slave:	Pin away from mini pwr closed.

ST 9051A, 9052A, 9080A, 9077A, 9096A 9100AG, 9140AG, 9144A, 9145A, 9150AG 9190AG, 9235AG, 9240AG, 9300AG 9385AG, 9550AG, 9655AG

Single:	None
Master:	Pin next AT cable On
Slave:	Pins away from AT cable on.

ST 3780A/31220A

Type A

14 pins outside of drive. 1-2 at rear

Single:	None
Master:	3-4 (J5)
Slave:	1-2 (J5)

Type B

4 pins at rear on left

Single:	None
Master:	Pin nearest AT connector on
Slave:	Pin away from AT connector on

ST 31720A

Single:	5-6
Master:	3-4, 5-6
Slave:	None

ST 5540A/5851A/51080A/51270A

Single:	None
Master:	3-4
Slave:	1-2

CS=9-10
If mstr wants 30 secs for slave, 3-4/5-6

ST 5660A/5850A

Single:	J8 1-2, 3-4 open
Master:	J8 3-4 On
Slave:	J8 1-2 On

34-33 closed for 1024 cyls.
J8 is at front of drive.

ST 9420A

Single:	None
Master:	Pin nearest AT connector on
Slave:	Pin away from AT connector on

ST 41200N/4385N/4702N

ID	*3*	*4*	*5*
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

ST 12550N

J01

1-2	On	Term pwr Address
3-4	Off	

J04

1-2	Spindle sync connector
3-4	Init SDTR msg at power on and reset
5-6	Remote LED
7-8	Write Protect
9-10	Delayed Motor Start Disabled
11-12	Spin Up with Start Unit Comd
13-14	Parity Checking
15-16	Reserved
17-18	Address 1
19-20	Address 2
21-22	Address 3

ST 19101W (Cheetah)

J5 (Rear)

1-2	SCSI ID
3-4	SCSI ID
5-6	SCSI ID
7-8	SCSI ID
10	GND
11	+5v

J2 (Side)

1 (RHS)	Term Power from A drive*
2	Term Power from B drive*
3	Reserved
4	Parity disable
5	Write protect
6	Motor Start
7	Start delay
8	Enable T-Res (W model only)

* Use bottom pins of 1&2 for supply from Bus. ½ not used on WC model. Use external active termination for WD drives.

J6 (Front)

1-2	ID1
3-4	ID2
5-6	ID4
7-8	ID8
9-10	Reserved
11	+5v
13-14	Remote LED
15-16	Always Off
17-18	Always Off
19-20	Always Off
21-22	Always On

Sequel

See also Maxtor, possibly Quantum. Bought Maxtor's LXT/XT drives.
See DEC for jumper settings

Model	Type	Cap	Cyls	Hds	SpT	Notes
SEQ 4125EXT	E	113	1224	7	54	
SEQ 4170E	E	158	1224	7	36	
SEQ 4175EXT	E	149	1224	7	34	
SEQ 4230E	E	203	1224	9	36	
SEQ 4280EXT	E	230	1224	11	34	
SEQ 4380E	E	338	1224	15	36	
SEQ 4380EXT	E	319	1224	15	36	
SEQ 1050	M	38	902	5	17	
SEQ 1065	M	54	918	7	33	
SEQ 1085	M	71	1024	8	17	
SEQ 1105	M	85	918	11	33	
SEQ 1140	M	120	918	15	17	
SEQ 2085	M	72	1224	7	33	
SEQ 2140	M	113	1224	11	33	
SEQ 2190	M	155	1224	15	33	
SEQ 1120R	R	105	1024	8	25	
SEQ 1240R	R	197	1024	15	25	
SEQ 4170S	S	158	1224	7	36	
SEQ 4380S	S	338	1224	15	36	
SEQ 5300S	S-2F	3000	3055	21	80	DEC DSP
SEQ 5350S	S-2F	3572	3055	25	80	DEC DSP
SEQ 5400S(W)	S-2FW	4000	3055	26	80	DEC DSP

Shinwa

Model	Type	Cap	Cyls	Hds	SpT	Notes
D 220	M	20	614	4	17	

Shugart

No longer making hard drives.

Model	Type	Cap	Cyls	Hds	SpT	Notes
1002	S1000	4	256	2	17	MFM
1004	S1000	8	256	4	17	MFM
1006	S1000	30			17	MFM
4004	S1000	14			17	MFM
4008	S1000	29			17	MFM
4100	S1000	56			17	MFM
SA 1002	SA	5	256	2	20	MFM
SA 1004	SA	1	256	4	2	MFM

Model	Type	Cap	Cyls	Hds	SpT	Notes
SA 602	M	2	160	2	17	
SA 604	M/R	5/8	160	4	17/26	159 cyls?
SA 605	M	5	160	4	17	
SA 606	M/R	8/12	160	6	17/26	159 cyls?
SA 607	M	5	311	2	17	306 cyls?
SA 612	M/R	11/16	311	4	17/26	
SA 706	M	5	306	2	17	320 cyls?
SA 712	M	11	306	4	17	320 cyls?
SA 724	M	20	640	4	17	
SA 725	M	20	615	4	17	

Siemens

Microscience connection?

Model	Type	Cap	Cyls	Hds	SpT	Notes
1100	E	83	1216	4	32	
1200i	E	156	1216	8	32	Megafile
1300	E	234	1216	12	32	Megafile
2200	E	74	1216	8	32	
2300	E	61	1216	2	32	
4410	E	334	1100	11	54	Megafile
5710	E	655	1478	15	54	
5720	E	655	1478	15	54	SCSI?
5810	E	777	1658	15	54	
2200i	S	156	1216	8	32	ESDI?
2300	S	234	1216	12	32	ESDI?
4420	S	334	1100	11	54	
5720	S	55		15		
5820	S	777	1658	15	54	
6200	S	1200	1658	16	54	
7520	S	655		15	54	

Simple Technology

Model	Type	Cap	Cyls	Hds	SpT	Notes
1.08 Gb	A	1080				2.5"
1.3 Gb	A	1300				2.5"
2.1 Gb	A	2100				2.5"
STI 260HD	P3	260				
STI 340HD	P3	340				

Singapore

Bought Micropolis

Sony

Model	Type	Cap	Cyls	Hds	SpT	Notes
SRD 3040C-50	A	42	822	2	51	Amstrad*
SRD 3080C-50	A	80	964	10	17	Amstrad*
SRD 4080A	A	85				
RMO 5550	S	650				
RMO 5350	S	128				
SRD 2020A	S	20				A=Apple
SRD 2040A-01	S	42	624	4	33	Mac
SRD 3040(A)S	S	42		2		A=Apple
SRD 3080L	S	80				
SRD 4080S	S	85		4		

* Found in Amstrad ALT 386SX portable

SRD 2040

1	5-6	***2***	3-4
3	3-4/5-6	***4***	1-2
5	1-2/5-6	***6***	1-2/3-4
7	1-2/3-4/5-6		

Southern Data

Southern Data Systems Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
2290S-40T	E	40				
2290S-80R	E	80				
2290S-130R	E	130				
2290S-150T	E	150				
2290S-190R	E	190				
2290S-300T	E	300				
2290S-34R	E	34				
2290S-90T	E	90				

SPC

Model	Type	Cap	Cyls	Hds	SpT	Notes
Scorecard 44	H	44	753	7	17	MFM

Specialised Systems Technology Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
Stor Stak 780	E	80				
Stor Stak 1650	S	342				
Stor Stak 170	S	70				

Model	Type	Cap	Cyls	Hds	SpT	Notes
Stor Stak 380	S	80				

Sperry

Model	Type	Cap	Cyls	Hds	SpT	Notes
20 Fixed Card	H					Tandon 362 in disguise

Spin Peripherals Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
1.2 GB	S-2	1230	1979	15		Toshiba MK 538FB
Spin 1021	S	1000				
Spin 32151	S	2000				
Spin 4221AV	S	2000				
Spin 34300	S	4000				
Spin 3423AV	S	4000				

Storage Devices

See Storage Dimensions, and Samsung

Storage Dimensions

Maxtor aka Speedstor

Model	Type	Cap	Cyls	Hds	SpT	Notes
AT 155E	E	156	1224	9	36	Maxtor XT 4170E
AT 335E	E	338	1224	15	36	Maxtor XT 4380E
AT 650E	E	651	1632	15	54	Maxtor XT 8760E
PS 155E	E	156	1224	9	36	Maxtor XT 4170E PS/2
PS 335E	E	338	1224	15	36	Maxtor XT 4380E PS/2
AT 120	M	120	918	15	17	Maxtor XT 1140
AT 133	M	133	1024	15	17	
AT 160	M	160	1224	15	17	Maxtor XT 2190
AT 40	M	44	1025	5	17	
AT 70	M	71				
LAN 160	M	159				Lanstor
LAN 320D	M	52				Lanstor
LAN 650D	M	651				Lanstor
AT 100	R	109	1024	8	26	
AT 140	R	142	1024	8	34	
AT 200	R	204	1024	15	26	
AT 100S	S	105		3		
AT 105S	S	105				Speedstor
AT 200S	S	204		7		

Model	Type	Cap	Cyls	Hds	SpT	Notes
AT 1000S	S	1000		15		
AT 155S	S	156	1224	9	36	Maxtor XT 4170S
AT 2640S2	S	651				
AT 320S	S	320	1224	15	36	Maxtor XT 4380S
AT 4320S1	S	320				
AT 4640	S	651				
AT 650S	S	651	1632	15	54	Maxtor XT 8760S
CDASM 1051F	S-2F	1000				
CDASM 2105F	S-2F	2100				
CDASM 400SF	S-2F	4300				
DMH A02W	S2FW	2100				
DMH A04W	S2FW	4300				
DMH B02W	S2FW	2100				
DMH B04W	S2FW	4300				
LAN 1050F	S-2F	1050				
LAN 150S	S	155				
LAN 2101F	S-2F	2101				
LAN 2105F	S-2F	2105				
LAN 21300S2	S	1300				
LAN 2320S	S	326				
LAN 2320S1	S	326				
LAN 2320S1	S	326				
LAN 2640S2	S	653				
LAN 4005	S-2F	4300				
LAN 650S(1)	S	651				
LAN 9000F	S-2F	9000				
MAC B-1000F	S-2F	1050	2570	14	57	DEC DSP 3105
MAC 1-2030F-1	S-2F	2129	2624	19	83	ST 42400N
Macinstor 100	S	101				
Macinstor 1020	S	1020				
Macinstor 195	S	195		7		
Macinstor 195i	S	194				
Macinstor 2040 HC2	S	2040				
Macinstor 325 II/i	S	325				
Macinstor 40	S	40				Mac (Maxtor)
Macinstor 595 II/i	S	594				
Macinstor 650 II/i	S	650				
Macinstor 80	S	80				Mac (Maxtor)
PS 155S	S	156	1224	9	36	Maxtor XT 4170S PS/2
PS 320S	S	320	1224	15	36	Maxtor XT 4380S PS/2
PS 650S	S	651	1632	15	54	Maxtor XT 8760S PS/2
PS 21300S2	S	1303				PS/2
PS 2640S2	S	640				PS/2
PS 41280S4	S	1280				PS/2
PS 41300S2	S	1303				PS/2
PS 41950S4	S	1954				PS/2
PS 42600S4	S	2606				PS/2
PS 4320S1	S	320				PS/2

Model	Type	Cap	Cyls	Hds	SpT	Notes
PS 4640S2	S	640				PS/2
PS 4650S1	S	650				PS/2
PS 4960S3	S	960				PS/2
OS 1000S	S	1000				
OS 200S	S	200				
OS 330S	S	330				
OS 650S	S	650				
SAZ-2610F2	S-2F	1370	2098	17	74	ST 41601N
XS 100S	S	104				Xstor
XS 200S	S	200				
XS 330S	S	330				
XS 1100S1	S	104				
XS 1200SI/2	S	200				
XS 1330S1	S	330				
XS 1400S2	S	400				
XS 1665S1	S	667				
XS 21320S4	S	1320				
XS 21330S2	S	1330				
XS 2200SI	S	200				
XS 2330S1	S	330				
XS 2400S2	S	400				
XS 2660S2	S	660				
XS 2665S	S	667				
XS 2800S4	S	800				
XS 2990S3	S	990				
XS 2600S3	S	600				

Storage Solutions

Model	Type	Cap	Cyls	Hds	SpT	Notes
SSI 1000(EXT)	S-2F	1000				
SSI 2000M	S2FW	2100				
SSI 4400	S2FW	4300				
SSI 5200	S2FW	5200				

Streamlogic Corp

Model	Type	Cap	Cyls	Hds	SpT	Notes
AV 9100	S-2F	9100				
LT/AV 2100	S2FW	2100				
LT/AV 4300	S2FW	4300				

Sumitronics

Model	Type	Cap	Cyls	Hds	SpT	Notes
NP 04	M	55		10	17	
RD 3000	M	10	306	4	17	
RD 4000	M	20	306	8	17	

Sumo Systems

Model	Type	Cap	Cyls	Hds	SpT	Notes
Subsystem 20	S	20				
Subsystem 50	S	50				

Summus Corp

Model	Type	Cap	Cyls	Hds	SpT	Notes
SUM 44100	E	65				
SUM 44600	E	82				
SUM 44600	E	82				
SUM 43000	S	70				
SUM 44100	S	65				
SUM 44600	S	82				
SUM 44900	S	38				

Sun Microsystems Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
104 Mb System	S	104				Sun
327 Mb System	S	327				Sun
654 Mb System	S	654				Sun
669 Mb System	S	669				Sun
71 Mb System	S	71				Sun
911 Mb System	S	911				Sun
1 Gb System	S	1000				Sun

SuperMac Technology Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
XP200	S	200				Mac
XP330	S	330				Mac
XP600	S	600				Mac

SyDOS

Division of Syquest

Model	Type	Cap	Cyls	Hds	SpT	Notes
44/2	S	88				
44e	S	44	1275	2	34	External Cartridge
44i	S	44	1275	2	34	Internal Cartridge
88/2	S	176				
88e	S	88	1774	2	36-52	External Cartridge
88i	S	88	1774	2	49ish	Internal Cartridge

Syquest

support@syquest.com

Model	Type	Cap	Cyls	Hds	SpT	Notes
SQ 105	A	105				
SQ 200	A	200				
SQ 2542A	A	42	985	5	17	
SQ 2543A	A	42				Cartridge
SQ 270	A	270				
SQ 3105A	A	105	841	16	16	Cartridge
SQ 3270A	A	256	1024	16	32	
SQ 225F	M	20	612	4	17	
SQ 306R	M	5	306	2	17	4 hds?
SQ 306RD	M/R	11/16	306	4	17/26	Removeable
SQ 312(RD)	M/R	11/16	615	2	17/26	Remove jumper W3
SQ 315F	M	21	612	4	17	
SQ 319	M/R	11/15	612	2	17/26	
SQ 325(A,F)	M	21	612	4	17	615 cyls Victor BIOS
SQ 330F	M	11	612	2	17	
SQ 338(F)	M	31	615	6	17	612 cyls?
SQ 340AF	M	38	640	6	17	
EZ 135	S-2	135				Removeable
SQ 01	S					ISA 8-Bit Interface
SQ 2543A	S	42				Cartridge
SQ 3105	S	105				Cartridge
SQ 555	S	44	1275	2	34	Cartridge
SQ 5110	S	88	1774	2	48ish	Cartridge
SQ 5200C	S-2	200				
SQ 400	S	44				Cartridge
SQ 800	S	88				Cartridge
SQ 88	S	80				

Sysgen Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
Maxi RD45	C	45		2		Cartridge
HD 40e	S	40				
HD 80e	S	80				

System Industries Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
S 1350	S	320				Sun
S 1350 Model 1	S	320				Sun
S 1350 Model 2	S	640				Sun
S 156QR	S	319				Sun
S 156QR	S	319				Sun
S 157QR	S	639				Sun
S 157QR	S	639				Sun

Systems Peripheral Consultants

Model	Type	Cap	Cyls	Hds	SpT	Notes
LHD 80H	M	119				
LHD 20H	M	22				
LHD 30H	M	33				
LHD 40H	M	44				

Talon

Model	Type	Cap	Cyls	Hds	SpT	Notes
TA 3020A	A	121	739	8	40	
TA 3101A	A	105	641	8	40	

Tandon

Model	Type	Cap	Cyls	Hds	SpT	Notes
TV 2009	A	110	1001	15	17	ST 1144A
MK 134F	M		733	7	17	
MKM 3114	M	40	733	7	17	
TM 251	M	5	306	2	17	
TM 252	M/R	11/16	306	4	17/26	
TM 253	M	30	695	5	17	
TM 261	M	10	615	2	17	
TM 262	M/R	21/32	615	4	17/26	
TM 270	M	71	1024	8	17	

Model	Type	Cap	Cyls	Hds	SpT	Notes
TM 3085	M	71	1024	8	17	
TM 344	M	27	780	4	17	
TM 346	M	41	780	6	17	
TM 352	M	20	612	4	17	
TM 353	M	10	306	4	17	
TM 361	M	10	615	2	17	
TM 362	M/R	21/32	615	4	17/26	
TM 364	M	27	780	4	17	
TM 383	M	38			17	
TM 501	M/R	5/8	306	2	17/26	
TM 502	M/R	11/16	306	4	17/26	
TM 503	M/R	11/16	306	6	17/26	
TM 6015	M	6	153	2	17	
TM 6025	M/R	5/8	153	4	17/26	
TM 6025E	M	7	230	4	17	
TM 6035	M/R	8/12	153	6	17/26	
TM 6035E	M/R	12/18	230	6	17/26	
TM 702(AT)	M/R	21/32	615	4	17/26	
TM 703(AT)	M/R	32/48	733	5	17/26	
TM 705	M	41	962	5	17	981 cyls?
TM 755	M/R	43/62	981	5	17/26	
TM 775	M	40				
TM 244	R	41	782	4	26	
TM 246	R	62	782	6	26	
TM 262R	R	20	782	2	26	WD 382R
TM 264	R	41	782	4	26	
TM 3085R	R	104	1024	8	26	
TM 344	R	41	782	4	26	
TM 346	R	62	782	6	26	
TM 362R	R	20	782	2	26	
TM 364	R	41	782	4	26	WD 384R
TM 3641	R	41	782	4	26	
TM 702	R	32	615	4	26	
TM 755R	R	65	981	5	26	
TM 2085	S	74	1004	9	26	
TM 2128	S	115	1004	9	26	
TM 2170	S	154	1344	9	36	
TM 270	S	161	1024	8	39	
TM 3085	S	10	1024	8	26	

Tandy

Model	Type	Cap	Cyls	Hds	SpT	Notes
25-1045	A	28				
25-1046	A	43	782	4	27	WD 93044-X 3:1
25-1048	A	40		2		
25-4124	A	52		2		

Model	Type	Cap	Cyls	Hds	SpT	Notes
25-4130	A	105	780	8	32	
?	S	80	823	6		

Tatung

Model	Type	Cap	Cyls	Hds	SpT	Notes
4000		10				

TCP

Model	Type	Cap	Cyls	Hds	SpT	Notes
105 AT	A	105				Quantum?
210AT	A	210				
52AT	A	52				
105S	S	105				
210S	S	210				
52S	S	52				

Teac

Model	Type	Cap	Cyls	Hds	SpT	Notes
SD 240	A	43	1000	2	42	
SD 260	A	63	1226	2	50	
SD 3040EA	A					
SD 3105(A)(H)	A	105	641	8	40	Also 1024 x 5 x 40
SD 3210A	A	215	847	8	62	1024 x 10 x 40
SD 3240	A	245	965	8	62	
SD 3250N-30	A	251	961	16	32	
SD 3360N-30	A	362	791	16	56	
SD 340A-27	A	43	525	4	40	Also 1024 x 2 x 40/977 x 5 x 17
SD 3540N	A	540	1059	16	63	
SD 380H(A)	A	86	525	8	40	Also 1024 x 4 x 40
SD 3240-30	A	240	1930	4	62	
SD 150	M	10	306	4	17	
SD 510-01	M/R	10/16	306	4	17/26	
SD 520(-U)	M/R	21/32	615	4	17/26	
SD 521	M	20	615	4	17	
SD 540	M	40	615	8	17	
OD 3000	O	27				S-2
SD 3105S	S	105	1282	4	40	
SD 3210S	S	215	1695	4	62	
SD 3240-00	S	240				
SD 340S	S	43	1050	2	40	
SD 380(S)(H)	S	41	1050	4	40	

SD 3105/340H/380

Single:	S0, S2, S3 On
Master:	S0, S1, S2, S3 On
Slave:	S0, S1, S3 On

SD 340A-27/3210

Single:	S1, S2, S3
Master:	S1, S2, S3
Slave:	S1, S3

Tecmar

Model	Type	Cap	Cyls	Hds	SpT	Notes
ATHD	M	21	612	4	17	
XTHD	M	10	306	4	17	
60W20	M	21	612	4	17	

Texas Instruments

Model	Type	Cap	Cyls	Hds	SpT	Notes
TI-5	M	5	153	4	17	
525-122	M	10	306	4	17	

Texas ISA

Model	Type	Cap	Cyls	Hds	SpT	Notes
ISA 9101	S-2	1300				
ISA 9102	S-2	2100				

Third Wave Computing

Model	Type	Cap	Cyls	Hds	SpT	Notes
1.2GB	S-2	1079	1658	15	85	Fujitsu MK 2266S-512
2.0GB	S	1662				Fujitsu MK 2265S-512

Time

Model	Type	Cap	Cyls	Hds	SpT	Notes
Smartcrd 100XL	S	100				
Smartcrd 200XL	S	200				
Smartcrd 340XL	S	340				
Smartcard 40XL	S	40				

Tokico

Possible Hitachi connection? Out of business?

Model	Type	Cap	Cyls	Hds	SpT	Notes
DK 503-1	M	5	306	2	17	
DK 503-2	M	10	306	4	17	

Toshiba

Model	Type	Cap	Cyls	Hds	SpT	Notes
DNB 540	A	540				2.5” EIDE
DNB 810	A	814				2.5” EIDE
DNB 135	A	1350				2.5” EIDE
MK 0200MAT	A	270				2.5” EIDE Libretto 20
MK 0803MAT	A	815	1580	16	63	2.5”EIDE Libretto 50/60
MK 1002MAV	A	1060	2100	16	63	12.7mm
MK 1003MAV	A					
MK 1022FC	A	22				Laptops
MK 1034FC	A	107	664	8	39	1339 x 4 x 39 (Unix) 25mm
MK 1122FC	A	43	988	5	17	977 x 2 x 43 17mm
MK 11422 FCV	A	86	988	10	17	
MK 1301MAV	A	1300	2633	16	63	12.7mm
MK 1302MAN	A	1300	2633	16	63	19mm
MK 1401MAN	A	1400	3720	16	63	
MK 1422FCV	A	86	988	10	43	
MK 1522FCV	A	126	812	8	38	12.7mm
MK 1624FCV	A	213	684	16	38	
MK 1701MAN	A	1700	3294	16	63	
MK 1702MAV	A	1700				
MK 1722FCV	A	131	842	8	38	
MK 1724FCV	A	249	842	16	38	63 Sectors?
MK 1824FCV	A2	352	682	16	63	12.7mm
MK 1924FCV	A2	540	1053	16	63	12.7mm
MK 1926FCV	A2	815	1579	16	63	12.7mm
MK 2024FC	A	86	988	10	17	977 x 4 x 43 19mm
MK 2101MAN	A	2100	4200	16	63	19mm
MK 2103MAV	A	2100	4200	16	63	2.5” 12.7mm
MK 2104 MAV	A	2167	4200	16	63	2.5”
MK 2124FC	A	130	934	16	17	1155 x 4 x 55 19mm
MK 2224FC	A	213	684	16	38	Try 995 x 8 x 52 19mm
MK 2326FC(V)(H)	A	340	969	14	49	19mm
MK 234FC(H)	A	101	845	7	35	
MK 2428FC	A	520	1016	16	63	19mm
MK 2526FC	A	528	1023	16	63	
MK 2528FC	A	704	1365	16	63	
MK 2628FC	A	810	1571	16	63	19mm
MK 2720FC	A	1250	2358	16	63	19mm

Model	Type	Cap	Cyls	Hds	SpT	Notes
MK 2728FC	A	1080	1579	8	63	19mm
MK 3003MAN	A	3080	5968	16	63	19mm
MK 3303MAN	A	3300				19mm
MK 4310	A	4300				UDMA 66
MK 6409	A	6400				UDMA 66
MK 153FA	E	74	830	5	35	
MK 154FA	E	104	830	7	35	
MK 156FA	E	145	830	10	35	
MK 250F	E	382	1224	10	35	
MK 350FA	E	765				
MK 353A	E	72				
MK 355FA	E	398	1661	9	53	
MK 358FA	E	676	1661	15	53	15 Mhz
MK 535FA	E	251	1632	9	35	
MKM 0363A/J	E	74	830	5	35	
MKM 0364A/J	E	104	830	7	35	
MK 130	M	50	733	7	17	
MK 132FA	M	18				
MK 133FA	M	30				
MK 134FA(M,R)	M/R	44/65	733	7	17/26	
MK 53F(ABMR)	M/R	36/55	830	5	17/26	ATs—disable J1/2
MK 54F(ABMR)	M/R	50/77	830	7	17/26	ATs—disable J1/2
MK 56F(ABMR)	M/R	72/105	830	10	17/26	
MK 72PC(R)	M/R	72/105	830	10	17/26	
MKM 0351E/J	M	36	830	5	17	
MKM 0352E/J	M	50	830	7	17	
MKM 0353E/J	M	72	830	10	17	
MKM 0381E/J	M	36	830	5	17	
MKM 0382E/J	M	50	830	7	17	
MKM 0383E/J	M	72	830	10	17	
MK 1301MAV	S2FW	1350	2633	16	63	Notebooks
MK 153FB	S	74	830	5	35	
MK 154FB	S	104	830	7	35	
MK 156FB	S	148	830	10	35	
MK 1824FBV	S-2	335	2050	4		12.7mm 4200 RPM
MK 1924FBV	S-2	540	2920	4		12.7mm
MK 1926FBV	S2FW	815	2920	6		12.7mm
MK 2101	S2FW	2160				
MK 2224FB	S	213	1560	4	66	19mm
MK 232FB	S	46	845	3	36	
MK 2326FB	S	340	1830	14	49	19mm
MK 233FB	S	75	845	5	36	
MK 234FB	S	106	845	7	36	
MK 234FBS	SAsync	106	845	7		
MK 2428FB	S-2	520	1920	8	49-83	19mm
MK 250FB	S	215	1224	10	35	
MK 2526FB	S-2F	528	2050			
MK 2528FB	S-2F	704				

Model	Type	Cap	Cyls	Hds	SpT	Notes
MK 2628FB	S-2F	773	2360			19mm
MK 2720FB	S-2FW	1350	2633	26		19mm
MK 2728	S-2F	1080				
MK 350FB	S	675				
MK 355FB	S	398	1632	9	53	
MK 358FB	S	664	1661	15	53	
MK 438FB	S-2	867	1655	15	68	Discontinued
MK 535FB	S	251	1632	9	35	
MK 537FB	S	1060	1979	13		
MK 538FB	S-2	1230	1979	15		
MK 182FB	SMD	83	823	5		
MK 184FB	SMD	116	823	7		
MK 186FB	SMD	166	823	10		
MK 286FC	HSMD	374	823	11		8"
MK 288FC	HSMD	510	823	15		8" 10 Hds?
MK 388FA	HSMD	720	1162	15		8" 10 Hds?

MK 234FC

Single:	5-6
Master:	5-6, 7-8
Slave:	3-4

1-2 (=LED) are furthest from IDE connector.

MK1724FCV, 1824FCV, 1122FC, 2024FC, 2124FC, 2224FC, 2326FC, 2428FC, 2628FC, 1422FCV, 1522FCV, 1722FCV, 2526FC, 2528FC

Single:	J2 open
Master:	J2 open
Slave:	J2 closed

T1200, 3100, 3200, 5100 Debug low level format

```
Debug
A
MOV AX,0703
MOV CX,0001
MOV DX,0080
INT 13
INT 3
<CR>

G=100
```

Tradewinds

Model	Type	Cap	Cyls	Hds	SpT	Notes
PD20-1		20				Removeable
PDH20-1		20				Removeable

Tricord Systems Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
SD 1200	S-2	1035	1931	15	71	ST 41200N
SD 385	S	330	791	15	55	ST 4385N
SD 702	S	601	1546	15	50	ST 4702

Trimarchi Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
Twin Sixes	S	600				Datakeg; Sun

TTP Enterprises Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
MC 80	M	80				

Tulin

No longer making hard drives. CMI connection? (640)

Model	Type	Cap	Cyls	Hds	SpT	Notes
HCPS 120B	A	121	1522	4	39	
HCPS 40B	A	40	1024	2	40	
HJ 510CB	A	509	987	16	63	
HJ 85B	A	85	526	8	39	
HJPS 1000MBH	A	975	1891	16	63	
HJPS 120CB	A	120	1522	4	39	
HJPS 40B	A	40	1024	2	30	
HJPS 85CB	A	85	526	8	39	
HS 85B/M	A	85	526	8	39	
HSPS 85CB	A	85	526	8	39	
TL 213	M	10	640	2	17	
TL 226	M/R	22/34	640	4	17/26	Not on XTs
TL 238	M/R	32/48	640	4	17/26	
TL 240	M/R	33/51	640	6	17/26	
TL 258	M/R	48/72	640	6	17/26	
TL 326	M/R	22/34	640	4	17/26	
TL 338	M/R	32/48	640	4	17/26	

Model	Type	Cap	Cyls	Hds	SpT	Notes
TL 340	M/R	33/51	640	6	17/26	
TL 358	M/R	48/72	640	6	17/26	
TL 640	M	48	640	6	17	
Hermit Crab	S					Mac, External
HJ 1000H	S-2F	1000				
HJ 2000	S	2000				
HJ 2100Q	S-2F	2100				
HJ 520	S	520				
HJ 540Q	S-3F	540				
HJ 730Q	S-3F	730				
HS 240	S	240				
TL 32	S	32				XT, Mac
TL 40	S	40				XT, Mac
TL 48	S	48				XT, Mac
TL 60	S	60				XT, Mac
TL 65	S	65				XT, Mac
TL 105	S	105				
TL 1050	S	1050				
TL 105NQ	S	105				
TL 154	S	154				
TL 200	S	200				
TL 2100	S	2100				
TL 3100	S	3100				
TL 320	S	330				
TL 330	S	330				
TL 340	S	340				
TL 612	S	612				
TL 675	S	675				
TL 84NQ	S	84				XT, Mac
TL 85	S	85				

Unbound Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
SunStor 1.2G	S	1200				Sun
SunStor 100	S	100				Sun
SunStor 200	S	200				Sun
SunStor 250	S	250				Sun
SunStor 380	S	380				Sun
SunStor 500	S	500				Sun
SunStor 760	S	760				Sun

United Peripherals

Rebadged Newbury Data drives, which came from Maxtor.

Unitek Systems Corp

Model	Type	Cap	Cyls	Hds	SpT	Notes
Unicard 20	H	21				MFM

US Design Corporation Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
VIP/F EM1200	E	1200				Sun
VIP/F EM8760	E	760				Sun
VIP/F EMA4380	E	380				Sun
Q STOR 1200X	S	1000				Sun
Q STOR 2000X	S	2000				Sun
Q STOR 380X	S	380				Sun
Q STOR 760X	S	650				Sun
Q K380R	S	380				Sun
Q K760R	S	760				Sun

ValueStor

Model	Type	Cap	Cyls	Hds	SpT	Notes
Mobile SX 1000	S-2	1020				
Mobile SX 540	S-2	540				
Mobile SX 700	S-2	730				
10363-01	Par	1000				
10369-01	Par	850				
10409-01	Par	1600				
Mobile EP 1000	Par	1020				
Mobile EP 540	Par	540				
Mobile EP 700	Par	730				

Vertex

See *Priam/Vertex*

Wang Laboratories Inc

Model	Type	Cap	Cyls	Hds	SpT	Notes
HDD 1001-AT	A	100				
HDD 2001-AT	A	20				
HDD 2002-AT	A	200				
HDD 4001-AT	A	40				
HDD 3211-PC2	E	321				
HDD 4001MC	PS/2	40				

Model	Type	Cap	Cyls	Hds	SpT	Notes
HDD 7601MC	PS/2	70				

Western Digital

1st numeral in model numbers indicates number of platters.

Model	Type	Cap	Cyls	Hds	SpT	Notes
SP 105A	A			14		Piranha
SP 210A	A	210		8		Piranha
SP 2100	A					Piranha
SP 4200	A					Piranha
WD 1410354	A	8400				
WD 1410355	A	6400				
WD 141035B	A	10100				
WD 280A	A	85				
WD 2120A	A	125				
WD 2170A	A	170				
WD 2200A	A	210				
WD 2250A	A	250				
WD 2340A	A	340				
WD 2540	A	540				
WD 273BA	A4	27300				UDMA 66 7200 RPM
WD 307AA-00ANA0	A4	30700				UDMA 66 5400 RPM
WD 36400AB	A	6449				
WD 380A	A	78	1021	4	39	
WD 4250A	A	425				
WD 93020A	A	10	615	2	17	
WD 93024A	A	21	615	4	17	782 x 2 x 27
WD 93028A(D)	A	21	615	4	17	782 x 2 x 27
WD 93042A(D)	A	21	615	4	17	782 x 2 x 27 Centaur
WD 93044A(D)	A	43	977	5	17	782 x 4 x 27
WD 93048A(D)	A	40	977	5	17	782 x 4 x 27
WD 95024A	A	21	615	4	17	782 x 2 x 27
WD 95028A	A	21	782	4	27	
WD 95042A	A	21	615	4	17	782 x 2 x 27 Centaur
WD 95044A	A	42	977	5	17	782 x 4 x 27 Centaur
WD 95048A(D)	A	42	782	4	27	
WD 95049A	A	43	782	4	27	
WD 95038X	A	32	615	6	17	XT In Amstrad 1640
WD 93020X	A	21	612	4	17	
WD 93024X	A	21	782	2	26	XT -X range hardcards
WD 93028X	A	21	782	2	27	XT
WD 93034X	A	32	782	3	27	XT
WD 93038X	A	32	782	3	27	XT
WD 93042X	A	21	615	4	17	XT 782x2x27 Centaur
WD 93044X	A	43	782	4	27	XT Tandy 25-1046
WD 93048X	A	42	977	5	17	XT 782 x 4 x 27
WD 93084X	A	43	782	4	27	XT

Model	Type	Cap	Cyls	Hds	SpT	Notes
WD 95024X	A	21	615	4	17	XT 3:1
WD 95028X	A	20	782	2	27	XT
WD 95034X	A	32	615	6	17	XT
WD 95038X	A	30	782	3	27	XT
WD 95044X	A	42	977	5	17	XT
WD 95048X	A	42	977	5	17	XT
WDAB 130	A	32	512	7	17	Tidbit XT/AT
WDAB 140	A	43	980	5	17	
WDAB 260	A	63	1024	7	17	Tidbit XT/AT
WDAC 11000	A	1056	2046	16	63	
WDAC 11200	A	1281	2484	16	63	
WDAC 11600	A	1624	3148	16	63	
WDAC 1170	A	171	1010	6	55	Caviar
WDAC 1200	A	212	989	12	35	
WDAC 1210	A	212	989	12	35	Caviar
WDAC 12100	A	2111	4092	16	63	
WDAC 1270	A	270	917	12	48	Caviar
WDAC 1365	A	365	708	16	63	
WDAC 140	A	43	980	5	17	Caviar
WDAC 1425	A	426	827	16	63	
WDAC 160	A	62	1024	7	17	Caviar
WDAC 18000D	A3	18000				Expert 7200 RPM
WDAC 21000	A	1033	2100	16	63	
WDAC 2120	A	120	872	8	35	Caviar
WDAC 21200A	A	1282	2484	16	63	CMOS Normal mode
			1242	32	63	CMOS Large mode
			621	64	63	CMOS LBA mode
WDAC 21600	A	1600	3148	16	63	EIDE
WDAC 2170	A	170	1010	6	55	Caviar
WDAC 21700	A	1707	3308	16	63	
WDAC 2200	A	213	989	12	35	Caviar
WDAC 22000	A	2000	3876	16	63	
WDAC 22100	A	2112	4092	16	63	
WDAC 2250	A	256	1010	9	55	Caviar
WDAC 22500	A	2560	4960	16	63	Caviar IBM 76H7236
WDAC 23200	A	3249	6296	16	63	
WDAC 2340	A	341	1010	12	55	Caviar
WDAC 240	A	42	820	4	26	Caviar
WDAC 2420	A	425	989	15	56	Caviar
WDAC 24300	A	4311	8912	15	63	
WDAC 2540	A	516	1048	16	63	Caviar
WDAC 2635	A	610	1240	16	63	Caviar
WDAC 2700	A	697	1416	16	63	Caviar
WDAC 280	A	85	980	10	17	Caviar
WDAC 2850	A	814	1654	16	63	Caviar
WDAC 29100	A4	9100				UDMA 66
WDAC 31000	A	1033	2100	16	63	Rebadged as IBM
WDAC 310100	A	10141	16383	16	63	UDMA 66

Model	Type	Cap	Cyls	Hds	SpT	Notes
WDAC 31200	A	1223	2484	16	63	For CMOS Normal mode
			1242	32	63	For CMOS Large mode
			621	64	63	For CMOS LBA mode
WDAC 313000	A	13000				UDMA 66
WDAC 31600	A	1594	3148	16	63	Normal Compaq type 65
			785	64	63	LBA
WDAC 3210	A	1250				
WDAC 32100A	A	2100	4092	16	63	ATA 3
WDAC 32500A	A	2560	4960	16	63	ATA 3
WDAC 33100	A	3166	6136	16	63	
WDAC 33200	A	3249	6296	16	63	
WDAC 34000	A	4001	7752	16	63	
WDAC 34200	A	4223	8184	16	63	
WDAC 34300	A	4304	8896	15	63	
WDAC 35100	A	5163	10672	15	63	5400 RPM UDMA
WDAC 36400-UD	A	6138	13328	15	63	5400 RPM UDMA
WDAC 38400	A	8455	16383	16	63	
WDAC 418000	A4	17200				UDMA/66
WDAC 420400	A4	20400				UDMA/66
WDAH 2160	A	159				
WDAH 240	A	42		2		Tidbit 2
WDAH 260	A	62	1024	14	17	Tidbit
WDAH 280	A	85	980	10	17	Tidbit 2
WDAL 1100	A	100	958	6	34	
WDAL 185	A	85	980	10	17	
WDAL 2120	A	130	1001	15	17	
WDAL 2170	A	170	980	10	34	Caviar Lite (2.5")
WDAL 2200	A	200	989	12	35	
WDAL 2540	A	540	1048	16	63	
WDAP 2100	A	100	987	6	35	Piranha
WDAP 2120	A	125	872	8	35	Piranha
WDAP 4105	A	105		4		Piranha
WDAP 4200	A	212	987	12	35	Piranha
WD CU 140	A	42	980	5	17	
Filecard 20	H	20	612	4	17	
Filecard 30	H	30	612	4	26	
TM 262	M	20	615	4	17	
TM 362	M	20	615	4	17	
WD 10XSAS	M	10	612	2	17	
WD 20XSAS	M	20	612	4	17	
WD 505	M	10	310	2	17	
WD 562-5	M	20	615	4	17	
PhD 1000	PIDE	1083	2100	16	63	
PhD 1400	PIDE	1440	2792	16	63	
PhD 2100	PIDE	2167	4200	16	63	
WD CU 140	P	42	980	5	17	Caviar Ultralite
WD M1130-44	PS/2	31	920	2	33	44 pin
WD M1130-72	PS/2	30	928	2	32	72 pin

Model	Type	Cap	Cyls	Hds	SpT	Notes
WD MI4120-72	PS/2	125	925	8	33	72 pin
TM 262R	R	20	782	4	26	
TM 362R	R	20	782	4	26	
TM 264R	R	40	782	4	26	
TM 364R	R	40	782	4	26	
WD 344R	R	40	782	4	26	
WD 382R	R	20	782	2	26	Tandon TM 262R
WD 383R	R	30	615	4	26	
WD 384R	R	40	782	4	26	Tandon TM 364
WD 544R	R	40	782	4	26	
WD 582R	R	20	782	2	26	
WD 583R	R	30	615	4	26	
WD 584R	R	40	782	4	26	
20 AP	S	20				Mac, Preference
40 AP	S	40				Mac, Preference
Enterprise 2170	S-3	2170	5956	4	133-225	
Enterprise 4630	S	4300				
HD 910-WA	S	9100				
Piranha 105S	S	105		14		
Piranha 210S	S	210		8		
WD 380SC	S	320				Mac
WD SC8320	S-2	320	949	14	48	Condor; IBM 0661-371
WD SC8400	S-2	400	1199	14	48	Condor; IBM 0661 467
WD SP2100	S-2	106	1265	4	41	
WD SP2400	S	209				
WD SP4105	S	105			4	Piranha
WD SP4200	S-2	209	1280	8	40	
WDE 18300	S-U2	18300				
WDE 18310-005042	U160	18300				Enterprise 10000 RPM
WDE 2170	S-3	2170				7200 RPM
WDE 4360	S-3	4360				7200 RPM
WDE 4550	S-3	4550		6		
WDE 9100	S-3	9100		12		

WDAC 2200

Single:	CP
Master:	MA
Slave:	SL

2540, 2700, 31000

Single:	None
Master:	5-6
Slave:	3-4

Cable select is 1-2
Default is across 3-5 (neutral).

WDAL 2200

Single:	None
Master:	Inside pr
Slave:	Outside pr

Centaur/Caviar/Piranha

6-pin connector

Single:	J8 nil
Master:	J8 5-6 (MA)
Slave:	J8 3-4 (SL)

10-pin connector:

Single:	J8 3-5
Master:	J8 5-6*
Slave:	J8 3-4
CS	J8 1-2

22500-23LA (IBM) J8 3-5
Slave to original Conner CP 342/3022: J8 1-2

WDAC 2120

Single:	Nil
Master:	MA
Slave:	SL

Western Dynex

Possible Western Digital connection?

Model	Type	Cap	Cyls	Hds	SpT	Notes
WD 505	M/R	5/8	310	2	17/26	

Workstation Technologies

See *Adcomp*

Xebec

Out of business

Model	Type	Cap	Cyls	Hds	SpT	Notes
XE 3040	A	40	814	2	48	
XE 3080	A	80	979	4	40	
XE 3100	A	105	979	6	35	
XE 3120	A	120	981	6	40	
XE 4000	M	10	306	4	17	In Amstrad 1512
XE 4020	M	20	615	4	17	
XE 4040X	M	40			17	In Amstrad 1512

Model	Type	Cap	Cyls	Hds	SpT	Notes
OWL I	S	25	733	4	17	MFM recording
OWL II	S	39	1124	4	17	MFM recording
OWL III	S	52	1512	4	17	MFM recording

Y-E Data

Bought C Itoh hard drive division.

Model	Type	Cap	Cyls	Hds	SpT	Notes
YD 3161B	A	45	1057	2	42	
YD 3162B	A	90	1057	4	42	
YD 3530	M	32	731	5	17	
YD 3540	R	42	731	7	17	
YD 3042	R	42	788	4	26	
YD 3081B	S	45	1057	2	42	
YD 3082	S	87	788	8	26	
YD 3082B	S	90	1057	4	42	
YD 3083B	S	136	1057	6	42	
YD 3084B	S	182	1057	8	42	
YD 308XB	S	45	1057	2	42	
YD 3181B	S	45	1057	2	42	
YD 3182B	S	90	1057	4	42	
YD 3541	S	45	731	8	15	

Zentec

Model	Type	Cap	Cyls	Hds	SpT	Notes
ZH 3100A	A	86	924	6	31	
ZH 3140A	A	121	993	7	35	Try 970 x 8 x 31
ZH 3270A	A	239	1124	10	41	
ZH 3380A	A	334	1020	16	40	
ZH 3490A	A	430	1115	16	47	
ZM 3140A	A	124	979	6	41	
ZM 3180	A	170				
ZM 3272	A	252	1994	4		
ZM 3360	A	340				
ZM 3370	A	340	2149	4		
ZM 3480	A	440	2149	6		
ZM 3540	A	518				
ZM 3560	A	510	2149	6		
ZM 3880	A	810				
ZQ 2048	A	42	525	6	26	
ZQ 2096	A	84	880	6	31	
ZQ 2140	A	126	1410	4	52	
ZR 2000A	A	42	525	6	26	
ZR 2040	A	42	976	2	42	
DRACO	S-2F	518	2142	6	Var	

Model	Type	Cap	Cyls	Hds	SpT	Notes
ZH 3100S	S	86				
ZH 3140S	S	121				

ZSI

Model	Type	Cap	Cyls	Hds	SpT	Notes
ZM 3140A	A	126	1540	4	40	
ZQ 2090	A	80				

CD ROM Drives

CD-ROM

CDs are made from highly reflective aluminium foil sandwiched between two plastic layers. There are pits in the foil to reflect 0 or 1 bits which are reflected back from a photo sensor. the technology comes from Laser Disks, originally brought out in Europe.

The CD-ROM drive will play audio CDs or allow you to run programs, although the original intention was just to supply program code on 1 CD rather than 2 dozen floppy disks. It will also be given a drive letter, typically the first one available after your hard drives, usually E. Make sure the drive's indicator lamp is off (it will be on whenever your computer is reading data from the disc), then press the Eject Button to open the disc tray. Holding your CD by its edges, place it in the disk tray with the label upwards, then push the tray to close it.

Never eject the CD tray from the drive, or try to insert or remove a CD from it while the indicator lamp is on.

Never place a CD in direct sunlight or near a source of extreme heat or cold, or you could damage or destroy the information on it.

CLV drives spin slower as the head moves to the outside of the disc to maintain a constant data transfer rate. CAV drives rotate at a constant speed, so the data transfer speed is variable, according to whether your data is on the inside or outside tracks. Audio data is always read at single speed, or 150K/sec. Partial CAV uses CAV only for the outer tracks.

Keys to performance are the quality of the spindle motor, software and head positioning system (access speed), not just rated data transfer speed, although the host PC's capabilites help as well. As drives are read from the inside first, you need data on the outside tracks to get the most benefit. From about 16-speed onwards, this started to be referred to as Max, or MX, meaning under optimum conditions, as opposed to all the time, so if you're loading lots of little files from the inside tracks, a 32-speed drive often fares no better than 8x.

Most ATAPI drives come out of the box set up for Slave; to set up for Master, look for three jumpers on the rear next to the audio connector, with **MA** and **SL** markings.

Acer

CD 612A	12 speed ATAPI	
CD 632A	32 speed ATAPI	Philips
CD 910E	10 speed ATAPI	

Alps

CD changer	4 speed IDE	

Aopen

CD 936E	36 speed ATAPI	Partial CAV UDMA
CRW 9420	CDRW	
DVD 5205	DVD RAM 2x SCSI-2	20x CD Caddy Matsushita
DVD 9632	6x ATAPI	32 x CD read Pioneer
52KMTRP	52x CD	

Apple

CD 300	2 speed SCSI	Sony CDU-561

Asus

CD-S340	34 speed ATAPI	Full CAV
CD-S400	40 speed ATAPI	Full CAV UDMA
CD-S500	50x ATAPI	

Aztech

CDA 1268	12 speed IDE	
Zeta	8 speed IDE	Philips drive

Chase Technology

Disq 6	6 speed external	

Consan

RO 1420C	2/4 W/R SCSI 1/2	Ricoh

Creative Labs

24MX	24 speed Max ATAPI	
Blaster CD 6x	6 speed ATAPI	Philips drive
Blaster CD 8x	8 speed ATAPI	Philips drive
Blaster CD 24x	24 speed ATAPI	Samsung
CD R 4210	2/4 W/R SCSI 1/2	MKE
CDRW 2224E	CDRW 24 speed	2x Write
DVD 5240E	5x ATAPI	32x CD read
DVD 6240E	6x ATAPI	Hitachi
DVD-RAM 1220S	SCSI	
PC DVD Blaster DVD	6x (24x CD)	

CTX

CD54S	54x CD ROM ATAPI	

Diamond

Multimedia 8000	8 speed IDE	Philips drive

Dysan

CRW 1622	CDRW EIDE	

Fujitsu

DynaMO	CDRW SCSI	

GoldStar

GCD R560B	6 speed IDE	
GCD R580B	8 speed IDE	

Hewlett Packard

CD-Writer + 7200	CDRW EIDE	
CD-Writer + 8250I	CDRW ATAPI 4x4x24	
6020es	6/2 W/R SCSI-2	Philips
7100e	6R/2W parallel	Philips
8210I	CDRW 4/4/24	

Hitachi

CDR 7930	8 speed ATAPI	
CDR 8130 16 Max	8-16 speed ATAPI	Partial CAV
CDR 8330 24 Max	24 Speed ATAPI	Full CAV
CDR 8430	32 speed ATAPI	
GD 1000	DVD	
GD 2000	DVD	
GF 1000	DVD RAM ATAPI	
GF 1050	DVD RAM 8x SCSI-2	8x CD Caddy
GD 2500BX	DVD 6xATAPI	20x CD
GD 5000	DVD 8x ATAPI	

Intre Source

SR 8583-B	6x ATAPI	Panasonic

JVC

Archiver Plus	2/4 W/R SCSI-2	
XR W2022	6/2 R/W S-2	
Maxi	DVD	SDM1002 (Tosh)

Kenwood

52X TrueX	52-speed ATAPI	CLV

LaCie

CD RW 2x2x6	Ext SCSI	Yamaha CRW 2260
CD RW 4424u	Ext USB 4x4x24	
DVD-RAM	Ext SCSI	Panasonic
Turbo LIMDOW	Ext SCSI 2.6Gb	Sony SMO F541+13

LG Electronics

CDR 8320B	32 speed ATAPI	
CRD 8400B	40x ATAPI	
CED 8041B	CDRW ATAPI 4/2/24	
DRD 840B	DVD 4x (32x CD)	
D2	DVD RAM SCSI	

MDI

SCSI Express	8 speed SCSI ext	4 x Juke Box/Nakamichi

Memorex

CDRW 2224	CDRW 2/2/24	
DVD 632R	6x ATAPI (32x CD)	Toshiba
Tri-Maxx 200	DVD/CD-R/W	

Microboards

PlayWrite 4000	4/4 W/R SCSI 1/2	Yamaha

MicroNet

Master CD +	4/4 W/R SCSI-2	Yamaha

Micro Solutions

Backpack	External CDRW	

Mirai

CD 1200/AT	8 speed	EIDE Mode 3
CE 1800/AT	12 speed	EIDE Mode 4

Mitsubishi

CDRW 226	SCSI	Ricoh MP 6200S

Mitsumi

CR 2801TE	8R/4W IDE
CR 4804TE	4x4x24 ATAPI
FX 120	12 speed IDE
FX 240	24 speed Max ATAPI
FX 320S B	32 speed ATAPI
FX 800	8 speed IDE
FX 810E	8 speed IDE

Nakamichi

MJ-4.8s	8 speed SCSI	4 x Juke Box
MJ 5.16	16 speed	5 disc changer SCSI/IDE

Narai

680.RW	6R/2W SCSI/Par	Ricoh MP 6200S

NEC

Multispin 4x4C	4 speed IDE	NEC/Nakamichi
Multispin 6X	6 speed SCSI-2	
Multispin 74	2 speed SCSI	

Nomai

680RW	SCSI	Ricoh MP 6200S

OAI

CD/Turbo 6-pak	2 speed SCSI	Pioneer DRM 604X

Olympus

CD R2X4	2/4 W/R	SCSI 1/2/3

Optics Storage

Stingray 8522	10 speed IDE	Philips drive

Optima

650CDR	2/4 W/R SCSI-2	Sony

Panasonic

10X Big 5	10 speed ATAPI	Juke Box
CDR 574-BCQ	Quad ATAPI	
CR 508B	24 speed SCSI II	
CR 583B	8 speed ATAPI	
CR 588B	32 speed ATAPI	
CW 7503-B	8x CD-R SCSI	
LF D101E(N)	DVD RAM 2x SCSI-2	20x CD Caddy
KXL 783A	8 speed	ext, type II SCSI PCMCIA
SR 8583-B	DVD 5x ATAPI	32x CD
SR 8584-B	DVD 6x ATAPI (32x CD)	Matsushita

Philips

CDD 3000	6R/2W IDE	
CDD 3610	6R/2W ATAPI	
CDRW 400	CDRW ATAPI	
DRD 5200	DVD 2x (24x CD) ATAPI	
EasyWriter	2/6 W/R SCSI-2	
PCA 323CD	32 speed ATAPI	
PCA 36x	36x CD ATAPI	
PCA 40x	40x CD ATAPI	
PCA 424D	DVD 4x (24x CD) ATAPI	24x CD
PCA 48x	48x CD ATAPI	
PC A 80SC	8-speed SCSI	
RO D1270/10	10-speed IDE	

Pinnacle

Micro 10Xtreme	10 speed IDE	Philips drive
RCD 4X4	4/4 W/R SCSI 1/2	TEAC drive
RCD 5040	2/4 W/R SCSI	JVC drive

Pioneer

DR A04S	32 speed ATAPI	
DR U10X	10 speed SCSI/IDE	
DR U06S	32 speed SCSI-1	SCAM
DR 502S	24 speed ATAPI	
DR 504S	32 speed ATAPI	

DR 506S	32 speed SCSI-1	SCAM
DR A04S	32 speed ATAPI	CAV Slot Loader
DR A24X	24 Speed	Partial CAV
DR 32X	32 speed ATAPI	CAV Tray Loader
DR 704S	36x CD ATAPI	
DR 706S	36x CD SCSI	
DR 744	36x CD ATAPI	
DRM 604X	2 speed SCSI	6 x Juke Box
DRM-624X	4 speed SCSI	6 x Juke Box
DVD A04SZ	10x (40x CD) ATAPI	
DVD 102	2.6 speed ATAPI	
DVD 103S	DVD 6x (32x CD) ATAPI	
DVD-R S201	SCSI	
DVD 302	2.6 speed SCSI-2	
DVD 303-S	SCSI	
DVD 403S	6x ATAPI	32x CD

Plasmon

CDR 4240e-S1	2/4 W/R SCSI 1/2	Matsushita CW 7501

Plextor

PlexWriter 2/4	2/4 W/R	
PlexWriter 4/2/20	CDRW SCSI	
PX 12CSi	12 speed SCSI	Caddy
PX 32TSI	32 speed U SCSI-2	Full CAV
PX 40STI	40x CD SCSI	
PX40TSE	40x CD SCSI	
PX 43CE	4.5 speed SCSI-2	
PX 83CS	8 speed SCSI-2	
PX-R412Ci	8R/4W SCSI	
PX-W124Tsi	12R,4W, 32CD USCSI	
Ultraplex 32Tsi	32 speed SCSI-2	

Ricoh

MP 6200S	6R/2W	SCSI/Par

Samsung

SCR 2030 20 Max	20 speed	Partial CAV
SCR 2430 24X	24 speed ATAPI	CAV
SCR 3230	32 speed ATAPI	CAV
SCR 830	8 speed IDE	

SD 606	6x ATAPI	
SD 608	8 x 40 DVD ATAPI	

Smart and Friendly

CDJ 4008	8 speed SCSI-2 ext	4 x Jukebox/Nakamichi
CDR 2004/Pro	2/4 W/R SCSI 1/2	S/F, Sony
CDR 4000/Pro	4/4 W/R SCSI 1/2	Yamaha

Sony

CDU 311E RP	8 speed ATAPI	
CDU 561	2 speed SCSI	
CDU 711	32 speed ATAPI	
CDU 76E	4 speed ATAPI	
CDU 76S	4 speed SCSI	
CRX 120E-RP	CDRW	
CSD 880E	8 speed IDE	
CSP 9411S	2/4 W/R SCSI 1/2	Sony
DDU 220E	DVD 5x ATAPI	32x CD
RMA S594 DWP	MO LIMDOW SCSI	
SMO F541+13	SCSI	

Teac

32X	32 speed Max ATAPI	
CD 512E	12 speed IDE	
CD 516S	16 speed SCSI	
CD 524E	24 speed EIDE	Mode 3 DMA 1
CD 532E/S	32 speed EIDE/SCSI	
CD 56	4 speed SCSI	
CD 58E	8 speed IDE	
CD 624E	24 speed 6 disc changer	
CD C68E	8 speed	6-disc changer M 4 DMA 1
CD R50S	4/4 recorder S-2F	
CD R55S	4/12 recorder S-2F	

Texel

DM 5024	2-speed SCSI	

Torisan

CDR S112	16 speed EIDE	Mode 4

Toshiba

SD M1001	DVD	
SD M1002	DVD	
SD M1102	DVD	
SD M1202	DVD 4.8x SCSI	32x CD
SD W1101	DVD RAM SCSI 6x	
SD R1002	DVD/CD	
XM 3401E1	2 speed SCSI	
XM 4101B	4-speed SCSI	Sun
XM 5401B	4 speed SCSI-2	
XM 5602B	8 speed IDE	
XM 5701B	12 speed SCSI	
XM 5702B	12 speed IDE	
XM 6102B	24 speed IDE	
XM 6201B	32 speed SCSI-2	
XM 6202B	32 speed IDE	Full CAV
XM 6402B	40x CD ATAPI	
XM 6501B	40x SCSI	

Traxdata

CDR 4120EL Pro	4W/12R SCSI	Teac CD-R55S
CDRW 2260 Plus	CDRW ATAPI 2/2/6	

Vertos

V400	4 speed IDE
V 800	8 speed IDE

Wearnes

CDD 1020	10 speed IDE	Phirips

Yamaha

CRW 2260	2 x SCSI RW
CRW 4001t	6R/4W EIDE
CRW 4260	4 speed CDRW SCSI
CRW 416E	CDRW ATAPI 4/4
CRW 8424EZ	8x4x24 ATAPI

DOS

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DOS

Although Windows hides most of its use of DOS and NT doesn't need it anyway, you still need to know about *filenames* and *directories*, because they are the basis of managing your own computer and the use of any operating system, including Linux. Actually, if you intend to do scripting in NT and therefore use the DOS prompt, you will need to read this chapter.

A computer is only a machine, so it needs instructions to run itself; for example, it can only put letters on the screen after you press a key if it's told to. However, it's a waste of time writing the same sort of instructions for every program, which is why computers have operating systems. These are *collections* of programs that perform standard housekeeping tasks, such as translating keypushes into screen displays, changing colours on the screen, or simply moving data from one part of the computer to another. Other software is then written up to the operating system level, without worrying about what sort of hardware it's dealing with. This saves programmers producing the same code that everyone uses over and over again.

On an IBM-compatible, the *Disk Operating System* (or DOS), is the program that's running when nothing else is; it's the one that starts the computer before you can load another. If you like, it's the set of instructions that tell the machine it's a computer and not a coffee machine! It's called the Disk Operating System (or *System* for short) because, in the early days, the disks needed the most management, but gradually the remainder of the computer got thrown in as well.

Every computer has an operating system, and they ultimately all do the same job. Some are more user-friendly, though (on the Macintosh), and some are downright user-hostile (like Unix). That used on IBM-compatibles is commonly called DOS, and mostly lies somewhere in between, when used with Windows.

User-friendliness is not necessarily a boon, however. Ease-of-use and automation take up processing power that could sometimes be better used elsewhere. Although not as easy to learn, DOS is fast, especially when the commands you use become reflex actions.

DOS itself lives in 2 files, **io.sys** and **msdos.sys**, which must be in a particular place on the boot disk, because the BIOS looks for them there when it finishes the boot process. This is why you must use a special command, **sys**, to create a system disk (or use **format /s**); you can't just use **copy**. Windows '95 has the same files, but **msdos.sys** is now a text file that can be used to change the way the system starts.

The boot sector contains the bootstrap loader, which contains a BIOS Parameter Block (BPB) that has details about the disk. If it's a hard disk, the BPB is read only once, as it won't be removed. There is also a partition loader program with 16 bytes of information per partition, identifying the Operating System it belongs to, the start and end and whether it is bootable. The BPB and partition loader are more properly called the *Master Boot Record*, which can be recreated with the **fdisk /mbr** command.

The bootstrap loader loads **io.sys**, which checks **config.sys**, which hands off to **msdos.sys,** which loads **command.com** (actually, **io.sys** itself hands off, after checking **config.sys**). command.com then lokks for and loads **autoexec.bat**.

Boot Sequence

- POST
- Bootstrap Loader
- io.sys
- config.sys
- msdos.sys
- autoexec.bat

DOS Versions

There are three main versions of DOS. All do the same job and use the same commands (well, more or less, anyway); they're just made by competing companies and each has one or two more services than the other. Only the common denominators will be mentioned here, though.

MS DOS

Written by *Microsoft*, hence MS. The first DOS was written by them for IBM's PC but, after version 4, they began to market it themselves; previously, it was supplied only to manufacturers and the only way you could get a copy was to buy a machine. Version 3.3 was quite stable, but couldn't handle large drives, although Compaq's version could.

We'll quickly pass by v4.0, and mention that v5 was the first MS-DOS to use advanced memory management, going on to v6.22, and now v7, which is unofficially behind Windows '95. If you type **ver** at a DOS prompt, you will see v4.0 or something, but if you replace **command.com** with your own command processor (e.g. 4DOS), you will find DOS 7 reported back.

Many commands with one version of whatever DOS won't work with another, even from the same manufacturer (I'm thinking particularly of **backup** and **restore**), although you will find that most commands from DR/NOVELL DOS will work with any other DOS. It makes sense, therefore, to ensure that all the PCs in your organisation are using the same version, to keep things simple. Also, use the correct DOS with the correct machines.

PC DOS

Written by IBM under licence from Microsoft and sold as a separate item. Although other manufacturers licenced MS-DOS as well, they were only supposed to sell it with their own machines. PC-DOS is now in version 7.

DR/Novell DOS

The DR stands for *Digital Research*, and if it wasn't for them, we wouldn't have the facilities now in MS-DOS, as DR had disk compression, memory management, etc, etc, a good 2 years before Microsoft did, in DR-DOS 5. DR was taken over by Novell, hence Novell DOS 7. It is supported, but not updated.

Starting a computer with DOS

The computer is started with a *System Disk*, or one that contains DOS. This process is known as *booting*, so the disk which kicks the machine into life is also called the *boot disk*. Because it contains the operating system, which takes up room, you won't be able to get as much data on to a system disk as you would on to an otherwise empty one, but this is not so much of a problem if you have a large hard disk.

Disk drives available

As we said before, drive A: is always the first floppy drive, and B: the second (if you have one). The first hard disk is called C:, the second D:, and so on. In this book, we assume that you have the "standard" fit of 1 floppy and 1 hard drive (A and C).

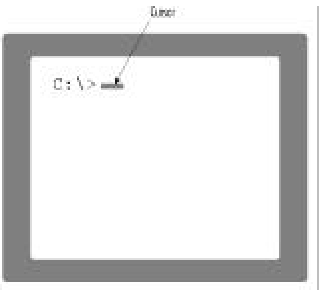
All you need to do is switch on, as the PC is trained to look in the first floppy drive (A:) for an operating system, then elsewhere, traditionally the first hard drive in the chain (C:). If it can't find one at all, it will display a message on screen, asking for a system disk.

Date and Time

During the startup sequence, you may be asked to supply the time and date (so the computer can keep track of when you create your work), because it has no other startup instructions (see later). For now, press **Return** each time to get to the *screen prompt* (see below).

The Screen Display

Once the computer has started, you should see a screen like this:



If you don't get anything, it's possible your disk hasn't got a system on it at all, so you will have to refer to the **format** or **sys** commands to see how to put one on, and come back here when it has. If your machine launches straight into a program as it starts, quit the program to get the above screen.

The screen contains the *system prompt*, so called because DOS (the system) is prompting you to do something, like give it a command. Just to make sure it gets your attention, there will be a flashing block next to it, called a *cursor*. The line which the prompt and the cursor occupy is called the *command line*, where you type the commands you want the computer to carry out, including the names of any programs you may wish to load. Giving commands to DOS is the way you manually override many of its automatic functions.

Let's try one! Just to prove you're the Boss, we will change the prompt on screen. The command to do this is (oddly enough) called **prompt**.

Type this word now, followed by your first name:

```
PROMPT FRED
```

(replace **fred** with your name). After the command, press **Return**.
From now on, it will be assumed that you will press the **Return** key after every command (it becomes automatic). Note that no superfluous words are used—DOS commands resemble broken English.

Your screen display should now read:

```
FRED
```

instead of:

```
C>
```

Just for fun, type:

```
PROMPT ^B
```

If you remember, the ^B means hold down the **Ctrl** key and press B.
To get the prompt reading what it was before, just type:

```
PROMPT $p$g
```

The $ sign means that the **prompt** command is to supply special information. For example, if you were to use **$d**, **prompt** would get the date from the computer's clock for you. **pg** tells it to supply information about the *current drive and directory* and place the > sign at the end. By now, you will have a lot of text on screen, so to tidy things up a little bit, type:

```
CLS
```

(plus **Return**!) which is short for **CL**ear **S**creen. Most computer commands are shorthand versions of the real words you would otherwise use, so quite often you can work out the name of the command you want to use by deducing it from what you want to do. For example, try the **dir** command, which is short for **DIR**ectory, or a list of what is contained on your disk.

Type:

```
DIR
```

(don't forget **Return**!). You'll probably see a long list of names flash past without you getting a chance to read them, but when it stops you might see something like:

```
Volume in drive C is BOFFIN
Directory of C:\

COMMAND      COM   50456 9-11-91  8:09a
AUTOEXEC     BAT   171   24-01-92 7:06p
LCD   IDX   473   25-01-92 4:52p
FORMAT       EXE   3432  30-01-92 7:44p
CONFIG       SYS   291   25-01-92 6:04p

24 File(s)  5097472 bytes free
System files exist
```

This is a list of the data files contained on the drive displayed at the prompt. The *volume* is the electronic name given to the disk.

Because you didn't include the drive name in the **dir** command, the computer assumes you mean the one displayed, in this case C:. Very often, the list of files is so long you don't get a chance to see it at all. You can vary **dir** to help you read it properly, by adding a *command switch* to it.

A command switch consists of a forward slash (/) followed by a letter, such as P. For example, the command:

```
DIR /P
```

will cause the display to pause after every pageful (P means *Page*).

To get a *wide* display, type:

```
DIR /W
```

This will spread the information you want across the screen. Can you combine **/p** and **/w**? Try it and see!

Note that the Wide display doesn't carry as much information about what's on the disk as does the normal one.

Not every switch works with every command in the same way, but the common ones that do are:

- **/P** Display a screenful of data at a time.
- **/W** Produce a wide display.
- **/S** Exercise the command on associated subdirectories as well, but see the **format** command, which uses it to place the system on a disk.
- **/V** Verify the command (usually **copy**) worked properly, but this only checks the readability of the data transferred, not whether what arrived was the same as what was sent (see **comp** for that). You can issue a command called **verify** to save yourself issuing this switch every time.
- **/?** Provide help (with later DOS versions only).
- **/h** As above.

Looking at other drives

If you wanted to see what was on a disk in another drive, for example A: (assuming there was a disk in it), you would have to include the drive letter in the command as well, as with:

```
DIR A:
```

Notice the space between the two parts of the command. Commands are often split into several parts, usually what you want to do, and where, as shown above. The space lets DOS know how the command is split up, and is quite important, as you will find when you use more complex commands later.

If you actually want to run the above command now, make sure you have a *formatted* disk in drive B: (see *Disk Formatting* if you're not sure about this).

Using other drives

You can check what the *current drive* is by looking at the command prompt, which may look like:

```
C:\>
```

This means that you are currently logged on to drive C:, in the *root directory* (directories are explained shortly). Changing to another drive simply means typing its letter, followed by a colon and **Return**, e.g.

```
A:
```

This will change the current drive to A: and, if there is a disk in it, you will see the following prompt on your screen:

```
A:\>
```

Loading programs

Although the prompt displays the current drive (and directory), you can use programs on others merely by prefixing your command with the appropriate drive letter. For example, if you wanted to use the **editor** program from drive A:, type:

```
A:EDITOR
```

from which it will load. If you see either of these two messages:

```
Command or filename not recognised
Bad Command or Filename
```

followed by:

```
Have A Nice Day
```

(only joking!) the system cannot carry out your request because it can't find the program with the name you typed, either because the program is not on the disk or, if it is, either DOS hasn't been told properly where to find it, or you have mistyped the name (you *must* be exact).

Some commands need extra information on the command line; for example, **diskcopy** requires to know FROM what drive and TO what drive when it is invoked:

```
DISKCOPY A: B:
```

really means:

```
DISKCOPY [from] A: [to] B:
```

Disk formatting

Unfortunately, you can't put data on a disk without preparing it first. Disks out of the box have to be made ready with a process called *formatting*, which dummy information in the right places so the computer knows where to put the real stuff later.

You can reformat old disks at any time, but any data on them will be *overwritten and lost!* Place a new disk in the empty floppy drive, close the gate and type:

```
FORMAT A:
```

DON'T type **format** just by itself without a drive letter! DOS may assume you mean the *current* drive and proceed to overwrite the contents of the disk already in there!

Remember the command says what to do (**format**) and where to do it (B: or A:), so don't forget the space between the two parts. Also **Return**!

You will be asked to place a new disk in the drive concerned; press **Return** if you're sure you've got the right disk in there and press **Return** to the question regarding *volume labels*.

When everything has finished, answer *N* to the question:

```
Format another disk (Y/N)?
```

Now type:

```
DIR B: (or A:)
```

again, to confirm that the disk is readable.

You might see:

```
Volume in drive has no label

Directory of B:\
File not found.
```

Filenames

The word *file* (mentioned above) refers to a separately identifiable set of computer code apart from any others, regardless of whether it is a real program, like a wordprocessor, or text, such as a letter to a bank.

When you work with your programs later on, you will be creating your own files, so it's important to know how to work with them as soon as possible.

Have a look at one example from the directory list given above.

```
FORMAT.EXE
```

A file has a first and second name, so the complete *filename* is in two parts, separated by a full stop or period, although it isn't displayed on the screen when the **dir** command is run (it's replaced by a space).

The first part of a filename is up to eight letters long, and is the actual name of the file; the second has three, to tell the computer what type of file it is. Normally, you shouldn't need to bother with this *extension*, as it's called, except when referring to the complete file as part of a command. Thus, a filename has the following structure:

```
filename.ext
```

Neither part of a filename should contain spaces, punctuation marks, or any of the following symbols:

```
~ = , : ; * ? @ " ' ` ^& ! % \ / $ [ ] ( ) . + |
```

Sometimes the computer uses the above for its own purposes, and if you use them, you'll just confuse it. The easiest way to get out of remembering them all is simply to create filenames with numbers and letters only, with *no* spaces.

Some file extensions, including the following, are either reserved or commonly used by programs:

.$$$
.TMP A temporary or incorrectly closed file. When memory runs out, many programs write the extra bits to a disk, marking the files created with extensions like these, so it can remember what they were.

Normally, you won't see them, since they're deleted automatically when finished with, but if the computer is switched off while the program that created them is still running, they won't be erased properly, and will thus be visible.

.BAK A Backup file. When a program opens a file, a copy of the original is loaded into memory to be worked on, while the original is renamed with this extension for safety.

.BAS A BASIC program.

.BAT A batch file, containing commands executed in sequence.

.BMP Windows Bitmap file

.CAB Windows 95/98 cabinet file

.CMD CP/M-86 program file (CoMmanD). Very ancient!

.COM DOS 64K compiled program file (short for COMmand).

.CPI Code Page Information file.

.DAT	Data file
.DIZ	Shareware description file
.DOC	Document file
.DLL	Windows Dynamic Link Library
.EXE	Large DOS program file (short for EXEcuteable).
.HLP	Windows Help File
.HTM	HTML file
.ICO	Windows icon file
.INF	Win 95 setup file
.MID	MIDI Sound file
.OVL	Program Overlay file
.PCX	Paint Raster image
.REG	Win 95 registry file
.SCR	Script or Screen Saver File
.TTF	True Type font
.TXT	Text file
.VXD	Virtual device driver
.WAV	Waveform sound file
.WMF	Windows MetaFile (graphics)
.WRI	MS Write file
.ZIP	Archive file
.SYS	Device drivers, which tell DOS how to work with special equipment.

Some application programs may have their own reserved extensions, such as **.gem**, **.wk1** or **.dbf**. You will have to refer to their manuals for further information.

There are also combinations of letters that refer to *devices* used by computers, such as:

```
CON, PRN, AUX, NUL, COM, LST or LPT
```

To avoid confusion, don’t use the above in filenames. If you're bothered, they stand for:

CON	CONsole (screen).
PRN	PRiNter.
AUX	AUXiliary.
NUL	A dummy device that fools the computer into thinking it's actually talking to something; the computer equivalent of a black hole to which you can send the

results of a command when you don't want to see them.

COM COMmunications port.

LST LiST device (usually a printer).

LPT Line PrinTer.

File information

When you display the contents of a disk with **dir**, there's a lot of information given about each file. Let's have another look a shortened version of the list given earlier:

```
Volume in drive C is BOFFIN
Directory of C:\

COMMAND  COM   50456 9-11-91  8:09a

24 File(s)  5097472 bytes free
System files exist
```

After the filename, the figures to the right indicate the size of the file, or how much space it occupies on the disk, in *bytes* (a byte is eight bits of computer language, and it takes one byte to place a single character on the screen). In the case of **format.exe**, the file is 3432 bytes in size, or 3K for short. K is an abbreviation of *Kilo*, which is Greek for 1000.

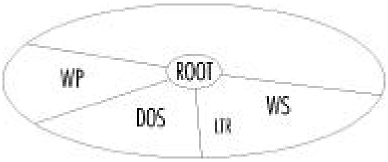
After the size of the file are columns containing the date and time the file was created, which is useful if you've written two letters and have forgotten which one you worked on last. At the bottom is how much disk space is free for more files.

Directories

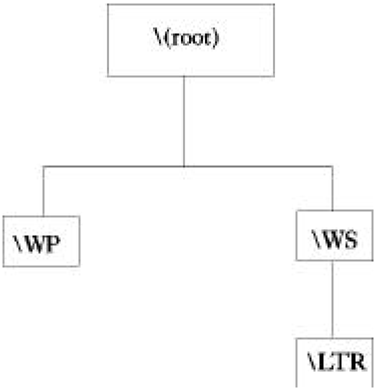
Some drives have bigger capacities than others, and if you just deposited your files on to them in one great lump, you would never find anything again (also, if you typed **dir**, the list would be so long you would never catch up with it all). Fortunately, you can split large drives into smaller areas in which to place different files, so you can keep your wordprocessor data away from your DOS files, or otherwise organise your programs.

A portion of a disk is called a *directory*, and is referred to with a backslash (\), in the same way that the disk drive is referred to with a colon. Everything starts with the *Root directory* and works downwards.

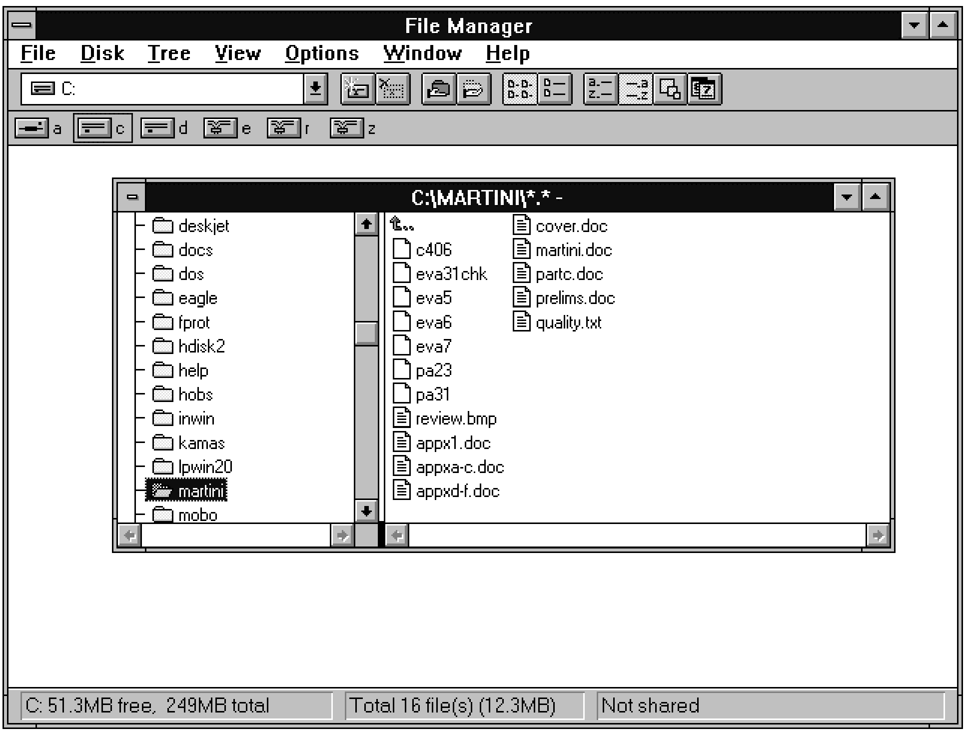
Although the directory system works on any disk, it is mostly relevant to hard disks. In concept, it all looks like this diagram:



It actually looks like this:



\ltr is a *subdirectory* of **\ws**. Multiple subdirectories are created below first-level directories, and the route from top to bottom is the *Path*. A directory display in the *File Manager* program that comes with *Windows (3.1)* would look something like this:



And for the *Explorer* program in Windows '95:

Directories have names as well, which are also eight letters long, but without the full stop and extension that filenames have. In a **dir** display, they would appear with **<DIR>** next to them:

```
Volume in drive C is BOFFIN
Directory of C:\

AB3       <DIR>  12-01-92 5:30p
AREV      <DIR>  7-02-92  5:02p
ARTLINE   <DIR>  12-01-92 5:30p
DOS       <DIR>  12-01-92 5:30p
AUTOEXEC   BAT   381 16-03-92  4:54p
CONFIG     SYS   281 20-03-92  6:04p
DRMDOS     CFG   6030 19-02-92 2:58p

    30 File(s)  8525824 bytes free
```

The combination of a drive letter and directory name is known as a *path description*, and usually includes the filename at the end. As an example, a typical path on drive C: for the **ws** program, based on the diagram above, could be:

```
C:\WS\WS.EXE
```

Here, the program file is in the **\ws** directory on drive C: (it helps if you give directories names that refer to what's in them).

Although you can have subdirectories off subdirectories, it's not advisable to go too deep, because eventually it becomes just as inconvenient to type the full pathname of any file as it would be to find it in the first place if everything was placed into the root directory (the prompt would also get so long it would take up most of the screen). In addition, your hard disk would have to work harder. Keep the root directory as clean as possible, and use the **path** command (see later) to help the system find things.

Directory Management

There are three commands associated with directory structures, **MD, CD** and **RD**, and they are used to **M**ake, **C**hange to or **R**emove **D**irectories respectively.

To create a directory *underneath your present level*, use:

```
MD directoryname
```

To change directories, just type:

```
CD\directoryname
```

Where *directoryname* is the name of the one you want to go to, which then becomes the *current directory*, or the one the computer is looking at directly. You can jump up one level of subdirectories by simply typing **cd ..** (the two full stops are shorthand for the *parent directory*, or the next one up in the hierarchy), or by using the full pathname.

For example, referring to the previous diagrams, you can go from **\ws\ltr** to **\ws** by typing either of:

```
CD ..
CD\WS
```

In the above example, the \ means "go via the root", so to move sideways amongst *first level directories*, include the backslash (\):

```
CD\WP
```

You can get to the root from anywhere by using:

```
CD\
```

Removing directories

You can't remove a directory that contains files (a good safety precaution). To do so, you must change to the directory concerned, (with **cd**), delete the files and subdirectories in it (with **del** and **rd**), go back up one level and then remove the directory (with **rd**). Note that the same limitations apply to subdirectories as well; they must be empty before they can be removed, so you have to change to the subdirectory, delete all the files in it and go through the whole performance with each one of them.

Copying Files

To copy a file from one drive to another, the **copy** command is used. We will practice on **format.exe**, with which we are already acquainted. Assuming you are logged on to a system drive, or the **\dos** directory of your hard drive (use **cd** to get you there), put a formatted disk in the empty floppy drive and type:

```
COPY FORMAT.EXE A:
```

If the file is present on the disk, you will see the disk access lights glow on the front of the drives as they are interrogated by the computer for information, and parts of the file are transferred a bit at a time.

Strictly speaking, you should include the drive letter and path with the source filename, but because you're copying from the current directory, you can safely leave it out (the computer knows where you are already). If you were copying the file from another directory, of course, you would have to include the drive letter in the command.

Now type:

```
DIR A:
```

again, and you will see the file you just copied on the directory listing. Note that you have *copied* the file, and not *moved* it – the original is still where it was (the **move** command, if your version of DOS has it, will have the same effect as **copy**, but the original will be deleted).

Practice

Copy several files to the other disk, one after the other, until you are happy with the concept of making duplicate files; about 10 should do it.

Just to remind you, the command (in DOS) is:

```
COPY filename.ext A:
```

where *filename.ext* represents the name of the file you want to copy, including its extension (not all files use **.exe**!). If you want a selection of files to choose from, list the files available on your current drive (the one shown at the prompt), with **dir**. Don't forget the full stop between the different parts of the filename is not shown on screen, but needs to be included in the command. So:

```
FORMAT  EXE
```

is equal to:

```
FORMAT.EXE
```

After you've copied a few files, check what's on the other disk again with **dir**.

Wildcards

Copying files individually is all very well if you've only got a few of them, but the process can be tedious when there are lots. *Wildcards* can simplify the process.

In poker, a wildcard is one that stands for another card, like the ace, which can represent anything. In the computer world, the principle is the same, where a wildcard is a *symbol* that stands for a word or a letter. There are two of them, * or ?, respectively, so if you typed the command:

```
COPY *.EXE A:
```

you would copy every file with the extension .EXE to B:, regardless of what the first part of the filename is. Similarly, if you typed:

```
COPY *.* A:
```

you would end up with *every* file, whatever the filename or extension is. Try both and see.

The other wildcard is the question mark (?), which stands for a single character only. It's not often used, but it does give you a handy way of dealing with filenames with spaces in, because although you can create such files (mostly by accident), you can't do anything else with them. Simply replace the space with ? and you can get DOS to recognise it.

Copying Disks

You will need to be able to copy disks for security purposes, and there are two ways of doing it. The long way round is to format another disk and copy the files from one to the other as described above but, even if you use wildcards, this can be time consuming. Alternatively, you can make exact duplicates of diskettes with the **diskcopy** command.

Unfortunately, there are disadvantages to this as well. For one thing, you get everything, and there may be some files you don't need.

A secondary reason is that you can't **diskcopy** between dissimilar disks, like a 3½" in relation to a 5¼". The main one, however, concerns the computer's untidy housekeeping.

Imagine you've typed a report and saved it. That report will occupy a certain amount of continuous space on the disk, which is OK when the disk is relatively empty.

Then you do other work and occupy the space surrounding your original report. If you subsequently re-edit that report (and make it longer in the process), the computer will find that it can't put the new edition in the original space, so what it does is put the additional bit somewhere else on the disk because it's more difficult to move the other files out of the way.

If lots of similar tag-ends are made, a single document could end up in dozens of different places with bits here and bits there, giving you a very untidy disk, which makes things run much slower than they need to because of the extra chasing around to find everything (this is known as *fragmentation*). You can either use a special program that puts it all together again (called a *Disk Optimiser*, or **defrag** in DOS/Windows), or **copy** the files to an empty disk which will make sure they're all joined up together in the right order.

However, serious fragmentation only occurs if you've been using the disk for some time. For optimum health, defragment your drive once every 7-10 days.

Batch Processing

In line with getting the computer to do the work for you, batch files simplify the way you give DOS instructions. A batch file is simply a list of commands that the system issues on your behalf—you collect them all together into one file, hence the name *batch*. If you like, they're the DOS version of macros.

This way, you can save typing the same commands over and over again, and replace many of them with one. Batch files also reduce the chances of making mistakes, since the computer will be less forgetful than you are.

Using batch files is like simple programming, and they can be as simple or complicated as you like. Create them with any *text editor* (see later) that produces *ASCII files*—a small example of a batch file is **z.bat**, which follows:

```
@ECHO OFF
cd\
cls
```

It's a useful routine for returning to the root directory and clearing the screen quickly—you only need to type **z** (the name of the batch file) instead of the dozen or so keystrokes you would otherwise require. So that the computer knows the file contains a list of commands, the file is given a **.bat** extension.

The first line stops the commands cluttering up (or being *echoed to*) the screen as they are executed; the @ stops the line containing the words *Echo off* appearing, so you could place @ the beginning of every line if you wanted to, to get the same effect. Note that each command has its own line, with a *Carriage Return* and *Line Feed* at the end of it (press **Return** each time to produce a Carriage Return and Line Feed).

Usually, commands are issued in the order they are given, that is, line after line, but there are ways of skipping bits of a batch file if they're not needed—see your DOS manual about the GOTO instruction and *labels*, if you're interested.

The name of the batch file should not be the same as any **.com** or **.exe** files, because they will always take priority. You can *chain* batch files (that is, make them run one after the other) by using the name of the next as the last line of the previous one, but you must use the **call** command if you want to return to the original.

To save *environment space* and reduce the length of the **path** statement, make a batch file for each of your programs and put them all in a directory called **\bat**. Then have that directory as the only one in the **path**.

Batch File Management

If you create large batch files, it can be impossible six months later to remember what the lines were for when you wrote them, so you can insert comments as short notes to yourself. If you place the letters **rem** at the beginning of a line, that line will not be treated as a command, but as a **rem**ark.

When testing, don't delete lines in batch files at random—it's best to disable them with **rem**, see what the effect is, then delete the line when you're happy. This is so you don't forget what was there if what you tried doesn't work.

DOS Error Messages

Abort, Retry, Ignore, Fail?

This one most often occurs during a read or write operation when DOS can't carry on and wants to know what you want it to do about the situation, such as where you change to a disk drive and there's no disk in it, or a file being read has become corrupted. Simply type the first letter of the courses of action proposed, e.g. **A** for **Abort**.

Abort Stops the current operation and puts you back where you started. You will lose all data entered or modified since the application started.

Retry Makes another attempt to carry out the operation.

Ignore Disregards the error and carries on to the next stage, but your data could be corrupted. This is dangerous!

Fail Notes there is an error, but the command is not aborted, giving you a chance to continue or terminate.

DOS Commands

There are many DOS commands available (just do a listing of the DOS directory), but you will be pleased to know you won't need to know all of them for daily use (about 18 is enough). Even those commands can be whittled down to the ones needed only when the computer is started, and about two or three that are used more often.

For example, one DOS command varies the keyboard's output according to your country. It's called **keyb**, which is short for **keyb**oard, and you include a two-letter country code to tell it where you are. The command:

```
KEYB UK
```

therefore makes your keyboard behave as if it were in the UK.
Naturally, once you've loaded this program, you won't need it again while your computer is switched on, and you can safely ignore it. You can load commands like these automatically from a special batch file that is run only when the computer is started, called **autoexec.bat**, which is described shortly.

Internal commands

Some commands are *built-in*, meaning they are loaded into the computer's memory from the start and are therefore easily available (you won't see the names of these commands if you run the **dir** command). Built-in commands are sometimes called *internal commands*. They include:

CD Changes between directories.

CLS Clears the screen.

COPY Transfers files between devices (usually disk drives, but also printers or screens).

DEL Deletes files.

DIR Gives the contents of a directory.

MD Creates directories.

PATH Establishes a permanent search path for files, usually from autoexec.bat.

PROMPT Modifies the prompt display on screen again, usually from autoexec.bat.

REN Renames files.

RD Removes directories.

TYPE Lists a text file's contents on screen (the same as copying them to the screen).

Internal Batch commands

Some internal commands are usually used only in batch files:

@ Prevents a command from being displayed when run.

ECHO Displays messages or command lines.

REM Allows comments, or lines of text that are not treated as commands.

External commands

External commands are stored on disk until needed (if they were all loaded as internal commands, there would be no memory left for programs!). The most useful ones are:

DISKCOPY Copies diskettes (of the same type).

FORMAT Initializes disks to receive data—dangerous! This program creates a boot sector, 2 copies of the FAT and the root directory. It also checks for bad sectors and can make a disk bootable with the /s switch.

KEYB Relates the keyboard to the language used.

XCOPY An advanced form of copy.

Stopping commands

If you need to stop a command once it has started, hold down the **Ctrl** key and press C (**Ctrl-C**) or the **Break** key (**Ctrl-Break**).

Everyday Commands

Although much of what DOS does is automatic, you can override it with various commands that come with it. As with application programs, approximately 10% of DOS is used for 80% of the time, so of the 160 or so commands that you could get involved with, you only really need to bother with about 18 for day-to-day use.

Of that 18, around 10 are generally used only when the machine is started up, and you can get it to run those on your behalf anyway. You will also find that most application programs can get DOS to do what you want, and in a much friendlier and more powerful manner, so the task of operating a computer (as opposed to just using a program) suddenly becomes not quite so daunting as it first appears. The catch is that you still need to know what you *can* do, so you can get the other program to do it!

Commands mentioned below are better described in the official DOS manual, since only enough information is given for daily use. As they are meant to cover many situations, the following details should not be regarded as authoritative (although the information given is accurate), as the intention of this book is to be a handy reference guide and not a rehash of the manuals.

@

Used in batch files to suppress the display of the line it is on.

Format:

```
@command
```

Comments:

Mostly used at the start of the traditional first line of every batch file:

```
@ECHO OFF
```

BUFFERS

Buffers are small blocks of memory that hold information being read from or written to disk.

Format:

```
BUFFERS=nn
```

Comments:

nn is a number from 3-99, but the default is 15. The more buffers created, the less memory there is for programs and data, which could result in things actually running slower! Between 10 and 30 is sensible, but a large hard disk, you may need more. Up to 40 Mb, use 20 buffers, and increase by 10 for every 40 Mb thereafter, up to 50.

Sometimes, disk cacheing procedures recommend reducing the number of buffers. In this case, don't simply delete the line, because you will get the default of 15. It's better to use a minimal figure like 2.

CD

Used to change directories (**chdir** is the full command).

Format:

```
CD path
```

CLS

This command **CL**ears the **S**creen.

Format:

```
CLS
```

Comments:

The screen is reset to grey characters on a black background, unless you have previously selected others with **ansi.sys** (see **prompt**).

COPY

Use this to copy files, which can come from the screen or a disk, and go to a screen, disk drive or printer (for example, you can **copy**, instead of **type**, a file to the screen).

Format:

```
COPY [switch] source [switch] destination [option]
```

Comments:

You don't have to copy files just to disk. You can also **copy** them (text files only) to the screen for viewing (instead of **type**), to a serial port for transmission or to a parallel port for printing. For instance:

`COPY FRED CON`	would display the contents of the file fred on your screen (as with type), while:
`COPY FRED PRN`	would print it.

You can change the name of a file as you copy it:

```
COPY C:FRED A:TOM
```

will copy **fred** from C to A, and call it **tom**.

Notes:

You can't copy a file to itself. Copying a file to a destination where one with the same name already exists will overwrite the existing file, with no prompting.

Be careful not to delete files after you've copied them until you are sure the operation has been carried out successfully. For example, copying all files in a directory (that is, *.*) into another seems simple enough until you mistype the name of the destination directory, which to the system will mean that the directory specified won't exist. In that case COPY will assume the contents are destined for one (very big) file and proceed to make it. However, if program files are included in the list, and you haven't included the /B option (meaning binary), they will be truncated at the first end-of-file marker.

COUNTRY

The country code (in **config.sys**) tells DOS to use the date, time, currency format and code page used by your country.

Format:

```
COUNTRY=nnn,cp,[d:]\path\COUNTRY.SYS
```

Comments:

nnn is one of the following codes (loosely based on the telephone system):

061	Australia	032	Belgium
002	Canada (Fr)	045	Denmark
358	Finland	033	France
049	W Germany	035	Hungary
972	Israel	039	Italy
081	Japan	082	Korea
003	Latin America	785	Middle East
031	Netherlands	047	Norway
351	Portugal	007	Russia
034	Spain	046	Sweden
041	Switzerland	090	Turkey
044	United Kingdom	001	United States

cp is the code page, if different from that associated with the code above.

Notes:

Country codes do not concern themselves with keyboards; use **keyb**.

DEL

A built-in command, used to delete files.

Format:

```
DEL [filespec] [options]
```

Comments:

If you try to delete all files in a directory, as when using wildcard characters (*.*), you will see a message like:

```
Are you sure (Y/N)?
```

Type *Y* to go ahead; *N* if you change your mind. This command does not query you before erasing a file, so the file deleted is not recoverable except under certain special circumstances (see below).

Notes:

A deleted file isn't actually erased from the disk; instead, the directory list is modified to show that the space occupied by the file is available for use. Provided that space has not been used again, it is sometimes possible (using a suitable recovery program) to recover a file once you've deleted it.

DIR

DIR displays the contents of a disk directory.

Format:

```
DIR [d:][filespec]
```

Comments:

Typing DIR by itself will show all files (that is, *.*) allowed to be shown in the *current* directory, together with the names of any subdirectories. Wildcards (* or ?) can filter the files selected. For instance, you can show only **.txt** files by filtering them with the command:

```
DIR *.TXT
```

DISKCOPY

This command copies entire diskettes of the same format, producing complete clones, sector by sector.

Format:

```
DISKCOPY [source] [destination] [options]
```

Comments:

If you only have one drive, DISKCOPY prompts you to swap disks at the right time.

Example:

```
DISKCOPY A: B:
```

copies the contents of disk A: to drive B.

Notes:

You cannot use **diskcopy** with a fixed disk, a floating drive or a remote drive. Certain diskette types cannot be copied properly in certain drive types. The following are supported (but see also the System Manual):

```
5.25"    DS DD 40T 360Kb
         DS DD 80T 1.2Mb
3.5"     DS DD 80T 720Kb
         DS DD 80T 1.44 Mb
```

where DS = Double Sided, DD=Double Density, so:

- a 360Kb drive can only copy 360K diskettes
- a 1.2Mb drive can copy 1.2Mb and 360K diskettes
- a 720Kb drive can only copy 720K diskettes
- a 1.44Mb drive can copy 720K and 1.44Mb diskettes

Although a 1.2Mb drive can copy 360Kb diskettes, you may not be able to read them in a 360Kb drive, because the track width is half the size in the higher capacity drive, and the (wider) lower capacity drive heads will read both the old information and the new that is written down the middle of the (old) track. If you want to copy between dissimilar diskette types, use **xcopy**, which will copy subdirectories, but don't forget to make the volume labels match (use the /L switch).

ECHO

Controls the display of text on screen, typically used in batch files for including messages and prompts as part of the startup procedure.

Format:

```
ECHO ON|OFF
ECHO [=] [message]
```

Comments:

echo can display any printable ASCII character and is ON by default. The line:

```
echo off
```

in a batch file stops all subsequent lines of it being shown on screen as they are executed (individual lines in a batch file can be suppressed by placing **@** as the first character). Some program messages, such as:

```
1 File(s) copied
```

and errors, are displayed regardless of the echo status. Suppress these by adding **>nul** at the end of the relevant line (**nul** is the computer equivalent of a black hole).

FORMAT

This command initialises diskettes.

Format:

```
FORMAT [d:][options]
```

Comments:

The diskette contents will be completely erased. Formatting takes place to the highest capacity of the drive used, which can be varied by using options as described below.

Options:

- ***/U*** Unconditional, to format the entire disk
- ***/4*** Forces 360k format (on 1.2 Mb drives).
- ***/F*** Sets the capacity of the drive to be formatted, using: **/F:size** (/F:720 formats 720k disks in a 1.44 Mb drive).
- ***/S*** Copies system files onto the formatted diskette.

Drives supported:

Only the most common types are described:

```
5.25"     DS DD 40T 360Kb
          DS DD 80T 1.2Mb
3.5"      DS DD 80T 720Kb
          DS DD 80T 1.44 Mb
```

where DS = Double Sided, DD = Double Density.

Example:

To format a 720k (Double Density) diskette in a 1.44 Mb (High Density) 3.5 inch drive, type:

```
FORMAT A: /F:720
```

Notes:

format will not work with networked drives, or assignments created with **assign** or **subst**.

KEYB

A device driver that loads national keyboard settings.

Format:

```
KEYB xx
```

Comments:

xx is a two-letter country code. The versions supported are given below, together with their two-character codes (and code page):

Belgium	BE (437)	Canada (Fr)	CF (863)<R>•
Denmark	DK (865)	Finland	SU (437)
France	FR (437)	Germany	GR (437)
Hungary	HU (852)	Italy	IT (437)
Lat America	LA (437)	Netherlands	NL (437)
Norway	NO (865)	Portugal	PO (860)
Russia	RU (866)	Spain	SP (437)
Sweden	SV (437)	Swiss (Fr)	SF (437)
Swiss (Ge)	SG (437)	Turkey TF	TQ (857)
UK	UK (437)	USA	US (437)

MD

Use **md** to create directories.

Format:

```
MD[\][d:]dirpath
```

Example:

If you want to create subdirectory **\wp** from the root directory, enter:

```
MD\WP
```

Notes:

It's very easy to create a directory to copy files into and then forget to change to it, thus getting the new files right where you don't want them (usually the Root directory) - don't forget to change to the new directory (with **cd**) after creating it!

PATH

Allows you to set up a standard search routine for programs or batch files (not data or overlay files - see append) which cannot be found in the current directory. The named directories will be searched in the order you enter them with this command. If the programs are still not locatable, you must specify the full *filespec* to run them.

Format:

```
PATH [[d:]dirpath [;[d:]dirpath]... |;]
```

Comments:

A semicolon is used to separate directories on one command line (see example).

Example:

To set a multiple path command in **autoexec.bat**, use the form:

```
PATH C:\OSUTILS;\DRDOS;\WS;\WP
```

Notes:

This command is used for **.com**, **.exe** or **.bat** files, and is usually run from **autoexec.bat**. For best performance, use the least number of paths, so that the system doesn't have to search through multiple layers of subdirectories.

Use a batch file for each program which resets the path as required (some programs need the DOS path to find their own files). You can then collect all the batch files into one directory and only have that in the path specified in **autoexec.bat**. If you do end up with a long path, and you need more, you can always continue with **append**, or use **subst** to swap a drive letter for a path description. See also **set**.

PROMPT

Modifies the command prompt with special commands beginning with **$**.

Format:

```
PROMPT [promptstring]
```

Comments:

The prompt can also carry out a command every time it displays. Typing **prompt** by itself resets the default (**ng**). The *promptstring* can contain valid ASCII characters, or these symbols preceded by **$**:

```
D         The date.
G         The > character.
P         The current directory.
T         The time.
_         Carriage Return and Line Feed
```

Examples:

Navigation around directories is made considerably easier by modifying the prompt to show you the current directory.

```
PROMPT $p$g
```

will display (for example):

```
C:\DOS>
```

This is the most common variation of the screen prompt, but you can also include the date, time and many other commands, e.g.:

```
PROMPT $t$d
```

Try this one for size (all on one line, and you will need **ansi.sys** loaded):

```
PROMPT $e[1;64H$e[1;33;44m$d $e[1;1H$e[1;33;44m$t $h$h$h$h$h$h
Time $e[0m$e[25;1H$e[1;33;44m$p$g$e[0m
```

RD

Removes directories, provided they are empty.

Format:

```
RD [d:]dirpath
```

Comments:

To remove a directory, the following conditions must be satisfied:

- ❑ It must be empty (check for hidden files).
- ❑ It cannot be a current directory on any drive
- ❑ It cannot be assigned to floating drives; that is, no subst or join in force.

Examples:

To erase directory SUB3:

```
RD SUB1\SUB2\SUB3
```

REM

REM is used to add comments (that are not displayed) to batch files, including **config.sys**, so you can understand the horrible mess much later on when you've forgotten what you wrote in the first place.

Format:

```
REM [comment]
```

Comments:

The max length of a comment is 123 characters (plus **rem**) - can actually type more if you want, but only 123 will be shown on the screen. The semi-colon is an alias for **rem**.

REN

Changes the name of a file.

Format:

```
REN oldfile.ext newfile.ext
```

Comments:

The wildcard characters (* and ?) can be used, for example, to rename all files having **.in** extensions as files with **.out** extensions:

```
REN *.IN *.OUT
```

You can't rename a file to an existing name. To set a variable, just use it as supplied (e.g. **setver=3.31**). For testing, it needs to be surrounded by "% on either side, e.g. "%..%", as in:

SHELL

An environment variable that tells applications where **command.com** is.

Format:

```
SHELL = filespec [options]
```

Options:

/E:nnnnn The size of the environment in bytes, where nnnnn is in the range 256-32751. Most times, the environment size can safely be reduced to, say, 192, which will gain a few extra bytes of memory for applications. Every little helps!

/P Fixes this copy of this command processor permanently in memory (usually the first one loaded). In addition, the autoexec.bat file is automatically run.

/F Automatically answers "F" to the error message "Abort, Retry, Fail?"

SYS

Transfers the system files **io.sys** and **msdos.sys** to make it bootable. The files must be in a particular place. The **/s** switch in **format** does the same.

Format:

```
SYS drive:
```

TYPE

Displays the contents of a text file on your screen. You can use the wildcard characters (* and ?) to type multiple files. The effect is the same as copying a file to the screen.

Format:

```
TYPE filespec [options]
```

Comments:

Press **ctrl-s** to stop the display from scrolling, and again to restart. **ctrl-c** aborts the display. Another way of sending file contents to the printer is:

```
TYPE filename.ext PRN
```

XCOPY

An extended version of **copy**; it selectively copies files and whole subdirectories.

Format:

```
XCOPY [@]filespec [dirpath] [options]
```

Comments:

The *filespec* is the drive, path and name of the files to be copied (wildcard characters are allowed). The *dirpath* is the destination drive and path to which the files will be copied. **xcopy** is intelligent enough to create a new directory on the destination if you have specified one that doesn't exist. Whereas **copy** deals only with individual parts of a file at a time and is therefore continually waiting for floppy disk drives to get up to speed, **xcopy** will read in as many files as memory allows, and write them to the destination in one continuous stream. This makes it extremely useful in backup procedures, as it retains files in a useable condition.

Options:

/E Create subdirectories, even if they are empty (see also /S).

/H Include system files. The default is to ignore them.

/L Copies the disk label as well as the files (great for diskcopying with different sizes).

/S Copy files from subdirectories and maintain structure (use with /E if you want all subdirectories).

/V Verify that data is written correctly.

Example:

To copy all files with a **.let** extension from the **c:\wp** directory, which has two subdirectories, **\wp\fred** and \wp\mary, to a diskette in drive A, and when you want to preserve the same subdirectory structure, use the command:

```
XCOPY \wp\*.let A: /S /E
```

Configuration Files

DOS looks for two text files in the root directory when it starts; the settings and commands in them set your computer up the way you want. The correct setting up of both the **config.sys** and **autoexec.bat** files is the key to getting the best out of your PC, and subsequently programs you run on it, especially Windows 3.x. They are edited with a *text editor* that creates ASCII files—*don't* use a word processor in its native format!

Windows '95 takes most of the same information and puts it in the *Registry*, so most of the entries will become redundant as some commands become built in; you would only need to insert commands to change the defaults or include them specifically for programs that require them. The two files are still used, however, for compatibility (you might need to run 16-bit drivers for some old equipment).

This chapter contains sample files that, aside from stuff you might want to add yourself, are about as bulletproof as you'll get. If you use these as a basis for your machines, you should keep out of trouble.

Symbols used in command descriptions

[ ] Square brackets indicate optional use of the data between them (don't type the brackets).

| A choice between options (e.g. ON|OFF = On or Off). Make one choice, and don't type the bar itself. On most keyboards, the | symbol has a gap in the middle and is usually obtained by SHIFTing the backslash (\) key.

d: A disk drive, e.g. C:

n A number you type in.

CONFIG.SYS

This file contains instructions that extend the capabilities of DOS, either by adjusting how certain resources are used, like memory, or loading software for devices that DOS is not geared up to cope with, such as CD-ROMs. It is called by the **sysinit** routine inside **io.sys** and is not required to start the system. The software loaded from **config.sys** actually *becomes part of DOS*, unlike commands run from **autoexec.bat**, which *run under DOS*. The file must be in the root directory of the boot disk and, in theory, the commands can be entered in any order; however, some must be issued first so that others based on them can work.

The **config.sys** file (for DOS 6.0, anyway) could look like this:

```
DEVICE=C:\DOS\HIMEM.SYS /M:1
DEVICE=C:\DOS\EMM386.EXE RAM|NOEMS [512] X=D000-D1FF
DOS=HIGH, UMB, NOAUTO
DEVICEHIGH=C:\DOS\RAMDRIVE.SYS 2048 /E
DEVICEHIGH=C:\DOS\ANSI.SYS
FILES=60
BUFFERS=10,4
LASTDRIVE=G
SHELL=C:\COMMAND.COM C:\ /P /E:192
COUNTRY=044,C:\DOS\COUNTRY.SYS
STACKS=9,256
FCBS=1,1
DEVICEHIGH=C:\DOS\SETVER
DEVICEHIGH=C:\CDROM\SGIDE628.SYS /D:MSCD001
INSTALLHIGH=C:\DOS\KEYB UK,C:\DOS\KEYBOARD.SYS
```

Menus

You can have selective boot up configurations with a menu, so you can select one OS with different flavours, or different OSs. Set up a menu like this, at the beginning of the file:

```
[menu]
MenuItem=Net, Install Network
MenuItem=NoNet, Don't Install Network
MenuColor=7,0
MenuDefault=Net,10

[Net]
DEVICE=HIMEM.SYS

[NoNet]
DEVICE=HIMEM.SYS
DEVICE=EMM386.EXE

[common]
```

The **[menu]** section at the beginning of **config.sys** produces a startup menu with whatever choices you insert, such as:

```
1.        Install Network
2.        Don't Install Network
```

Net on the first **MenuItem** line refers to another section, labelled **[Net]**, in which you put the commands you want to be carried out when **Install Network** is chosen. The last line is what is selected if you take no action after the specified time, in this case 10 seconds.

To have subsequent actions in **autoexec.bat**, have something like:

```
IF "%CONFIG%"=="Net" GOTO Net
```

which will jump to a **:Net** label with the commands you want next, such as loading network drivers, changing path mappings, etc. These are case sensitive, by the way.

The **[common]** section is to encourage installation programs to put commands at the end of the file, so they don't interfere with the rest. In **config.sys**, you can't use commands not relevant to your machine, or which aren't supplied with your version of DOS (check the manual); for example, **emm386.exe** is only for 386-type machines and above, and is supplied with DOS 5/6. If you have a 286, leave **emm386.exe** out (if you don't have DOS 5 or later, you haven't got it anyway). Also, make any adjustments for paths, memory, and other variations relevant to your machine (the sample was for a 486 with 8 Mb of RAM).

Line 1

```
DEVICE=C:\DOS\HIMEM.SYS /M:1
```

Activates the HMA so DOS can load into it, and specifies the machine type (check on HMA usage with the **mem /a** command). Some non-standard machines don't respond properly to **himem.sys**'s interrogations, and the wrong settings can be chosen, so you can edit them manually as follows.

Common himem.sys switches

/HMAMIN:nn specifies how large a program must be before it can load into the HMA; :32 means you will get at least 50% utilisation. You don't need this if DOS is high.

One way of preventing problems with Windows is to make sure that **himem.sys** knows it's working with the correct hardware. This concerns the A20 memory line, and the way it's handled when switching in and out of protected mode. Different machines have their own way of doing this and the **/M** switch indicates this to DOS.

Although auto-detection takes place, it's not always right and you may need to adjust it with the following numbers:

```
1       The default.—100% AT compatible
2       IBM PS/2
3       Phoenix Cascade BIOS
4       HP Vectra (A/A+)
5       AT&T 6300 Plus
6       Acer 1100
7       Toshiba 1600/1200XE
8       Wyse 12.5 MHz 286
9       Tulip SX
10      Zenith ZBIOS
11      IBM PC/AT (alternative delay)
12      IBM PC/AT (alternative delay) CSS Labs
13      IBM PC/AT (alternative delay) Philips
14      HP Vectra (fast)
15      IBM 7552 Industrial Computer
16      Bull Micral 60
17      Dell XBIOS
```

If your computer isn't listed above, or you're not sure, try the numbers in this order: 1, 11, 12, 13, 8, 2-7, 9-10, 14-16.

Line 2

```
DEVICE=C:\DOS\EMM386.EXE RAM [512] X=D000-D1FF
```

Loads an Expanded Memory Manager for 386-type computers and above, and creates Upper Memory Blocks. This line creates 512 K. If you didn't specify 512 (or any other amount), all available XMS memory would be claimed for EMS, and Windows could be starved of it. You have the choice of creating a page frame or not, by specifying RAM or NOEMS. With NOEMS, of course, you get another 64K of Upper Memory, because the page frame won't be created.

In this example, the D000-D1FF range of upper memory has been excluded for use as UMBs; this area is commonly used for PCMCIA cards. Although Windows itself doesn't need this driver, it is used by Windows to simulate Expanded Memory in Standard Mode; note it's LIM 4.0, not 3.2!

D= is an undocumented switch that establishes DMA buffers, useful with more than 16 Mb of memory in an ISA machine.

Line 3

```
DOS=HIGH, UMB, NOAUTO
```

Tells DOS to load itself up into the High Memory Area and to use any Upper Memory Blocks it may find, increasing the amount of base memory for programs and data. **noauto**, for Win '95, stops DOS loading **fileshigh**, **buffershigh**, **lastdrivhigh**,

ifshlp.sys, **dblbuff.sys** and **drvspace** (the drvspace bit is undocumented). Saves memory for games.

If any program rewrites **config.sys**, you may find this line split up over 2 lines; it means the same.

Line 4

```
DEVICEHIGH=C:\DOS\RAMDRIVE.SYS 2048 /E
```

This line loads the software that creates a RAM disk or, in other words, sets aside a portion of memory to behave as if it were a disk drive, so you can get some speed.

The default is 64K, which is usually next to useless, so 2 Mb is specified here, because the only reason you would want one is for temporary files, which can be large.

devicehigh instructs DOS to load **ramdrive.sys** high; that is, into upper memory.

The /E switch tells DOS to use extended memory for the RAM disk. You can use base memory or expanded if you wish (with /A), but using the former reduces memory for programs and the latter is less efficient, although you might have an old expanded memory board that you could use; it would be slow, but still faster than a hard disk.

With **qemm**, you can be specific about which areas of the whole memory map you want to be expanded.

Windows ‘95 can only handle RAM disks less than 15 Mb in size, since it uses memory below 16 Mb for its operation, and gets very unhappy when it can’t find any.

Line 5

```
DEVICEHIGH=C:\DOS\ANSI.SYS
```

A device driver needed for putting strange characters and colours on your screen, aside from the ordinary system ones, that is. Some programs need it for proper operation of their screen displays. Needed for the special prompt command in **autoexec.bat**, below.

Line 6

```
FILES=60
```

Here you specify the amount of files that can be open at any time, or that DOS can access at any time. A file handle is a number assigned to a file or device, and a table is maintained that relates handles and the files (or devices) they refer to; it supports the hierarchical directory system. DOS automatically allows 8, 5 of which cover printers, serial ports, etc, but you will find 30 to be more sensible (or 60 with Windows or on a networked PC).

An average DOS application can require about 20 open files at any time; in a multitasking environment, you must accommodate the needs of as many applications as you may have running, so if you regularly run three, count on having *at least* 60 open files for Windows.

Each file here takes 50 or so bytes of base memory away from your programs, so you can scale back here if you're tight on memory.

Line 7

```
BUFFERS=10,4
```

Buffers are small amounts of memory used as temporary holding areas for data *en route* between drives and memory. Linked closely to **files=**.

Each buffer is about 532 bytes, which coincides (nearly) with the size of a sector on a hard disk, as one is read at a time - the extra is due to overheads. Data not used is left in the buffer so a full disk access is not needed later, reducing disk activity and increasing performance, but not as much as a cache would. You can have up to 99 buffers, but the more you allocate, the more memory you use, and, after a point, performance reduces as well. Up to about 48 can be placed in the HMA if just DOS is loaded there, after which they are *all* loaded low (40 buffers=more than 20K).

The amount of buffers specified here doesn't matter if it's less than 48 and destined for the HMA, but if you're using disk cacheing, reduce it to 10 or below regardless, otherwise you might confuse the computer. If not, use 24-30, but be aware that if more files are open than there are available, buffers need to be refreshed more often. If you don't specify buffers, you get the default of 15.

The second figure is the number of sectors to be read into a buffer, but pretty useless if using smartdrive.

You will probably have to experiment with this figure to find the best one for your circumstances; there are several shareware programs that can check the optimum setting for you.

Line 8

```
LASTDRIVE=G
```

The last drive letter allocated in your system. If you have RAM disks, CD-ROMs, or other devices that use a drive letter, you need to tell DOS about them here because it assumes you only have 5 drives; that is, up to E. Each entry takes up 88 bytes of memory, so it makes sense to specify less drives if you have less, to save memory.

Note that the next network drive letter starts after this one.

Line 9

```
SHELL=C:\COMMAND.COM C:\ /P /E:192
```

SHELL is an environment variable that indicates where **command.com** is, which is the program that decides what to do with your commands (as well as containing the internal ones).

When it loads, it splits itself in half, and loads into each end of base memory; that is, just above DOS and just below 640K. The top half is often kicked out of memory by programs that are tight for space, so DOS needs to be able to find it again for reloading. The second part of the command tells **command.com** itself where to find its other half.

The *environment space* is an area where DOS keeps details about its environment. The /E switch used here (this command's only real use) allocates the specific amount of 192 bytes because the default is 272 bytes (with DOS 6.22), which is usually way over what people usually need (unless you have long **path** commands see **autoexec.bat**).

The /P switch both disables the first **command.com**'s ability to unload itself (you can load more than one when chaining), and also makes it search for **autoexec.bat**. If you don't have this, you could crash the machine when typing **exit** from a Windows DOS prompt.

You can also alter the environment size from within Windows, should you need it for a DOS Session under it. You need to add the line:

```
CommandEnvSize=###
```

to the **[386enh]** section of **system.ini**, where ### is the size of the space you wish to reserve.

Line 10

```
COUNTRY=044,C:\DOS\COUNTRY.SYS
```

The country you're in needs to be specified because computers assume they're in the USA unless told otherwise, and you will get the wrong date and time settings. The numbers are loosely based on the telephone system, and the space between the commas is for the code page number, should you change that as well.

country.sys is the file where DOS keeps details about the countries concerned, and its location is specified here.

Line 11

```
STACKS=9,256
```

The stack contains the next command to be issued, and when an interrupt occurs (such as a mouse movement), the command the computer was going to perform before it was so rudely interrupted is placed on top of the stack. When the interruption ceases, the computer takes the details off the stack again and resumes from where it left off. Stacks therefore contain commands the computer can't handle right now, which could be several at once. The stack's location changes as programs are loaded and unloaded, but it can typically be found above the current program's code and data. Since the stack grows downward as it gets bigger, it mustn't get above a certain size, or it will interfere with running programs and cause all sorts of trouble.

A program assumes there is enough stack space to handle the interrupts it generates, but when multitasking, this is not necessarily the case, especially when you get *nested interrupts*, or a situation where another starts before the previous one has finished.

A typical hardware interrupt handler needs between 16-128 bytes of stack space. If you run out, you get a *stack overrun*. The default is 9 stacks of 128 bytes each (or 9,128), for 286s and above, but if you specify 0,0, no memory is allocated at all (saving 2K). Most programs do their own stack handling anyway, so stacks aren't usually needed, but Windows is lazy and gets DOS to do its work, so it needs 9,256.

Line 12

```
FCBS=1,1
```

File Control Blocks are a DOS 1.x method of allowing multiple files to be open at the same time (as opposed to using **files=**). An FCB is a data structure at the start of a file that keeps information about it, such as size, etc. If your program cannot access files outside the current directory (e.g. WordStar 3.3), then it probably uses FCBs. The default is 4, so you gain 176 bytes by specifying 1 here. You can't use 0.

Line 13

```
DEVICEHIGH=C:\DOS\SETVER
```

setver fools programs into thinking they are talking to a particular version of DOS. You may or may not need this if your programs don't care what DOS they are running under, this is useless baggage.

Line 14

```
DEVICEHIGH=C:\CDROM\SGIDE628.SYS /D:MSCD001
```

Loads a device driver for a CD-ROM (supplied with the device). The /D: parameter gives the device a name which must match the line for **mscdex** in **autoexec.bat**.

Line 15

```
INSTALL=C:\DOS\KEYB UK,C:\DOS\KEYBOARD.SYS
```

install can load TSRs before **command.com**, so they take up less memory. Not always successful (e.g. with those that use environment variables, or short-cut keys to activate them), but it's worth trying.

IFSHLP.SYS

You also need this for Windows For Workgroups. It's the Real Mode component of 32-bit File Access, and should not be loaded high, even though it works there, and only takes up 3K.

DR/NOVELL DOS

Here's a similar **config.sys** for DR DOS (NOVELL DOS is like MS-DOS):

```
DEVICE=C:\DRDOS\EMM386|HIDOS.SYS /B=FFFF /F=AUTO
HIDEVICE=C:\DRDOS\VDISK.SYS 1024 /E
HIDOS=ON
FILES=30
BUFFERS=10
LASTDRIVE=D
SHELL=C:\COMMAND.COM C:\ /P /E:192
COUNTRY=044,C:\DOS\COUNTRY.SYS
STACKS=9,256
FCBS=1,1
HIDEVICE=C:\CDROM\SGIDE628.SYS /D:MSCD001
```

The commands are similar, but the differences are detailed below:

Line 1

```
DEVICE=C:\DRDOS\EMM386|HIDOS.SYS /B=FFFF /F=AUTO
```

DR DOS's way of activating the HMA and Upper Memory blocks, like **himem.sys** and **emm386.exe**, but only one command is used for both.

Use as appropriate, with the command switches to vary their operation. /B=FFFF forces DR DOS into the HMA. /F=AUTO means find a space for the page frame automatically, assuming you use **emm386.sys** (use /F=NONE if you don't want one).

Line 2

```
HIDEVICE=C:\DRDOS\VDISK.SYS 1024 /E
```

hidevice is the same as **devicehigh** in MS-DOS.

Line 3

```
HIDOS=ON
```

DR DOS's version of **dos=high**. Upper Memory Blocks are opened automatically.

AUTOEXEC.BAT

This is a batch file in the root directory of the system disk (usually C:). It runs immediately after **command.com** has been loaded (after **config.sys**), and typically contains DOS commands that are run once only; usually at the start of a working session. All batch commands are valid, and it may look like this:

```
@@ECHO OFF
LOADHIGH C:\DOS\KEYB.COM UK
LOADHIGH C:\DOS\DOSKEY.COM /bufsize=192
LH C:\DOS\MSCDEX /D:MSCD001 /L:G /M:10 /S /E
C:\WINDOWS\SMARTDRV.EXE 2048 128 /X A-
PATH C:\DOS;\UTILS;\BAT;\WINDOWS
PROMPT $p$g
SET TEMP=C:\TEMP
SET TMP=C:\TEMP
SET WINPMT=$e[s$e[1;44m This is WINDOWS!!!$e[40m$e[u$_$p$g
LH C:\DOS\SHARE.EXE /F:4096 /L:30
```

Note the memory-resident commands (TSRs) that have been loaded before the **path** or **set** commands, or other variables. This is because each program gets a copy of the (used) environment space as it loads, and if you have a lot in the environment (like long **path** commands), you use memory more than once for the same information, so those loaded first don't get excess baggage.

Line 1

```
@ECHO OFF
```

Don't display this line (@), or the following commands as they execute.

Line 2

```
LOADHIGH C:\DOS\KEYB.COM UK
```

Specifies the keyboard driver; not needed if not running DOS programs.

Line 3

```
LOADHIGH C:\DOS\DOSKEY.COM /bufsize=192
```

Loads a command line editor; aside from allowing you to edit mistakes as they happen, **doskey** is useful for recycling past commands so you don't have to type them again.

Line 4

```
LH C:\DOS\MSCDEX /D:MSCD001 /L:G /M:0 /S /E
```

The *CD-ROM extension* software; the name must be the same as specified in **config.sys**. The drive letter is allocated automatically, but it is possible to specify one on this line, in this case G. Version 2.23 of **mscdex** is much more efficient than others, as well as having better error correction and less impact on memory. Versions prior to 2.22 needed a block of upper memory equal to the load size, plus 48K! **mscdex** takes 12 buffers, 2K each, for the CD directory which can be adjusted with the /M: switch. It's set to 0 here (disabled), as Smartdrive is used; apparently this is unnecessary with DOS 6.2 or later, anyway. If you have to use them, try the /E switch, which places the buffers into expanded memory.

/S allows the CD ROM to be shared. /E makes it use expanded memory (reduces base memory used).

Line 5

```
C:\WINDOWS\SMARTDRV.EXE 2048 128 /X A-
```

This is loaded after **mscdex** so the CD-ROM is picked up for cacheing as well, since the latest version can cope with them. The parameters establish a cache size for DOS (2048), leave a bit in Windows for the CD (128), disable lazy writes for drive C and exclude drive A from cacheing.

Some tips for using Smartdrive:

- ❑ Disable write back for floppy drives (remove the + after the drive letter). You could lose data if the floppy is removed before being written to; having said that, installation of programs is quicker.

- ❑ Don't use more than 2 Mb; the percentage increase in performance is not worth the extra memory used.
- ❑ For temporary and swapfiles, you don't need cacheing.
- ❑ Don't use double buffering unless you need it.
- ❑ Don't use Smartdrive if you have 32-bit File Access turned on in Windows for Workgroups 3.11, unless you want to cache a CD ROM or floppies; it has its own cacheing (vcache).
- ❑ Defrag often, so Smartdrive gets as near to 32BFA performance as possible, by pulling in complete files.
- ❑ Use less buffers. 10 is sufficient.

Line 6

```
PATH C:\DOS;\UTILS;\BAT;\WINDOWS
```

Establishes a search path for programs. Each entry is separated by a semi-colon. The **path** statement must be less than 127 characters, including the words **path=**, but DOS 6 allows you to use more. Use **append** to make it longer if needed. One tip is to include the drive letter with each entry if you change drives a lot, otherwise you will lose the connection. DOS filenames can be up to 127 characters; it's just that every ninth character must be a backslash. Long path commands can slow a file server, as every time the directory is searched, the directory is transferred over the network cable.

Line 7

```
PROMPT $p$g
```

Sets the prompt to display the current directory. Make variations to this with **ansi.sys** loaded in **config.sys**. More in **set winpmt** (line 10). DOS assumes that the volume referred to is removeable, as it can't tell the difference between that or permanent. This command causes DOS to check the directory in RAM against that of the volume, which can slow things up if it is a shared volume on a server.

Line 8

```
SET TEMP=C:\TEMP
```

Sets up a variable that can be interrogated by programs to find out information about the computer, in this case, where to place temporary files. The directory should be empty to prevent excessive searching, which will slow things down, and at least 6-8 Mb in size. You can add your own variables if you wish (see the **set** command). They are near the end of **config.sys** to reduce the environment loaded by previous programs. A directory is used because of the number of entries allowed in the root directory (with '95, one long filename can take up to 20 directory entries).

Line 9

```
SET TMP=C:\TEMP
```

As for Line 8, in case some programs need a TMP variable.

Line 10

```
SET WINPMT=$e[s$e[1;44m This is WINDOWS!!!
$e[40m$e[u$_$p$g
```

This variable sets the prompt for DOS sessions under Windows, in this case a line with a blue background reminding you of where you are (i.e. **This is Windows!!!**). It's something to help stop you deleting the wrong files or trying to run programs under Windows that you shouldn't.

ansi.sys must be loaded in **config.sys** for this to work, as it uses some of **ansi**'s escape codes. All the above needs to be on one line.

Line 11

```
LH C:\DOS\SHARE.EXE /F:4096 /L:30
```

share allows two or more applications to use the same file. Windows for Workgroups loads a device driver called **vshare.386** from **system.ini**, which does the same job, although for some inexplicable reason, some programs expect to see this line present.

DR DOS

The DR/NOVELL DOS version is similar, except for:

```
HILOAD C:\DRDOS\KEYB UK+
LH C:\DOS\NWCDEX /D:MSCD001
```

Line 2

```
HILOAD C:\DRDOS\KEYB UK+
```

hiload is used instead of **loadhigh**. The + sign indicates an enhanced keyboard. Command-line editing is built in, so a program like **doskey** is not required. In DR/NOVELL DOS, this facility is turned on and off with in the **config.sys** file, using the **history** command.

Line 3

```
LH C:\DOS\NWCDEX /D:MSCD001
```

Novell's version of **mscdex**.

DOS files you don't normally need

Many of these aren't around anyway with Windows '95 - those that survive will be found in the **\windows\command** directory. The reason these are mentioned is both to save you hard disk space, and to give your users less to play with, since they have a tendency to believe that if something is available, they must use it.

File	What it does
.CPI files	Code Page Information files, used to vary screen and printer output for the country you're in. Get rid of them by typing del *.cpi.
.BAS files	Used for BASIC, and boring. del *.bas.
ANSI.SYS	For changing how the screen looks and what the keyboard does. If your programs don't need it to display screens correctly (check the manual), delete it.
APPEND	Tells the system what directories (other than the current one) it should look in for data files (e.g. those not covered by the path command, which is only used for .com, .exe or .bat files), so you can open data files as if they were in the current directory rather than elsewhere. However, when the file is saved, it's not put in its original place but in the current directory, so append only helps you to find files in the first instance. Very confusing! It's not really necessary unless your programs have problems finding their overlay files, or you want a larger path command.
ATTRIB	For manual changing of file attributes. Only useful if other people are using your machine and you want to protect your files, or manually change the Archive attribute.
BACKUP	Makes backup copies of file(s), mainly between hard and floppy disks, unfortunately in a special format, so you can't directly use the backed up files, or restore single ones (you have to restore the whole lot). backup is sensitive to DOS versions, and if a disk becomes unreadable, you can't complete the restore operation. Third party programs are better, and so is xcopy.
CHKDSK	Checks a disk for space allocation and spacing errors. It does not check the surface of a disk, but only whether it presents the device structure that DOS expects. It can also be used for file repair, using the /F switch, but you should use this program without /F first, to ensure that you really want to fix what it finds. This is because chkdsk is to fixing things what a pile of bricks is to the Arts, however good it might be at diagnostics. It always writes to the disk – when it gets to an address on the disk, copies the information into RAM and writes it back again before checking the entries in the FAT. There are better solutions!

File	What it does
COMP	Compares files.
DEBUG	Used for debugging programs for programmers only!
DISKCOMP	Compares two diskettes of the same format track by track.
DISPLAY.SYS	Enables code page switching for EGA and VGA displays. Mostly useless unless you really want to change the way that text looks on screen. Automatically loaded when you install DOS.
DOSSHELL	A pretty front end to DOS that does many tasks on your behalf. Has many associated files as well. Sort of useful, but not a replacement for Windows.
DRIVER.SYS	In config.sys, allows DOS to work with strange disk drives.
DRIVPARM	Allows you to specify the characteristics of a disk drive so that DOS can use it.
EDLIN	A primitive text editor with every version of (MS) DOS; use only in dire necessity, or when you want to show off.
EXE2BIN	Converts .exe (executable) programs into .bin (binary image) or .com (executable) files—programmers only!
FC	Compares files.
FDISK	Used to split hard disks into partitions (not directories). The DR DOS version formats the hard disk as well. For technical people only!
FIND	Looks for text strings in text files and displays the lines containing them. Useful if you're continually forgetting what's on your hard disk.
GRAFTABL	Displays extended graphics and code pages on CGA monitors. But you've got VGA anyway, haven't you?
GRAPHICS	Prints a graphics display on to an IBM-compatible graphics printer, using the Prt Scr key.
GWBASIC	A BASIC program used to create and run .BAS files. Useful for programming, but little else.
JOIN	Makes a complete drive structure appear to be a subdirectory of another drive (related to subst, which allocates a drive letter to a directory path).
MSHERC	Does things to Hercules monitors.
NLSFUNC	Provides support for extended support for country information so you can use chcp to change code pages.
PACKING.LST	A list of files supplied with DOS.
PRINTER.SYS	Switches code pages for IBM printers.
QBASIC	A BASIC program used to create and run .bas files. Useful for programming, but little else; however, it is required by DOS 5 to run the edit text editing program.
RECOVER	Dangerous, this! It's supposed to recover files from a damaged disk, and if used with a particular filename can be successful. However...... under other circumstances, all your subdirectory entries will be rewritten as files, and you won't be able to get to the files that were in them! DON'T use wildcards with recover every file will be renamed and you won't be able to remember what they used to be! Delete this and use a third party program instead (even on floppies).
REPLACE	Copies selected files from one place to another; it's like copy, but sensitive to target files. For

File	What it does
	example, you can update previous versions of files, so it may be useful for updating software, but little else.
RESTORE	Restores directories and files that have been backed up with backup. If you don't use backup, you don't need this.
SETVER	Allows DOS to report a different version number when interrogated by programs. Sometimes needed.
SHARE	This provides support for file locking, so files can be shared between programs, or you can load more than one copy of a program. With some versions of DOS (i.e. 4), it's needed to cope with large hard disks.
SID	The DR DOS version of debug.
SORT	A filter program that reads data, sorts it alphabetically and writes it again.
TOUCH	Changes the time and date stamps of files.
TREE	Gives a picture of your directory structure.
VIEWMAX	The DR DOS equivalent of dosshell (GEM revisited).

Using Text Editors

You need a text editor to create or modify batch files and the like. The three described are supplied with their respective DOS versions, and enough instructions are given to allow you to open, edit and save a batch file. For full information, refer to the DOS manual.

You can also use a wordprocessor, but *make sure you save the file in ASCII format* (printing to disk will have the same effect). Some wordprocessors (e.g. Wordstar) can create ASCII files directly with a special method of operation called *non-document* mode, which means simply that the text you are editing will not be in document format—there will be no special instructions for margins, word wrap and the like, just straight ASCII text with a Carriage Return and Line Feed at the end of each line.

EDLIN

Comes with all versions of MS-DOS below 5, and is a very rudimentary line editor (not a text editor), and used in dire emergency (or for showing off!).

Format:

```
EDLIN filename.ext
```

Comments:

If the file you propose to edit does not exist, you will see:

```
New file
*
```

At this point, type:

```
I
```

followed by **Return**, and you will see:

```
1:*
```

Simply type the text you want on line 1, press **Return** to go to line 2, and so on. When finished, type **Ctrl-C** to return to the asterisk prompt. Then type:

```
E
```

to end file creation. If the file you designate does exist, you will see:

```
End of input file
*
```

which means that the contents of the file you want to work with have been loaded into memory. If you want to see them, type:

```
L
```

followed by **Return**, then type the number of the line you want to alter, also followed by **Return**. Edit the line as necessary.

Quick command list

Command	Meaning
?	List the commands available.
D	Delete the current line (the one with the asterisk).
I	Insert a line; use with the number of the line before which you want a new one; e.g. I5 for a line between 4 and 5.
Ctrl-C	Stop editing and return to the * prompt.
E	Save the file and exit.
Q	Quit without saving.

EDITOR

A full-screen text editor that comes with DR DOS which can handle files of any size.

Format:

```
EDITOR [/Help] [d:][path][filename[.ext]]
```

Comments:

On the command line, you can add a filename (and path, if necessary) so you can bypass the opening screen:

```
EDITOR AUTOEXEC.BAT
```

If a filename is not supplied, you will be asked for it. If the file does not exist, **editor** will ask permission to create it.

The next thing you will see is a blank editing screen.

Keys used:

Basically similar to WordStar (remember that?). Combinations of keys are used; for instance, holding down the **Ctrl** key while pressing S will move the cursor one space left through the text, while pressing **Ctrl-D** will move it one space to the right. These key combinations are commonly written as **Ctrl-S** or **Ctrl-D**, and the same system applies to all the other commands (the full list is given below). Notice that **Ctrl**-E, X, S and D form the shape of a diamond on the keyboard and move the cursor Up, Down, Left and Right respectively.

There are short cut keys, like **Insert** or **Delete**, that do the same job as some of the **Ctrl**-*key* combinations, which are also described later. Enter text as required. There is no word wrap facility, so **Return** is needed at the end of each line.
editor starts in *Insert mode*, which means that any text typed will move any already there one space to the right. To use **editor** in *overtype* mode, where text you type in overwrites any already there, press **Ctrl-V**, or the **Insert** key if you have one. The display at the top of the screen to show you which mode you're in.

To delete a character *at* the cursor, press **Ctrl-G** or **Delete**. The text to the right of it will shift to the left to fill the space.

Delete

To delete the character to the *left* of the cursor, type **Ctrl-H** or use the **Backspace** key. To delete a whole word (that is, all characters up to the next space on the right), put the cursor on the first character and type **Ctrl-T**.

To delete the line the cursor is on, press **Ctrl-Y**.

Moving Pages:

Move text up or down a page (actually 14 lines) with **Ctrl-R** and **Ctrl-C**, or the **Pg Up** and **Pg Dn** keys, respectively.

Help:

Help is available with **F1** or **Ctrl-J** (quit Help by pressing **Esc**).

Leaving:

When you have finished typing, you can either:

- ❑ Save your file and start a new one (**Ctrl-KD**).
- ❑ Save your file and quit **editor** (**Ctrl-KX**)

To abandon your file and open a new one, as you would having opened the wrong file by mistake use **Ctrl-KQ**. If you have made any changes, you will be asked if you really want to abandon the file.

To leave **editor** from the title screen, press the **Esc** key.

EDIT

The *MS-DOS Editor* (to give it its full title) comes with MS-DOS 5 and upwards, and depends on the presence of **qbasic.exe** in the same directory to operate. It can only handle files up to a certain size, but should be OK for most batch files.

Format:

```
EDIT filename.ext
```

Comments:

As soon as the edit screen is loaded, you can start typing. Normal editing keys apply; that is, you can move around the screen with the arrow keys, and **Insert**, **Delete**, **Backspace**, etc all work as they should.

Use **Shift** and the arrow keys to highlight text as a block, and **Shift-Delete** to cut the highlighted text. **Shift** plus **Insert** will place that text into a new location.

Help is available with **F1**.

Menus

There is a menu system that makes issuing commands easier. All menus are accessed by pressing the **Alt** key, then the first letter of the one you need, such as **F** if you want to *Open* and *Save* files, and leave the program.

Then press the highlighted letter of the command (mostly **O**, **S** or **X**).

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Windows 3.x

Table Of Contents

Windows 3.x

The core elements behind successful Windows 3.x operation are:

- The PC.
- DOS (where used).
- INI files.
- PIF files (if using DOS programs).

Without getting them right, you won't get Windows running at its best. Working on the principle that the best way out of trouble is not to get into it, the more problems you can eliminate before you start, by setting things up properly, the less you have to look for later.

Windows is based on DOS, and therefore subject to the limitations imposed by that operating system, and its relationship to the PC. Memory is covered more fully in *The BIOS Companion*, and its management in the DOS chapter, but there are several 64K restrictions for Windows to cope with, all due to its association with DOS and/or the 286 processor.

The 286 architecture uses a 64K *data segment size* or, in other words, it moves data round in chunks of 64K at a time (DOS/Windows code, where it is 16-bit, still thinks it's running on a 286). The effects are most noticeable when you start to use *System Resources*, of which more later. Notepad, for example, can only handle files up to 54K (often less), and the logo on the startup screen must be small enough to keep the **.com** file that starts Windows within 64K (e.g. approx 15K).

It's not the 16-bit code that causes problems, but the allowances that had to be made for compatibility and performance. However, time marches on, and the minimum architecture for Windows '95 is 386-based, which is why you don't need to worry so much.

Most people refer to Windows as an operating system; To Microsoft, it's an operating *environment*, since it doesn't actually replace DOS. Having said that, it bypasses it for almost everything, so the answer lies probably somewhere in between. Windows actually consists of a *DOS extender* and an operating environment. It relies on DOS to perform some operations, so it's a DOS extender with a graphical interface. Technically, it doesn't multitask, but Microsoft says it does, so it must be true.

Windows is:

- A GUI (or Graphical User Interface, for short), using drop-down menus, dialogue boxes, program icons and groups.

- A platform for applications using more than 640K.

- A vehicle for multitasking (actually task-switching), of which there are two types:

  - Pre-emptive, where the operating system is in control, and tells applications when they've had enough attention (so you can switch away from an hourglass).

  - Co-operative, where the responsibility is on the application to relinquish control. Windows is co-operative, but pre-emptive when it comes to DOS applications, and 32-bit ones in '95.

  When multitasking, Windows and its programs run in one virtual machine, called the *System VM*, and DOS programs each have their own. Where multiple copies of Windows programs are loaded, some code is shared, through **.dlls**, so the impact on memory is less than you would expect.

  There is a messaging system between Windows and running applications, which means that a program won't receive inputs (say from mouse or keyboard) directly, but get messages from Windows saying they are waiting.

  When you bring an application to the foreground, it should check the message queue and act on what it finds there, which is a convenient point for Windows to take control. This carries on constantly, until you choose another application, or the message queue is exhausted, at which point the program yields. When a program appears to go to sleep and you have to press **ctrl-alt-del** to get out, the message queue has probably become clogged.

- An environment for common services; that is, programs all use the same printers, fonts, etc.

- A structure for data exchange between programs running under it.

As seen elsewhere, the design of the PC is not necessarily suited for all these, and it's often a wonder that Windows works at all, so it presents many problems of its own, which will become apparent as we proceed.

Versions

The first was an imitation of the Apple GUI, in that you could use pull-down menus to launch programs and there was something prettier than DOS to look at (or OS/2, because the original idea was to be a front end for it). There were no compatible programs of course, so all you got was **write** and **paintbrush** and an early version of **clipboard** to link the two. At this stage, November 1983, it was basically another DOS utility, in competition with GEM, a similar attempt from Digital Research.

Windows 2

This was the front end to OS/2 1.0, which contained Program Manager and was based on IBM's SAA, or *Systems Application Architecture*, a uniform text-based system of menus and windows for managing applications. DDE first appeared in this one, as did the creation of virtual machines on the 386.

Windows/286 and /386

In 1987, Windows 2 was renamed Windows/286, and /386 was introduced to use virtual 8086 mode. They didn't make much of an impact, though.

3.0

Out first in May 1990, this caused the first real breakthrough, coming out just when colour monitors became affordable. It ran on an XT, was buggy, with unreliable and slow areas (Print/File Manager), and bitmapped fonts. It could run in Real, Standard and Enhanced modes and had *Unrecoverable Application Errors* (UAEs). It's real claim to fame, however, was *Solitaire*, often the only reason many people bought Windows anyway. 3.0 is out of date now, but can still run software that doesn't expect too much.

3.1

Of Spring '92 vintage, no UAEs, but only because they were renamed as GPFs (*General Protection Faults*). Or should that be *undocumented features*? However, there are fewer of these, because the product is less buggy, but there is also more information when something goes 'orribly wrong. We'll be looking at GPFs more closely later on. 3.1 also has:

- Co-operative multitasking.
- 32-bit Disk Access, where the hard disk is run from protected mode.
- Better screen drivers.
- True Type fonts.
- Dr Watson troubleshooting aid.
- OLE.

Windows 3.11

Came out just after *OS/2 for Windows*, which used the copy of Windows (3.1) already on your hard disk.

Windows For Workgroups 3.1

Introduced in 1992, with peer-to-peer networking built in (actually bought from a Canadian company in Vancouver), and the resulting capabilities, such as CHAT, and file and printer sharing.

- Clipbook, rather than Clipboard, to help with NetDDE and OLE.
- Built in support network print queues directly.
- Microsoft Mail.
- Better help.
- Enhanced File Manager and Print Manager.

WFW 3.11

The first Windows that is actually useable in terms of speed and performance. It interacts more closely with DOS, and has better NetWare support. The device drivers are mostly 32-bit and therefore run in protected mode, and using less real mode services (and fewer lines in **config.sys**!).

- Fax modem sharing over the network.
- Remote dial access to NT servers.
- Better security.
- No Standard Mode. Well, not officially, but try win /d:t.
- 32-bit File Access and network drivers. 32BFA accesses the DOS FAT in protected mode, eliminating unnecessary switching to real mode (or v8086 mode). It also caches files, rather than sectors (4 MB is best).
- **admincfg.exe** utility for system administrators.

Windows' use of memory

Any remaining base memory after DOS has loaded, together with extended memory is known as the *global heap*, and belongs to the system. The *local heap* is free memory in an application's own data segment, which is called upon first, but the global heap can be used if it needs more.

As mentioned, Windows uses segment sizes of 64K or less, like DOS. A *code segment* would contain program code, and a *data segment* any related data. An application's segments would be:

- *Fixed*, which means that it can't be moved. Mostly used for Interrupt Service Routine (ISR) code, for supporting mice or serial ports, or doing something tricky with hardware. Many older **dll**s use fixed segments, which cause most problems when established below 1 Mb (for interrupts) and interfere with the Task Database.

They usually come from the lowest available part of memory, but '95 puts them in extended memory.

- *Moveable*, meaning that the segment can be moved anywhere in memory that Windows wants it (most common).
- *Discardable*, or able to be moved or destroyed when memory is needed (not data segments, for obvious reasons).

Fixed segments are loaded first at the bottom of the global heap, then moveable or discardable ones, but the latter are loaded from the top downwards. When an application with a fixed segment is loaded, moveable and discardable segments are rearranged so the fixed segment can be loaded as low as possible. The reverse happens when the program is unloaded, so fixed segments are not popular as CPU time is used for rearrangements.

With virtual memory, discardable segments are paged to disk, and only destroyed if virtual memory is exhausted. Paging out to disk is handled through DPMI, with the CPU moving data around the system as it wants to. Essentially, as long as Windows requests a block of memory, one is provided for it, even though it might not have real memory related to it.

Windows 3.1 doesn’t use much 32-bit code. Any it does have lives at the low end of physical memory, inside the first 4 Mb, which doesn't give the other memory you have much exercise, and explains a sudden increase in the detection of parity errors when you upgrade to Windows '95. Windows needs to communicate with DOS for Real Mode services, such as saving to disk, and Translation Buffers in Upper Memory are used to do this. They are like a vector table where Windows hands addresses to DOS and are also used for real Mode networking calls. There are 2 4K buffers for each Virtual PC, which therefore means each program, so any application has an immediate overhead of 8K. If the machine is networked, expect to use 6 buffers and 24K.

If Upper Memory is all used up by adapter cards, you can put the buffers in base memory, but not both.

Remember that Virtual PCs inherit the environment that Windows gets when it loads, so if base memory is low to start with, so it will be for Windows applications.

Privilege Levels

Intel chips have a privilege system of memory allocation. Three Rings, 0-3, are used, where whatever software occupies Ring 0 controls everything, what is in Ring 1 controls 1, 2 and 3, and so on. The obvious candidate for Ring 0 is the operating system, and Ring 3 should contain applications, to keep them well away, which is how NT operates, and '95, mostly.

A change of control from one privilege level to another, that is, a *ring transition*, involves a lot of validation and register reloading, and is therefore expensive in terms of execution time, which is why Windows '95 uses 0 and keeps applications and the three core files, **user**, **gdi** and the **kernel** at Ring 3, plus the System VM (the *System Virtual Machine* is the virtual 8086 where Windows and Windows programs are run). The *Virtual Machine Manager* (VMM) is at Ring 0.

The problem is that all programs under Windows 3.x have Ring 0 privileges, so although they are all protected from each other, they can overwrite the protection if they want to! No program is really safe, hence GPFs.

Shared memory address spaces (that is, below 4 Mb and above 2Gb) are mostly unprotected, which means that 16-bit and 32-bit applications can write all over sensitive system areas.

VxDs (see below) are 32-bit protected mode modules running at the most privileged level. They run at Ring 0, and a failure can halt the system.

RISC processors use 2 rings, which is why NT uses 0 and 3 only, to maintain compatibility (NT 4 has **gdi** in ring 0).

Swap Files

These are what Windows creates out of Virtual Memory. Two files will be created - a small read-only file in the **\windows** directory called **spart.par,** plus the swap file itself, as described below. The least recently used pages are swapped out when memory is required; there is no attempt to predict which will be needed later (this is not cacheing).

- A **permanent swap file** is a hidden file on the hard disk used exclusively by Windows, bypassing DOS. It's called 386spart.par. Allocate a permanent file through Control Panel|Enhanced, but Windows always overestimates its requirements. A good rule of thumb is to have approx 12-15 mb of total memory available, so if you have 8 Mb, create a 4-8 Mb swap file. Use more, of course, if you're a heavy graphics user. When reading from the swap file, Windows uses just the part occupied by the application. Network drives do not support the INT13h calls needed to set up a permanent swap file.

- **Temporary swap files** are normal DOS files that vary in size with circumstances, called win386.swp. They are created and deleted automatically when Windows 3.x is started and stopped, do not have a hidden or system attribute and can be deleted, if necessary, any time you are not running Windows. Temporary swap files should only be used if you're short on hard disk space, or if Windows can't create a permanent one (you may have a fragmented, compressed or network drive), as they are real mode services (created with DOS), and you want to restrict the use of real mode as much as possible. Defrag often, and don't point a temporary swapfile to a network drive unless you absolutely must, or you will clog up the network.

If you are running Standard mode, you will also get an *application swap file* whenever you start a DOS program.

If possible, set up swap files locally. The benefits include increased performance for the workstation and less network traffic. You also get the chance of a permanent swap file. Approximately 2 Mb of free hard disk space is needed. You can't have multiple use of the same swap file, so if you set one up on a network drive, it should be in the *user's directory* where no one else can use it.

Temporary swap file location and size can be adjusted by inserting parameters in the **[386enh]** section of **system.ini**. You can specify the drive and subdirectory with the *PagingFile*= setting. Size is controlled by *MaxPagingFileSize*=, which can also be limited by *MinUserDiskSpace*=, that tells 386 enhanced mode to leave the specified amount of disk space (in K) free when creating temporary swap files.

Recommended Maximums

Temporary

Physical memory (actually XMS), rounded to the nearest 4, multiplied by 4, to a maximum of 50% of available disk space. On a network server, this may *not* be the user directory, but half of the hard disk.

When you load Windows, the temporary swap file is initialized wherever Windows is started up from.

Permanent

The largest contiguous free space under 50% of available disk space.

If you have enough memory, say 20 Mb, a swapfile wouldn't be accessed (and you could even run in standard mode to get some speed), but memory is allocated to programs 64K at a time in this case, which is less efficient than the 4K pages that would be used if you were swapping to disk in enhanced mode; smaller pages means more of a chance to knit memory together to suit the system, even though you eliminate a level of disk access. Just set the minimum of 512K.

Not in RAM Drives

The idea of a swap file is to help Windows out when low on memory, so the RAM drive is actually a memory drain; Windows could make better use of that memory as memory, and not need a swap file at all if it has access to it (aside from a diskless workstation, of course, where you could markedly reduce the network traffic).

So, it's generally not a good idea to take memory away from Windows that it could make better use of, but if you have to, make sure the RAM drive is big enough—Windows doesn't handle excessive file sizes gracefully (watch those Postscript files). *At least* 6-8 Mb is recommended. A RAM drive is definitely not a good idea if you only have 8Mb.

Disk Cacheing

This is one of the uses that extended memory can be put to. Briefly, a cache is memory that stores most-often used code so retrieval from the cache is quicker than going to its original location, usually a hard disk. It's a way of bridging the speed gap between components running at dissimilar speeds, like the way queues on a network bridge the gap between PCs and printers.

Should cacheing be on the hardware, that is, on the hard disk controller, or in main memory? There are good arguments for both but, whatever you use, it's worth remembering the bottleneck over the bus. Having a hardware cache only makes the bottleneck easier to live with; it doesn't get rid of it!

Smartdrive

This is the cacheing software that comes with MS-DOS, and Windows. If you're using DOS 5, use the one that comes with Windows 3.1 or above. If not, use the DOS version. The very latest version has write back cacheing turned off by default, after concern about losing data if there was a power cut before the cache was flushed (this is what the **/X** switch is for).

There are two types of cache, *write-back* or *write-through*, with cost/performance tradeoffs with each; write-back is a better choice for performance, where the contents are retained until the system is relatively quiet, and written to the disk at a convenient time. Write-through means that data is written to the disk directly.

Smartdrive also uses *Double Buffering*, which is for bus mastering ISA cards that can only use DMA below 16 Mb RAM. With DMA, as a result of paging, memory addresses passed to DOS are frequently not the same as physical addresses. Double buffering provides a buffer to keep track of where the address is the same as main memory, so nothing gets lost. To see whether your system needs it, type **smartdrv** at the command line and look at the right hand column of the resulting display, which will say **Yes** or **No**.

But do you need to use Smartdrive at all? It's not really necessary with 3.11, which has *32-bit File Access*, but you will if you want to cache a CD-ROM. The faster the hard drive, and the tighter the interleave, the smaller the cache should be, and *vice versa*. The interleave really applies only to older drives, i.e. non-IDE, SCSI or ESDI, as these automatically have a setting of 1:1 (see the *Hard Disk Database* for an explanation).

Increase the cache also for faster CPUs and applications that produce a lot of disk activity (e.g. databases). The more fragmentation you have, the less effective cacheing will be.

Vcache

This is the replacement for smartdrive, both in Windows for Workgroups and Windows '95. Its main claim to fame is that it caches files rather than sectors, so is less affected by fragmentation. As with the swap file, its size changes with need and system resources.

Set the parameters from **system.ini**, in the **vcache** section. *MaxFileCache=1024* seems to work best on an 8 Mb system.

What does Windows consist of?

To work correctly, Windows programs must follow the *Application Programming Interface* (API), which is a set of rules that ensures programs behave themselves, even down to using the same interface, so several of them can run at the same time.

win.com (with 3.x) is a real mode program, created during setup by combining three files during the setup stage. As one of these is the front screen logo, it is possible to change this, which is done with the following command line, in the **\system** directory, after creating your logo as a 4-bit **.rle** file (which is just a compressed .**bmp** file):

```
copy /b win.cnf+vgalogo.lgo+yourlogo.rle win.com
```

The **/b** indicates a *binary copy*, so **ctrl-z** commands are ignored. **vgalogo.lgo** is a short binary program that switches the screen into graphics mode for the **.rle** file (incidentally, you can use an **rle** file directly as wallpaper).

Otherwise, **win.cnf** is a **.com** file that decides what mode to run Windows in, based on your system, then runs the appropriate programs described below. If you don't want to display an opening picture, you can rename **win.cnf** to **win.com** to start Windows for *any* video configuration; **vgalogo.lgo** switches your graphics into the correct mode. **vgalogo.rle** is the logo.

Once loaded, **win.com** hangs around in DOS memory space to provide real mode services, through v8086 mode, as there is no real mode code available once Windows has started. It can also shrink **smartdrv** down to the minimum size specified on the command line (usually in **autoexec.bat**) before starting the protected mode part of Windows. **win.com** also loads the DPMI servers; DPMI is what DOS extenders use to coexist with each other. In a 386 with 2 Mb RAM, **win386.exe** is used as the DPMI host; **dosx.exe** is used if you have a 286, or less than 2 Mb RAM.

Aside from that, three files are at the heart of Windows (actually **.dlls** (see below) with **.exe** extensions):

- ❑ **The Kernel**. Runs programs and passes messages between them and hardware; broadly similar to command.com in scheduling program execution and managing memory. There are two versions, krnl386 and krnl286, for enhanced and standard mode, respectively. Provided its DPMI requirements are met, you can run krnl386.exe by itself, which is how REAL/32 and OS/2 manage to run Windows without DOS. All Windows programs run in the same Virtual Machine, the System VM. krnl386.exe runs in real mode, but in the System VM, not outside Windows.

- ❑ **Graphical Device Interface** (**gdi.exe**). Ensures that all programs look the same, responsible for all events on screen. It contains a palette manager which meets the needs of conflicting applications when colours are limited. gdi provides device independence, with a generic interface, so you don't have to worry about the hardware your application might need, although details are left to GDI device drivers, such as vga.drv. Because of device drivers, applications don't need to bother about the gory details of talking to devices, which can be anything from mice to modems; Windows is responsible, through gdi, for passing application requests to hardware. Kernel is roughly 64K in size, while gdi is over 200.

- **user.exe**. Creates and maintains windows on screen and directs input from the mouse, keyboard, etc, to the right places. Before a button is displayed by an application, for example, user is consulted, which tracks the object's details. Then user will talk to gdi, which will display the item and call for the correct device drivers. Both user and gdi use 64K segments to store working information in, which can be problematical when they become full (see Resources). user is still used in '95; it had to stay in because it has been tweaked so much over the years that programmers have come to rely on its idiosyncracies. One problem here is that it doesn't know how to cope with preemptive multitasking properly.

DLLs

Dynamic Link Libraries are files with commonly used program code, so the same stuff doesn't have to be written over and over, or occupy memory several times over when many applications are running. In short, a collection of functions available to any Windows application. They cannot execute on their own, and are called by **.exe** programs, which don't need to know how they work. Updating just involves changing the **.dll**, so, in theory, you should be able to use a new **.dll** without changing the rest of your software, but overwriting old **.dlls** (by accident or design) is a common source of trouble.

In the same way that **config.sys** and **autoexec.bat** control how DOS uses your computer, two other text files, **win.ini** and **system.ini** control the way Windows works. These will be looked at in more detail later.

VxDs

Virtual Device Drivers, which are loaded from **system.ini** (the [386enh] section) into the lowest segment of the global heap, usually just above the low memory area used by DOS. They are used by Windows to handle the keyboard, mouse, printers, and other stuff that connects to the motherboard. Technically, a VxD is a 32-bit protected-mode **.dll** that manages a system resource that can be shared by many applications so they can support multitasking. Being 32-bit, they are only available on 386s or above. The *x* is a variable, where *D* might represent *Display*. If the VxD runs a software resource, it envelopes the code and fools it into thinking it is only being run on one computer.

In Windows 3.x, VxDs remain in memory. In Windows 95, they are dynamic, that is, loaded and unloade as and when needed (or not). Windows 95 will also try to substitute a VxD for any device listed in **config.sys**.

Maths Coprocessor

Most Windows applications don't benefit from these, aside from the usual spreadsheets and CAD programs, although Corel Draw! does use one, for gradient fills. If you're using a DX/2 or above, you get one anyway.

Installation

There are certain tasks that are best performed before you start. The best tip is to get it on the hard disk with basic settings, *then* install the exotic hardware, so you can at least get the files copied and expanded with relatively little trouble.

Check Hardware

Can your hardware run the software? *Is it reliable?* An overnight test with a repeating **xcopy** loop will be a good check.

Is there enough hard disk space?

The system partition needs enough space for a swapfile 12 Mb greater than system memory, and you need enough for print queues, temporary files and another (basic) installation in case the first one breaks and you need to back up data. Windows for Workgroups requires approx 4.5 Mb more disk space than Windows 3.1. This table gives you an idea:

Type	Win 3.1 (Mb)	WFWG 3.11 (Mb)
Full installation	9.5	15.0
Upgrade 3.x	5.2	10.0
Network (Setup /A)	15.3	21.0
Network (Setup /N)	.3	1.2

CHKDSK/SCANDISK

Run one of these, as defragmentation (below) won't happen if there are cross-linked files or lost clusters (parts of files that don't have a corresponding entry in the File Allocation Table; cross-linked files exist where the FAT allocates the same disk space to more than one file, and are more likely to be reported if you run **chkdsk** from inside Windows).

Scandisk comes with DOS 6 (and '95), and is a better bet if you've got it. It may not get everything, as some error correction takes place independently of DOS, and **chkdsk** only tidies up the FAT—it doesn't tidy up the hard disk! For that you need....

Defrag

Which joins all the files up together again, and maybe compact them to get the most space available in one area. The swap file should be kept well clear and in contiguous space for best performance.

Backup Files

Make copies of all your **.ini** files, and **config.sys** and **autoexec.bat** as a minimum. Microsoft suggests these:

- ini files.

- dat files (for the Registration Database).
- pwl files (password lists).
- DOS-based real-mode drivers in config.sys and autoexec.bat.
- config.sys and autoexec.bat.
- network configuration files and log-in scripts.

Ideally, do a complete backup.

Uninstall software

Particularly antivirus programs, or maybe **qemm** or **highscan**. Edit your initialisation files and **rem** out anything non-critical. Check the **[incompTSR]** section of **system.inf** and check what TSRs are unpopular before you start (**subst**, **join**, **mode**, etc). Reboot to make sure the machine is actually working after all that surgery.

Pre-installed Windows

Many manufacturers don't provide the original disks, so you have to use your own if you want a backup. There should be an automatic routine to make you create some original installation disks, and you may need them if you ever want to install the Windows for Workgroups *upgrade* on such a machine. One problem concerns automatic detection of the network card, and there is a warning message, to be fair, to the effect that the machine may freeze at this point, and to rerun **setup** if it does. What they don't tell you is that your original Windows directory has been doctored and some files deleted, and that, if you're installing an upgrade you need to have Windows installed first. Of course, there isn't one, and you can't reinstall it unless you made a backup of the original disks. Don't save pennies unnecessarily, buy the full version of Windows for Workgroups, or at least have the original disks to hand, because you will be doing this on a Friday about 5 minutes before all the help desks go home for the weekend. The workaround is to edit **system.ini** and edit the **shell=** line to read:

```
shell=progman.exe
```

which will at least give you program manager back.

SETUP.INF

This is a text file that contains information about what Windows needs, or doesn't need, to install properly; for example, this is where text in setup dialogue boxes and choices comes from, and it is used to determine where files will go, or what icons appear in program groups. You can modify it to exclude any device drivers or files that you know no-one will need, so they won't appear in the selection lists. With reference to TSRs, it's worth a look at the **[IncompTSR1]** section, which lists all the TSRs that shouldn't be loaded when installing Windows (I'll be explaining the various ins and outs of Windows text files and their sections later).

Don't try to bypass **config.sys** and **autoexec.bat** to avoid incompatibilities; **setup** reads them anyway to see what you've got loaded, particularly network drivers. **setup.inf** has several sections:

General Installation

`[setup]`	Notes where the **setup** help file is, if you want online help during Setup.
`[run]`	Applications to be run after setup. Empty, usually.
`[dialog]`	Text strings used in dialogue boxes, for example:

```
caption="Windows Setup"
exit="Exit Windows setup"
```

`[data]`	Default settings for **setup**, such as hard disk space for various types (full or custom), and default files, etc. For example, you can make people use only the network installation (**setup /n**) by specifying **NetSetup=true**. If you plan to install additional files, you must increase the minimum disk space required for installation here.
`[winexec]`	Data needed by DOS mode **setup** to copy kernel files for Windows mode **setup**. Leave alone.
`[disks]`	The disks to be used for installation. You can install other apps by adding entries in this section.
`[user]`	Which install disk contains user and company ID.
`[windows]`	Files DOS mode copies to the **\windows** directory.
`[windows.system]`	Files DOS mode copies to the **\system** directory.
`[windows.system.386]`	Files copied to the **\system** directory for 386s.
`[386max]`	As above, if using 386Max.
`[bluemax]`	As above, if using BlueMax.
`[shell]`	The Windows shell for startup (default **progman.exe**).

Display Driver

`[display]` Windows display drivers need three different file types, specified here. Add data for custom displays here.

- ❑ **Display driver** (.**drv**) e.g. **vga.drv**. Handles the communication between the video adapter and Windows.
- ❑ **Grabber file** (.xGR). 2GR is for Standard Mode, 3GR for Enhanced; data exchange between Windows/DOS programs.
- ❑ **Virtual Display Driver** (VDDx.386). Virtual display support in enhanced mode.

Keyboard and Code Page

`[keyboard.driver]`	Maps keyboard driver filenames to keyboard short names defined in **[keyboard.types]**.
`[keyboard.types]`	Creates keyboard short names used in **[machines]**.
`[keyboard.tables]`	Maps short names for **.dlls** to disk locations and filenames for **.dlls** required by specific keyboards. Only for foreign language support.
`[codepages]`	Referred to when any other code page than 437 is installed, so the correct files for the translation table and correct OEM font can be installed.

Mouse Driver

`[pointing.device]`	A table of information for supported mice.
`[lmouse]`	Data for the Logitech mouse driver.
`[dos.mouse.drivers]`	Maps the Windows mouse driver to the DOS one.

Network Installation

`[network]`	Associates the network keyname with the files that must be installed for it.
`[network.drivers]`	Information about specific versions of network drivers, e.g. **[banyan.versions]**.
`[network specific]`	The data **setup** must add to **win.ini** or **system.ini**.

System Fonts

Refers to the following sections to install the system font. **setup** figures out what fonts to install by matching the resolution in the **[display]** section.

`[sysfonts]`	Defines system font files.
`[fixedfonts]`	Defines fixed-pitch font files.
`[oemfonts]`	Defines OEM system font files.

Copy-Files

Used by Windows mode **setup** to figure out which groups of files to copy to the **\windows** and **\system** directories.

`[win.copy]`	For 286s.
`[win.copy.net]`	For 386s on network installations.
`[win.copy.net.win386]`	For 386s and network installations.
`[win.copy.win386]`	For 386s and upwards.
`[DelFiles]`	Files to be deleted when upgrading from Windows 3.
`[RenFiles]`	Files to be renamed when upgrading from Windows 3.
`[Win CopyFiles]`	Contains sections like **[win.games]** that describe applications. Files are copied if requested during Custom setup. Otherwise, all are copied during Express setup.

Program Manager

Program Manager creates groups listed here after files have been copied.

`[new.groups]`	This section is used instead of **[progman.groups]** (below) if you are updating from Windows 3.0.
`[progman.groups]`	A list of Program Manager groups built for a new installation of WfW 3.1. Add custom ones here.
`[group#]`	After Program Manager groups have been created, program items are installed in them based on the entries in this section.

Fonts

The last files to be copied are raster, vector and TrueType fonts.

```
[fonts]
[ttfonts]
```

Incompatible Drivers

Some DOS drivers and TSRs are not compatible with Windows, and can therefore cause problems if running at the same time. The following sections are checked for the names of known incompatible software:

`[compatibility]`	If **setup** finds anything in **config.sys** that loads files listed in this section, it is removed and substituted with a blank line.
`[incompTSR1]`	TSRs and drivers here can prevent **setup** from running, and should be removed before running it.
`[incompTSR2]`	TSRs and drivers listed herecan cause problems if running during setup or when Windows loads.
`[block devices]`	Those listed here are not compatible with Windows for Workgroups 3.11.

Miscellaneous

[installable.drivers]	Specifies drivers for multimedia, e.g. Soundblasters.
[translate]	Translates Windows 3.0 **oemsetup.inf** entries.
[update.files]	Installable drivers to be updated if earlier versions are already present.
[update.dependents]	Updates dependents of files in **[update.files]**.
[ini.upd.patches]	Used by both versions of **setup** to temporarily rename profile strings for **.ini** entries during **setup**, if the original exists and has a value defined.
[blowaway]	Marks the end of installation information and the beginning of the configuration sections. Tells Windows mode **setup** where to stop reading **setup.inf**, as it doesn't need this information.
[ini.upd.31]	Tells **setup** which lines in **system.ini** and **win.ini** are to be replaced with new values in the upgrade from Windows 3.0.

System Configuration

Provides information for installing appropriate files for various computers.

[system]	Maps the system short names used in the **[machine]** section (below) to the appropriate system files.
[machine]	Used by **setup** to install appropriate system files for various computers that don't work with DOS System option. Do not change the order of entries here.
[cookz]	Information for modifying entries in **.ini** files, usually to define **[386enh]** entries in **system.ini** as defined in the **[machine]** section. For example, you may be using an AST system and require the lines **EMMExclude=E000-EFFF** to be added.
[special adapter]	Used by DOS mode **setup** for special adapters that need additional files for a standard installation. For example, Etherlink MC adapters need **DMABufferSize=32** to be placed in the **[386enh]** section of **system.ini**.
[ebios]	Used by the **[machine]** section to indicate which files are copied for EBIOS support.
[language]	Installs language libraries.

OEM.INF

When you install new drivers, an **oemx.inf** file is automatically built with a list of driver descriptions and saved to the **\system** directory. You can clutter up your system with these, though; so much so that the DOS version of **setup** won't be able to cope with them all in memory, which is why you might get an "out of memory" message. They are numbered chronologically so you can delete the earlier ones first, that is, they are renamed **oemx.inf** as they are added to, where *x* is a number.

In Windows ‘95, they are kept in a hidden directory, **\windows\inf**, which you can only get to with **cd** from a dos prompt. If you are trying to reinstall hardware and ‘95 refuses to accept your new settings, look in here and delete some old **.inf** files.

Running SETUP

Done with the floppy shuffle, unless you have a network, which is discussed separately. The **setup.shh** file is also useful for automated installations. Windows '95 is mentioned in a few pages.

3.1x Express Install

Makes assumptions about your equipment, but creates a *temporary* swap file. You should never use the Express setup of *anything*, anyway!

3.1x Custom Install

Use this even though you eventually only choose what you would have got with the Express Setup. It gives you maximum control over the installation, plus it doesn't overwrite **config.sys** and **autoexec.bat**, unless you tell it to. Also, you don't get to load programs you don't want, such as help files and screen savers, *and* you get to choose the type of swap file. The problem is that you have to tell **setup** what equipment you have; if you specify it wrongly, Windows may not work afterwards. If you get a problem, run **setup** again with the defaults, then reinstall any variations later. If in doubt use basics, and only change what you're sure about.

You need certain information to hand before running Custom Setup:

- **Target directory**. You're given the chance to install Windows in another directory, which you might want to do if you've got a highly specialised setup, or want to test the new installation before you go live, particularly with accounts systems, which need to be run in tandem with the old system for a few months just to make sure.

- **Computer**, **display**, **mouse** and **keyboard** types.

- **Language**. Check out the International section of Control Panel before releasing the machine.

- **Printers**. WP and DTP software sometimes build font lists from typefaces supported by the printer, rather than those that can be seen on the system, so if you have primitive printers installed that don't use TrueType (e.g. Generic Text Only), you might not get the fonts you expect, therefore its worth installing a good printer, even if you don't intend to use it.

  Otherwise, it's handy to have the following installed:

  HP Laserjet II/III/4
  Generic Text Only
  Epson FX
  Postscript
  Deskjet/Canon BJ series

  The Generic/Text printer can be used to print to a file, to help if an application doesn't have an ASCII export option.

- **Network equipment**. IRQ, Base Address, I/O address, etc. Windows for Workgroups attempts to autodetect the type of card, but it won't find the settings.

- **Type of Network**. Primary, secondary, etc.
- **Names of users**. And companies. You can change them later with winsetup /f (setup /f for 3.1), run from inside Windows.
- **Graphics adapter**. Choose VGA to get the system installed, then go on to more exotic varieties later (particularly Diamond cards).

Command switches

SETUP /? will get you the following on screen:

/I	ignores automatic hardware detection.
/N	sets up a shared copy from a network server.
/A	administrative setup, dealt with shortly. '95 uses **netsetup**.
/B	gives you monochrome display attributes.
/T	searches the drive for incompatible software.
/H	gives you a hands off setup, dealt with shortly.
/O	allows you to specify the setup.inf file.
/S	is as above, but including a path for the Windows disks.
/F	with WfW forces network card detection (run inside Windows —try **winsetup /f**), changes user and company information.
/L	keeps a log of the installation so you can spot errors.

Network Installation

Refer to *Networks*.

Setup Template File

You can create a template file yourself (in ANSI characters), to your own requirements, which is useful if you regularly have shiploads of machines coming in (it's just the same as having a set of standard **ini** files). You can also cut out user interaction, to keep their sticky fingers off! Take care of all the questions you get asked during setup automatically with ....

SETUP.SHH

Comes with Windows (Disk 1), which you can modify to create your own template. It is only copied over when you invoke **setup /a** and should naturally be placed in a directory where the rights are available to open it. If you leave something out, Windows uses the default in **setup.inf** or what it actually finds; when upgrading it uses those already installed. To override existing devices, use an exclamation mark first. Sections included are created from profiles in **setup.inf** and are as follows:

[sysinfo]

Showsysinfo=no	Yes displays the blue setup screen. It's quicker without, but you might want confirmation.

[configuration]

`machine = ibm compatible`	from **[machine]**
`display = !vga`	from **[display]**
`mouse = tdcbp`	from **[pointing.device]**
`network = wfwnet`	from **[network]** in **winnet.inf**.

[windir]

`d:\windows`	Where to put your Windows files..

[userinfo]

`"Fred Bloggs"`	User Name (Max 30 chars—required
`"Bloggs Trading"`	Company Name (Max 30 chars)
`xx-xxx-xxxx-xxxx`	Product No. (Max 16 chars)

The User Name is required. Both can be up to 30 characters long and must be in quotation marks if they have blank spaces. The third line specifies the product number, which will be ignored if you are setting up across a network.

[network]

Network options and adapters. This will only be processed if the Network entry in the **[configuration]** section is a version of **wfwnet** (Workgroups).

`Network =`	wfwnet/00026000
`MultiNet =`	from [multinet] in winnet.inf
`UserName =`	from system.ini (20 chars)
`WorkGroup =`	from system.ini (15 chars)
`ComputerName =`	from system.ini (15 chars)
`ShowNames =`	whether to display user names.
`MakeProtocol =`	whether setup.shh contains protocol.ini.

If **MakeProtocol=yes**, the **.shh** file will be copied as **protocol.ini** and the non-**.ini** sections deleted. If no, but no previous **protocol.ini** exists, setup will prompt for a netcard and install default protocols.

[protocol.ini]

Sections deleted from the **.shh** file to make **protocol.ini.**

```
      sysinfo=
configuration=
       windir=
     userinfo=
      network=
 protocol.ini=
  dontinstall=
      options=
     printers=
   endinstall=
```

[dontinstall]

Components you don't want on your system (default=all).

```
accessories
    readmes
      games
screensavers
    bitmaps
```

[options]

Whether you want to set up applications during **setup**, and/or start the Windows Tutorial at the end. If you don't want any, omit this section. You can either set applications up interactively (e.g. you choose the applications) or get **setup** to do it automatically. If you specify both "setupapps" and "autosetupapps", all applications on your hard disk will be set up.

`setupapps`	Setup applications on hard disk
`autosetupapps`	Set up all applications on hard disk
`tutorial`	Start Windows Tutorial at end of Setup

[printers]

The printer description must be in quotation marks if it contains blank spaces. The port value must be the same as in **win.ini**. If you don't want a printer, omit this.

`"HP LaserJet III",LPT1:`	Specify a printer description and a port. Values for the printer description variable are in the [io.device] section of **control.inf**. Values for the port variable are in the [ports] section of **win.ini.**

[endinstall]

Whether **setup** should make modifications to **config.sys** and **autoexec.bat**, and whether you want **setup** to exit to DOS or restart your system when finished. "configfiles" specifies whether **setup** should modify **config.sys** and **autoexec.bat** with the necessary changes, or whether **setup** should save the proposed changes in separate files called **config.win** and **autoexec.win** in your **\windows** directory. If you choose the latter, you must make the changes yourself. "endopt" specifies what happens at the end of **setup**; exit to DOS (as above) or reboot the computer.

```
configfiles = modify
       endopt = exit
```

If you are using **setup /n**, the reboot option is not valid. **setup** will exit to DOS instead of rebooting.

Here is an abbreviated sample, with no games:

```
[sysinfo]
showsysinfo=yes
```

```
[configuration]
machine=ibmcompatible
display=vga
mouse=ps2mouse
keyboard=t4s0enha
language=enu
kblayout=nodll

[windir]
c:\windows

[userinfo]
"Fred Nurk"
"ACME office cleaners"

[dontinstall]
games
```

Network card detection

Comes with Windows for Workgroups and doesn't always work! Once you've got the right card, you can tell whether your setup works when you start Windows; it will tell you whether it's found the card or not. You don't need to reinstall Windows to change any settings, but go through **protocol.ini**.

After Installation

The job isn't finished after the last disk! You might want to do the following for a neater setup, but you can take care of them all in one go with a suitably adjusted **.shh** file.

Check correct language in Control Panel

Even though this is specified in **setup**, you will still need to use **Control Panel|International** to change the language to suit wherever you are (it will default to USA).

Rearrange Desktop

Causes less hassle from users later. It's quite handy to impose a standard screen layout so when you talk them through a problem over the phone later, you can ask them to open a group and you will know the location of the icons on the screen. Aside from making things quicker and easier, it will also instil an element of confidence in your user's mind. You could:

- ❏ **Tile Program Manager** (through Task Manager) so you can see any minimised icons along the bottom of the screen.

- ❏ **Combine groups**, or at least put all the commonly used icons into one group and minimise the rest. On a network, create some fixed groups and others that users can modify, to give them the illusion of power. It's 50 items per group, by the way, and a total of 40 groups. Neither can you officially nest groups, although Norton Desktop, etc allows you to (unofficially, you can "nest groups" by placing icons as packages in a Write document and treating that as a "group"). Startup icons operate in the order they were put there. Open two groups, one to be always open, tile them and close the other, repeating for all others, so that any others always go into the empty space and you don't get phone calls saying that an icon has disappeared when all that's really happened is that it's got hidden behind a window.

- Highlight the most often used icon before you save the Desktop, so all the user needs to do is press Enter to start it.
- Remove some settings or options so users can't change anything (more in progman.ini).

Adding programs after installation

With Windows 3.x, you might have to do this if something gets corrupted. Files are in compressed format, so you can't copy them directly. Use the **expand** command:

```
EXPAND A:MOUSE.CO_ C:\WINDOWS\MOUSE.COM
```

With Windows '95, you can add files after installation with **Settings|Control Panel**, and the **Add/Remove Programs** section; choose Windows setup for programs that come with '95.

Delete unnecesary files

Like **read.me**s, screen savers, wallpapers, File Manager, Solitaire, etc, which will save space on a laptop. You can make sure they aren't loaded in the first place through the *Custom Install* option. However, there are still files that can safely be done away with, and a full list of unnecessary ones is overleaf.

You might also want to delete **bootlog.txt** if your installation was successful, and the memory managers that won't be used, if you're already using the DOS ones, together with whatever version of **smartdrv** will be redundant. If running NetWare, look at the **ipx//netx** files you don't need as well. Don't forget any files in the **\temp** directory, any ending with **.tmp**, or starting with **~woa** or **~grb** and any named **win386.swp**, BUT NOT WHILE WINDOWS IS RUNNING!

Name	Subdirectory	Size (K)
*.BMP	WINDOWS	187
*.WAV	WINDOWS	80
*.SCR	WINDOWS	58
*.WRI	WINDOWS	364
SOL*.* WINMINE.*	WINDOWS	239
*.MID	WINDOWS	74
CALENDAR.* CARDFILE.* CLOCK.* MPLAYER.* PACKAGER.* PBRUSH.* PRINTMAN.* RECORDER.* SOUNDREC.* WINTUTOR.*	WINDOWS	1020
CALC.* CHARMAP.* MSD.* TERMINAL.* WRITE.*	WINDOWS	714
*.HLP WINHELP.EXE	WINDOWS	724
*.TXT	WINDOWS	27
MODERN.FON ROMAN.FON SCRIPT.FON	SYSTEM	34
COURx.FON SMALLx.FON SYMBOLx.FON	SYSTEM	105

Name	Subdirectory	Size (K)
MCI*.* MIDI*.* TIMER.DRV	SYSTEM	134
SYSEDIT.*	SYSTEM	18
xxLOGO.*	SYSTEM	27
Total		+3805

Install latest drivers/DLLs

The idea behind drivers in Windows is that all programs share the same ones, which works pretty well now—manufacturers used to supply their own all the time in the old days. Actually, it used to be that software had to cater for all the hardware on the market; Wordperfect, for instance, had a good reputation for all the printer drivers it came with.

The result was that you had software people writing software, but now, its hardware that has to work with Windows, so you have hardware people writing software, which is probably one reason for so many problems.

However, the latest drivers don't always work, so take the advice to keep them ruthlessly up to date with a pinch of salt; keep the fact in mind that you've actually got the latest driver as a potential trouble source; this is particularly true with Canon scanner drivers; the older IX-12 one often works better, or rather, less badly.

One source of drivers is Microsoft's web site; others include CIX, Compuserve and, of course, the people who wrote your software. For NetWare, you may need to supply the following yourself:

```
VIPX.386
VNETWARE.386
NWPOPUP.EXE
NETWARE.DRV
NETWARE.HLP
```

You will almost certainly need the latest Video for Windows drivers, which seem to change every week, and **vbrun300.dll**, for Visual Basic programs.

Starting Windows

3.1x

What mode Windows starts in is mostly automatic, but force it with:

/3 Enhanced mode (uses 35 million instructions).

/S Standard mode (3.1). Up to 15% faster (only 5m instructions), but no multitasking, windowed DOS sessions or virtual memory. Starting with **/s** actually loads **krnl386.exe**, together with its excess baggage, rather than **krnl286.exe**. To get real Standard mode, use a 286 or delete/rename **krnl386.exe** so **win.com** can't find it. Does not apply to 3.11, which doesn't have standard mode anyway. At least, not officially from the command line, but see **/D** below.

/B creates a **bootlog.txt** file to record system messages generated during startup. It will identify the process with one of three statements; **Loadstart**, **LoadSuccess** or **LoadFail**:

```
LoadStart = system.drv
LoadSuccess = system.drv
LoadStart = keyboard.drv
LoadSuccess = keyboard.drv
LoadStart = mouse.drv
LoadSuccess = mouse.drv
LoadStart = vga.drv
LoadSuccess = vga.drv
```

/D is for troubleshooting when Windows doesn't start. Most useful when telling somebody what to do over the phone, because you can't expect them to edit startup.
:F turns off 32-bit disk access, which only works with controllers based on the WD 1003 standard. Equivalent to the **32BitDiskAccess=False** setting in **system.ini**
:C in WFW turns off 32-bit File Access
:S specifies that Windows should not use ROM address space between F000-FFFF for a break point. Equal to the **SystemROMBreakPoint=False** setting in **system.ini**
:V specifies that the ROM routine will handle interrupts from the hard disk controller, so this disables virtual HD access. Otherwise, they are handled in protected mode, which is best for performance. Equivalent to **VirtualHDIRQ=False** in **system.ini.**
:X excludes all upper memory from Windows. If Windows loads successfully, that's the source of your problem. You can exclude specific areas with **EMM386.EXE X=XXXX-YYYY**, and **EMMExclude=XXXX-YYYY** in the **[386enh]** section of **system.ini**
:T starts Windows For Workgroups 3.11 in Standard Mode.

/N Starts WFW without a network connection.
: Starts Windows without the opening logo.

Start Windows with the **Shift** key down during the startup logo and the Startup group isn't invoked.

Starting with a batch file

You might want to do this for several reasons:

- ❑ To preserve or change drive mappings on a network.
- ❑ To rename files you don't want users to touch, and back later.
- ❑ To run a TSR for all DOS Sessions, but only before Windows loads, to save DOS memory.

WINSTART.BAT

The Windows equivalent of **autoexec.bat**, in that TSRs in it are executed automatically when Windows starts in 386 enhanced mode (just after the loading screen), and are only made available to Windows applications; they are not loaded into DOS sessions. Otherwise, TSRs loaded before Windows starts are available in Windows and DOS Sessions.

Initialisation files

Windows uses certain text files to define its working environment; they include **control.ini**, **progman.ini**, **system.ini**, **win.ini** and **winfile.ini** which are text files split into several sections, described by a keyword in **[square brackets]**. There should be a blank line between each section; don't be tempted to delete them to save memory, as suggested in some magazines. Not only is the memory saving minimal, if any, but some programs expect to see one (and only one) blank line. Any more or less will stall the installation process on one disk; Powerpoint is, or was, sensitive to this.

Normally, you change the contents of these files through Control Panel or **setup**, but sometimes you need to edit them manually. Since they are text files, use a normal text editor; Notepad is not always useful, since it can't take long files, which you will get if you load too many fonts with **win.ini**.

There is a program called **sysedit**, that opens and allows you to use a selection of **.ini** files, together with **config.sys** and **autoexec.bat**; all your startup files, in fact. Windows 3.1 opens up **win.ini** and **system.ini**, while WFWG includes **mail.ini** and **protocol.ini** as well.

But first make a backup! In fact, it's a good idea to have spare copies around the place anyway. A typo in **system.ini** can cause Windows not to load – the implication is that **system.ini** is a required file for Windows. **win.ini** isn't, and, if it's missing, Windows will create a new one as it loads.

Some settings are case sensitive, and the value *On* can be represented by *1*, *True* or *Yes*. Similarly, *Off* can be either *0*, *False* or *No*. Lines beginning with ; are ignored, so they are useful for comments to yourself, like **rem** in batch files. If a line is absent, the default is used.

WIN.INI

Settings that customize the environment to your preferences, and looked for by Windows after **system.ini** is loaded. It is the equivalent of **autoexec.bat** in DOS. Many programs add their own sections, instead of creating their own **.ini** files in their own directories. The ones Windows puts in are as follows:

[Windows]

Entries that affect the Windows environment, such as whether the machine beeps or not, window border width, keyboard settings, etc.

```
[windows]
MouseTrails=-4
spooler=yes
load=
run=
Beep=yes
NullPort=None
BorderWidth=3
```

```
CursorBlinkRate=530
DoubleClickSpeed=452
DoubleClickHeight=10
DoubleClickWidth=10
Programs=com exe bat pif
Documents=
DeviceNotSelectedTimeout=15
TransmissionRetryTimeout=45
KeyboardDelay=2
KeyboardSpeed=31
ScreenSaveActive=0
ScreenSaveTimeOut=120
CoolSwitch=1
MenuDropAlignment=1
```

The **DoubleClick** entries for width, height and speed affect the area and time within which a double click is detected. New users tend to move the mouse between clicks and you may want to give them a better chance.

You might also want to delete the **bat** entry from the **programs=** line, so when you double click on a batch file to edit it with whatever text editor (usually Notepad) has an association, you don't run the batch file instead.

The **documents=** section details entries regarded as documents, not already in **[extensions]**.

load= and **run=** are there for Windows 3.0 compatibility; load= runs a program as an icon, that is, minimised. They work under Windows ‘95, too!

The **CoolSwitch** is **Alt-Tab**, used for cycling round running applications.

[Desktop]

Contains entries that control the appearance of the screen background (desktop) and the position of windows and icons on the screen.

You can vary the position of wallpaper (aside from centring or tiling it) by adding the following lines to this section:

```
WallPaperOriginX=20
WallPaperOriginY=40
```

where the numbers represent how many pixels there are between the left and top edge of the screen and the corresponding edge of the image. 0 for both means that the image is centred.

You can use longer titles for icons, and you will likely need to increase the spacing between them for the extra text. The following lines are relevant:

```
IconSpacing=
Icon TitleWrap=
You can change the font as well, with:
IconTitleFaceName=MS Serif
```

You would be forgiven for thinking that you could take the name of a font from the **[fonts]** section of Control Panel, but this doesn't work! To get the correct name, open up File Manager, go to the *Options* menu and select *Fonts*. The name you want is included there.

The settings here will also affect Print Manager, amongst others, so be slightly careful. Something that looks OK in one part of Windows may not look so good in another.

Change the size of the font with:

```
IconTitleSize=
```

The default is 8.

```
IconTitleStyle=1
```

will make it bold (the only choice you get).

```
[Desktop]
Pattern=(None)
Wallpaper=(None)
GridGranularity=0
IconSpacing=75
IconTitleFacename=MS Serif
IconVerticalSpacing=55
IconTitleSize=11
TileWallPaper=0
```

Grid Granularity concerns the size of the invisible grid used for positioning objects on screen. 0 means off, but you can go up to 49. Each step (of 1) is equal to eight pixels, so 4 means 24 pixels between grid lines. You can use **.rle** files as wallpaper rather than **.bmp**s; saves disk space.

[Extensions]

Entries that identify document files with corresponding command lines, so that opening a document automatically starts the application. If an entry here is duplicated in the Registration Database, File Manager uses the latter.

```
[Extensions]
cal=calendar.exe ^.cal
crd=cardfile.exe ^.crd
trm=terminal.exe ^.trm
txt=notepad.exe ^.txt
ini=notepad.exe ^.ini
```

```
pcx=pbrush.exe ^.pcx
bmp=pbrush.exe ^.bmp
wri=write.exe ^.wri
rec=recorder.exe ^.rec
hlp=winhelp.exe ^.hlp
```

[intl]

Tells Windows how to display dates, times, currency amounts and other items for countries other than the USA, which is the default. Changed through the *International* Section of Control Panel.

```
[intl]
sLanguage=eng
sCountry=United Kingdom
iCountry=44
iDate=1
iTime=1
iTLZero=1
iCurrency=0
iCurrDigits=2
iNegCurr=1
iLzero=1
iDigits=2
iMeasure=0
s1159=
s2359=
sCurrency=#
sThousand=,
sDecimal=.
sDate=/
sTime=:
sList=,
sShortDate=dd/MM/yy
sLongDate=dd MMMM yyyy
```

s1159= and **s2359=** concern strings that follow times before and after noon.

[ports]

Lists the available COM and LPT ports, defines defaults and lists files to which output can be sent (similar to **mode** for DOS).

```
[ports]
LPT1:=
LPT2:=
LPT3:=
COM 1:=9600,n,8,1,x
COM 2:=9600,n,8,1,x
COM3:=9600,n,8,1,x
COM4:=9600,n,8,1,x
EPT:=
```

```
FILE:=
LPT1.DOS=
LPT2.DOS=
```

You can get printers to share one port by replacing the port section above (e.g. LPT1:=) with two filenames, such as **lpt1.ps=**, and **lpt1.lj2=**. These are filenames, which Windows has no problems printing to, but DOS will only read the first part, LPT1, which is a reserved device name. Same as **lpt1.dos**, which came about with OS/2.

Only ten lines can be read here, so maybe delete one or two, like **ept:=**.

[fonts]

Describes screen font files loaded at start up; same as *Fonts* in Control Panel.

```
[fonts]
Arial (TrueType)=ARIAL.FOT
```

[fontSubstitutes]

Fonts used by Windows in place of others; those on the left are for Windows 3.0, so the default here tells Windows what to show if it sees an old font.

```
[FontSubstitutes]
Helv=MS Sans Serif
Tms Rmn=MS Serif
Times=Times New Roman
Helvetica=Arial
```

[Compatibility]

This section is for backwards compatibility with Windows 2 or 3, and is provided so Windows 3.1 can be patched to make allowances for the programs described here. Actually, Windows checks this section to see if a program being loaded is mentioned here, then the hexadecimal number after it is converted to binary and used to set flags inside Windows. the changes can be minor, such as a single binary 1 for Excel.

The **mkcompat.exe** utility with '95 also uses this for 16-bit programs, as they cannot write to its Registry. 32 bit programs use **[compatibility32].**

```
CCMAIL=0x0008
AMIPRO=0x0010
NOTES=0x200000
EXCEL=0x800000
```

NOTES=0x200000 sets the Windows version number, for example. EXCEL=0x800000 cures a Postscript printing problem with Excel 3.

[TrueType]

Options that affect the use and display of True Type fonts in your applications. The more fonts, the more memory is taken up. Not above 300.

[mci extensions]

Entries that associate different media files with MCI drivers.

```
[mci extensions]
wav=waveaudio
mid=sequencer
rmi=sequencer
avi=AVIVideo
```

[network]

Network settings used by secondary Windows network drivers and not **wfwnet.drv**. Handy for defining the location of network printers.

[embedding]

Lists OLE objects, their description, the program used to create them, and their file formats. This information also appears in the Registration Editor, which is recommended for inter-program communications; this section is only to maintain compatibility with Windows 3.0 and its applications.

[WindowsHelp]

Settings that specify size and position of the help window and dialogue boxes, and the colour of text in windows or panels.

```
[Windows Help]
H_WindowPosition=[213,160,213]
```

[sounds]

Lists system events that support sound, and files associated with them.

```
[Sounds]
SystemDefault=ding.wav, Default Beep
SystemExclamation=chord.wav, Exclamation
```

[printerPorts]

Lists active and inactive printers, and the ports to which they are connected. Otherwise done through *Printers* in **Control Panel**, or *Printer Setup* from the *Options* menu in **Print Manager**, then choose *Connect*.

[devices]

Lists active printers, and is for compatibility with Windows 2.x applications. Entries here are identical to those in **[printer ports]** (below), without the timeout values at the end, so make sure they're the same for consistency. Changes are made through the *Printers* section of Control Panel. In theory, you could delete this section to save a bit of space, but I tried that and found I couldn't find my printers!

```
[devices]
HP LaserJet 4=HPPCL5E,LPT1:
WINFAX=WINFAX,COM 1:
```

[programs]

Identifies paths searched to start an application, as well as those in **autoexec.bat**.

[colors]

Defines the colours for parts of the Windows display. Normally changed through the *Colours* section of Control Panel. The numbers specify the relative intensities of the respective colours in the format **rrr ggg bbb** (RGB), defining the amount of Red, Blue and Green in the colour, ranging from 0-255. Example:

```
Scrollbar=255 255 255

[colors]
GrayText=128 128 128
```

A good ploy for security is to create a **win.ini** file with all these set to 0, so the screen is all black; when others type **win**, all they get is a blank screen. You, of course, have a batch file that renames **win.ini** to one of your choice with colours you can see.

[Mail]

Global information for the Mail Program. This section is read by some Mail-enabled applications to check that Mail support is available.

[MRU Files]

The 12 Most Recently Used (MRU) file share connections.

[MRU Printers]

The 12 Most Recently Used (MRU) printer share connections.

[spooler]

Used by Print Manager.

SYSTEM.INI

Settings that affect Windows' hardware needs—broadly equivalent to **config.sys**, and loaded directly after the core files and before **win.ini** – it is required, and Windows won't load without it. Many entries aren't included by Windows, and are only inserted when you need them; there are also default values that don't normally need to be changed unless you want to; there are nearly 200 commands, most of which are self-explanatory.

[boot]

A list of the drivers and Windows modules used to configure Windows.

```
[boot]
386grabber=v7vga.3gr
oemfonts.fon=vga850.fon
286grabber=vgac24.2gr
fixedfon.fon=vgafix.fon
fonts.fon=vgasys.fon
display.drv=vgac24.drv
shell=progman.exe
mouse.drv=mouse.drv
network.drv=
language.dll=langeng.dll
drivers=mmsystem.dll
power.drv
sound.drv=mmsound.drv
comm.drv=comm.drv
keyboard.drv=keyboard.drv
system.drv=system.drv
SCRNSAVE.EXE=(None)
```

The **shell=** entry can be changed for another program, as can **TaskMan.exe=**.
The **grabber** is a device driver that makes a non-Windows (i.e. DOS) application visible. See *Communications* for a discussion on **comm.drv**.

[boot.description]

Plain text descriptions of devices you can change in **[boot]** when using **setup** (i.e. what you see on the blue screen).

```
[boot.description]
aspect=100,96,96
displayinf=OEM0.INF
display.drv=SVGA
keyboard.typ=Enhanced 101 key
mouse.drv=Microsoft, or PS/2
network.drv=No Network
language.dll=English
system.drv=MS-DOS System
```

```
codepage=850
woafont.fon=Multi-Lingual
```

[drivers]

A list of aliases (or names) assigned to installable driver files. Associated with the **drivers=** entry in **[boot]**.

```
[drivers]
timer=timer.drv
VIDC.MSVC=msvidc.drv
VIDC.RT21=indeo.drv
VIDC.YVU9=indeov.drv
MSACM.msadpcm=msadpcm.acm
MSACM.imaadpcm=imaadpcm.acm
```

[keyboard]

Information about the keyboard; not needed for the US. The **type=** 4 entry indicates 101 or 102-key enhanced.

```
[keyboard]
subtype=0
type=4
keyboard.dll=kbduk.dll
oemansi.bin=xlat850.bin
```

[mci]

Drivers that use the Media Control Interface to play files—best changed through **Control Panel|Drivers**.

```
[mci]
AVIVideo=mciavi.drv
```

[NonWindowsApp]

Entries that affect the performance of DOS applications. Edited manually.

```
[NonWindowsApp]
CommandEnvSize=
localtsrs=dosedit,ced
ScreenLines=
```

CommandEnvSize increases the environment space available to batch files, boosting that set in **config.sys** with **shell=.**

Local TSRs are for those that cause problems when loaded before Windows; those listed here will be loaded separately into each DOS Session and won't interfere with the other copies (uses memory of course).
ScreenLines increases those visible on screen.

[standard]

Entries specific to Standard mode; for 286s and other obsolete settings. For network management, though, **netheapsize=** sets aside a pool of base memory to buffer data moving to and from the network.

[386enh]

Information for 386 Enhanced mode. * means built in to **win386.exe**, so you want to make sure that those drivers specified without it are actually present on the disk, otherwise Windows may not load properly. V=virtual. Most entries beginning with **emm** control both placement of the page frame and translation buffer mapping.

```
[386Enh]
display=vddc24.386
EGA80WOA.FON=EGA80850.FON
CGA80WOA.FON=CGA80850.FON
32BitDiskAccess=on
device=*int13
device=*wdctrl
DMABUFFERSIZE=018
MinTimeslice=20
WinTimeslice=100,50
WinExclusive=0
COM 1AutoAssign=2
COMVerifyBase=false
COM 1Base=3F8
COM 1IRQ=4
EMMExclude=C800-CFFF
PermSwapDOSDrive=C
PermSwapSizeK=8183
DOSPromptExitInstruc=Off
```

Interrupts are generated every time the hard disk is accessed, which are intercepted by Windows to be handled in protected mode, to minimise their effect on performance. If you get hard disk access problems in Windows, try setting **VirtualHDIrq=Off**, which will allow the interrupts to be seen by the BIOS. **IRQ9Global=On** will also solve some floppy access problems.

SystemROMBreakPoint allows 16-bit programs running in real mode to call programs in protected mode, which is 32-bit, by giving the program the address of an illegal instruction; a *breakpoint* is either a pause in program execution or a small scratchpad for memory managers. An invalid opcode fault is generated and the CPU is switched to protected mode as a side effect, where the protected mode fault handler gets the address of the routine the real mode program wanted. If this is *On*, the illegal instruction is located in ROM, between F000-FFFF; otherwise it is placed in RAM (to use a ROM-based breakpoint, Windows simply scans ROM until it finds a byte whose value is 63hex). ROM breakpoints can't be changed, but some memory managers can remap data into the same location, which is why this setting sometimes needs to be *Off* if Windows won't run with QEMM or similar.

Related to this is **MaxBPs=**, which determines the maximum number of ROM breakpoints. 768 is a good setting for stability, then go on to 1024.

PERVMFiles increases the number of file handles available in a DOS Session (usually added to the **config.sys** setting). Ignored if **share** is loaded, maximum is 255 (imposed by DOS).

ComBoostTime= is the time given to a DOS application to process a COM interrupt. 2 milliseconds is the default, but 4 is often better.

***Int 13** traps and emulates Int 13H BIOS calls made by the application to the hard disk controller. It passes them to **BlockDev** for filtering and queuing. Int 13 and **PageFile** (below) act as input for 32-bit disk access.

PageFile handles virtual memory paging files. It makes calls through **BlockDev** to the hard disk controller when appropriate. **BlockDev** is the core of 32-bit disk access—it creates and manages the queue of INT 13 calls to the hard disk controller, and sends some to the BIOS for processing.

***wdctrl** is the 32-bit disk access device that talks to standard Western Digital 1003 or ST506 hard disk controllers (about 90% of them). This device is only installed if **setup** detects a compatible hard disk controller.

It has the same limitations as INT 13, so you can't use 32 bit Disk Access with greater than 528 Mb (more specifically, 1024 cylinders). Neither does it support block mode, DMA transfers, SCSI or ESDI drives, and ATAPI CD-ROMs on the primary channel.

COM 1AutoAssign=2 may want changing to the other port (1) if you want to receive faxes. The line may need adding in Windows '95, if you find you can't dial with another comms program already open.

If you set something at Com 4, but don't have a Com 3, Windows will get confused unless you tell it what you've got, by commenting out the **COM3AutoAssign=**-1 line. See *BIOS Data Area and Address Packaging* in *Communications*.

To improve the performance of **swap files**, you can increase the number of page buffers, which store data transferred to and from the permanent swap file. You only get 4 by default, so increasing them increases the amount of data transferred with each hard disk access. The line is **PageBuffer**=*n*, where *n* can be up to 32. Each page buffer takes up 4K.

[ClipShares]

Used by the ClipBook Viewer to identify the names of clipbook pages that have been shared by other workstations.

[DDEShares]

Defines the DDE shares database; used to identify names of DDE shares that can participate in Net DDE conversations.

[network]

Settings that affect how your computer interacts with the network. To make sure a PC has no share in network chores, include the line:

```
MaintainServerList=No
```

in this section. Change *No* for *Yes* for the PC that's to do all the work (the other setting is Auto). For the most efficient operation, start the browse server first and close it down last.

[PasswordLists]

Found with Windows for Workgroups.

PROGMAN.INI

Program Manager initialisation file, with the following sections:

[settings]

Settings for Program Manager.

```
[Settings]
Window=6 0 634 410 1
display.drv=vgac24.drv
Order=3 1 10 7 4 2 5
AutoArrange=0
SaveSettings=0
```

On the **Window=** line, the first two numbers describes the x,y coordinates for the top left corner of the window. The next two are the bottom right coordinates. The last one can be 1, 2 or 3, which means that Program Manager can run as a normal window, minimised or maximised, respectively. The **Order= line** dictates the order in which groups will appear in the Windows menu.

[groups]

Where your groups are.

```
[Groups]
Group1=C:\WINDOWS\MAIN.GRP
Group2=C:\WINDOWS\ACCESSOR.GRP
Group3=C:\WINDOWS\GAMES.GRP
Group4=C:\WINDOWS\STARTUP.GRP Group10=C:\WINDOWS\THINKPAD.GRP
Group5=C:\WINDOWS\APPLICAT.GRP
```

[restrictions]

Stop people interfering!

```
NoSaveSettings=1
NoFilemenu=1
NoClose=1
NoRun=1
EditLevel=0,1,2,3,4

    0  No restrictions
    1  Groups cannot be renamed, deleted or created
    2  As above, but affects icons as well
    3  Can't change Command Line in Properties box
    4  No changes to Properties
```

Edit Level 4 together with **NoClose=1**, **NoRun=1** means that only programs with icons can be run (but disable File Manager and DOS icon).
The equivalent to **NoSaveSettings** in Windows '95 is in the Registry, under:

```
HKEY_USERS\Default\Software\Microsoft\Windows\
CurrentVersion\Policies.
```

You can add it if it's not there, with a value of 0000 01 00 00 00 (the 01 is what enables NoSaveSettings; 00 doesn't).

CONTROL.INI

Control Panel initialisation file, with the following sections:

[current]

```
[current]
color schemes=Windows Default
```

[Don't Load]

Programs listed here won't be loaded as icons in Control Panel. The syntax is strange at first sight, i.e. *Yes*, Don't Load this item:

```
[Don't Load]
Ports=Yes
Sound=Yes
```

Actually, put anything you like after the equals sign, and the module will still not load.

[color schemes]

To reduce the amount of colour schemes available, delete them from here. The Health and Safety people now take an active interest in colour schemes.

```
[color schemes]
Arizona=804000,FFFFFF,FFFFFF,0,FFFFFF,0,808040,C0C0C0,FFFFFF,4080FF,C0C0C0
,0,C0C0C0,C0C0C0,808080,0,808080,808000,FFFF
```

Control Panel Icons

If you regularly use only one aspect of Control Panel, say fonts, you can just have that as an icon by adding its name to the command line in properties:

```
CONTROL FONTS
```

would create an icon which, when double clicked, would load only the fonts section of Control Panel. You may need MAIN in the command line as well, because several of the functions come under its umbrella. You don't need it for **cpwin386.cpl**, **drivers.cpl** and **snd.cpl**. Note that you can only use one such icon at a time, as you can't load multiple instances of Control Panel.

Control Panel launches icons in the following order:

- The ten used for **main.cpl**.
- Modules referenced from system.ini.
- Modules referenced from the **[MMCPL]** section of **control.ini**.
- Remaining **.cpls** in the \system directory.

It follows that if you tweak the entries to the **[MMCPL]** section of **control.ini**, you can have a little control over the sequence of loading. Use the format:

```
icon name=CPL filename
```

Although you can't do much with **main.cpl**, you can alter the position of all its icons as a group. Move it to another directory and add the line:

```
Main=C:\DIRECTORY\MAIN.CPL
```

to **[MMCPL]**. As it can't find MAIN in the **\system** directory, it is bypassed, and loaded after the others specified.

CONTROL.INF

The Control Panel information file, containing information about printers and international settings.

[io.device]

Lists all supported drivers. Edit this section for files you don't want displayed in the choices.

[io.dependent]

Lists supplementary files needed by printer drivers.

[country]

Defines international formats.

WINFILE.INI

This only has one section, to specify options you can set by choosing menu commands in File Manager.

WRKGRP.INI

Used by System Administrators in Windows for Workgroups to define default workgroups that users can choose from when installed. It helps stop all those workgroup names appearing.

[Options]

Information used to interpret [Workgroups].

ANSI=True|False	Whether names below need to be converted from the OEM character set to ANSI. Default is False.
Required=True|False	Whether users must choose from the list below or not. Default is False (e.g. No).

[Workgroups]

A list of workgroups from which the user can choose, e.g.:

```
Finance=
Marketing=
Tech Support=
```

Managing INI Files

You can make automatic backups of your vital files with the following batch files. First, you need to copy each one of them to files with the following extensions: -1, -2, -3, e.g. WIN.-1, WIN.-2, etc. Then repeat the following lines for as many files as you want to back up:

```
CD\WINDOWS
DEL WIN.-4
REN WIN.-3 WIN.-4
REN WIN.-2 WIN.-3
REN WIN.-1 WIN.-2
COPY win.ini WIN.-1
```

If it's run after closing Windows down, you will have the last four versions of the **win.ini** file. Change the numbers for however many backups you want.

DOS Applications

Support for non-Windows applications (actually DOS ones) is varied, depending on the capabilities of the system and the mode Windows ends up running in, so you could get many problems, particularly where "extender" technology is used to gain access to more than 640K (like with games). As a result, some DOS programs just won't run with Windows, or at least will only run in full screen mode. Windows '95 performs a lot better with games, but many will still only work under native DOS.

DOS applications were only meant to be used for a while, to help people out until they bought Windows versions, hence the limited support.

There are two kinds of non-Windows application; what you might call "normal", like Wordstar, Wordperfect or Lotus, and TSRs, such as mouse drivers or pop-up programs, which stay in memory and may be run before or during Windows (see **winstart.bat**, below). Both must be "well behaved" with respect to video and memory, and they can even run in protected mode provided they stick to the rules (which won't necessarily apply to games).

With 3.1x, there are two kinds of file that provide Windows support for DOS applications; *drivers*, such as **himem.sys**, and *grabber files*, like **vga.3gr**, that support data exchange between them and Windows. The grabbers are specific to the display driver. 286 grabbers only support **Prt Scrn** and copying and pasting text between Windows and DOS applications. The 386 ones are much more sophisticated, and can handle graphics into the clipboard and windowed DOS apps.

PIFs

PIFs tell Windows what facilities a DOS program needs. This information is needed because programmers can use various tricks to bypass DOS and get better performance, which is why running Lotus used to be such a problem.

Many applications come with a standard PIF for their product, but you usually have to edit it to suit your system, or even create your own, which is what we'll be discussing here. PIF files can come from:

- ❑ The company that wrote the software.

- You (e.g. roll your own).
- Windows, created when you select Set up Applications from within setup (you get a new group called Applications). Windows gets information for many popular applications from the apps.inf file.

Most times, you don't need them, though.

APPS.INF

This is a database containing default PIF settings for major applications, used when you migrate DOS applications to Windows and select *Set up Applications* and a PIF doesn't already exist. It has the following headings:

[dialog]

Title text used in the Setup Applications dialogue box.

[base_PIFs]

Defines a batch file for creating **default.pif**, and specifies settings for **command.com**.

[enha_dosprompt]

Memory requirements for the DOS prompt when in enhanced mode.

[dontfind]

Windows applications to be ignored during *Setup Existing Applications*, so they won't be placed in Program Manager. Aside from possibly restricting user's choices, it also ensures that no duplicates are loaded. Naturally, the Windows programs you just installed will all be included here.

[pif]

Contains parameters for non-Windows applications.

PIFEDIT

This is a program that edits **.pif** files, available in the MAIN group. Two sets of settings cater for Standard and Enhanced mode; you might use the former if you have a program that is unstable in enhanced mode, like Paradox. The procedure is to create a **.pif** (file) for a DOS program and double click on the **.pif** file to start it. This being the case, you want to give the **.pif** file the same name as the application concerned, and keep it in whatever directory is convenient. You might also want to alter the default **.pif** to cater for users who don't do things the right way round! A number of **pif** settings can affect DOS application speed; these are mentioned below. Essentially, these revolve around giving the programs more memory and more attention.

Windows looks for a **pif** in:

- ❑ The application directory
- ❑ The active directory
- ❑ The \windows and \windows\system directories
- ❑ The PATH.

There's nothing to stop you having multiple PIFs for any program, depending on the mode you want to run it in. On first running **pifedit**, you need to select the operating mode for which you're specifying the PIF. This is assumed, however, according to the mode which is currently running in. You can set up a PIF to run in Standard Mode when in Enhanced Mode, but not the other way round. Select *Mode* from the Main Menu to change.

Standard Mode

As you might expect, there are less options available for standard mode. Those that are *not* available with enhanced mode are listed below:

No Screen Exchange	Prevents copying the screen to the clipboard when **Prt Scrn** is used, similar to reserving the keys for enhanced mode.
Prevent Program Switch	Prevents switching back to Windows, to conserve memory, or free it for the application. The end result is that to get back to Windows, you have to quit it.
No Save Screen	Prevents Windows from updating the screen when you switch back to the app, which saves memory. Use only if the app saves its own screen information.
Directly Modifies	For resource sharing. Prevents applications from using serial ports, etc at the same time, and switching between ports. The keyboard option specifies that the application has exclusive control of the keyboard, so there's no switching away. This means more memory is available, as nothing needs to be saved for the return.

Enhanced Mode—First Screen

Program Filename	The file to be activated, including extension and path.
Window Title	What appears under the icon when minimised, or in the title bar when active, overridden by **File|Properties**. If none, you will get the PIF filename with no extension.
Optional Parameters	Secondary, or application-specific, commands, such as switches. A question mark brings up a dialogue box so you can put them in at load time. You can use variables, such as **%1** for a filename. **/K** (undocumented) will run a batch file.

Start-up Directory

Which directory to be made current when the program is started (optional). Useful if you keep overlays in strange places. If this is blank, the current directory will be the one the program's executable file or pif is kept in, depending on which line you double-clicked. This is the directory *to which Windows will change before* it runs the application, so it can find a configuration file, or something.

Video Mode

Memory is set aside for screen regeneration and Clipboard activity, and the amount is determined by this setting, so when you switch away from the application, its screen is saved and restored when you switch back. This memory is subtracted from application memory, so use *Text* when you can get away with it, although you should rarely have to adjust this (wait till the screen gets scrambled). Windows will cope with any changes you make to the video mode when the application is running.

- Text requires 16K
- Low Graphics (=CGA) needs 32K
- High Graphics (EGA+) needs 128K

To reserve the most video memory for any application, choose *High Graphics* and check *Retain Video Memory* (below).

AutoRestoreScreen=On in **system.ini** makes Windows keep a copy of the screen display when switching away, as opposed to having the application do it; using Windows is faster, but more memory is used. This only applies to VGA, and the default is on anyway.

Memory Requirements

You should only modify these if you get tight on memory, which is not so much of a problem these days.

- **KB Required** is what must be available before attempting to start the program, but the amount received is not limited. 0 means no minimum memory. -1 means the program will not be started unless it has access to all conventional memory. The standard is 128K.

- **KB Desired** is the largest amount the program will ever use (max 640K). -1 gives as much memory as possible to the application.

EMS Memory

Whether the program needs it, and therefore whether Windows should simulate it.

- **KB Required** is the smallest amount needed; 0 means never (default), but you may need to set this greater than 0 to cater for programs that treat 0 as meaning there isn't any EMS!

- **KB Limit** is the largest amount, preventing it from using more than it needs. -1 gives as much as possible to the application. 1024 is the default.

XMS Memory

The amount of extended memory that should be made available.

- **KB Required** is the smallest amount needed; how much should be available before loading the application. 0 means never (default).

- **KB Limit** is the largest amount; -1 gives as much as possible to the application, but this will affect system performance.

Display Usage

How the application will initially be displayed (**Alt+Enter** normally moves between the two).

- **Full Screen** saves memory and resources; it uses hardware directly. The video adapter keeps a check on its memory and uses the numbers in it to generate the display. The appearance and colour of each character cell on the screen depends on two values; its ASCII code and one selecting foreground and background colours. The hardware then converts those into the characters you see. In graphics mode (as with windowing), the numbers in memory merely specify the colour of each pixel on screen, and the characters are produced as if drawn, pixel by pixel.

- **Windowed** will display it in a moveable window, which will give better data sharing and Clipboard usage. The drawback is that the DOS application must share the display with whatever else is running. Note that windowed DOS applications do not become Windows applications.

As you can see, the DOS and Windows methods of screen display are basically incompatible, and cause problems when they have to share the same space. Windows diverts output for the video buffer to a dummy buffer somewhere in memory, into which it looks periodically to update the screen display. Windows uses its own font shapes to create characters according to what it finds there. **WindowUpdateTime=50** in **[386enh]** is the default time in milliseconds between updates, and you might want to play with this to get a smoother display.

Execution

How your program can run, and how it shares resources with other running programs.

- **Background** allows it to run even when not currently in use, i.e. not active, although this will slow down other applications as well. If not selected, the application is suspended when in the background. If another DOS program has its Exclusive box checked (see below), this is ignored. This will likely need to be checked for comms programs, or terminal emulation.

- **Exclusive** is the opposite of Background, and means the application will take all system resources while other loaded (DOS) applications will do nothing, that is, they are suspended. However, when this checked and the application is in a window, Windows is still active. Can give applications more memory and attention from the CPU. Check this if you find connections being dropped by comms programs.

These options are not mutually exclusive; you can use one or both. Mostly best left unchecked, unless using comms.

Close Window on exit

If unchecked, keeps the window open when you quit the application, until you press a key to return to Windows. This allows you to see any error messages you may miss when they scroll by too fast.

Enhanced Mode—Advanced Screen

Settings that control how Windows uses system resources. The key elements are the *Memory* and *Display* options. If system integrity is violated, you may need to lock memory down so it isn't swapped out. Locking memory creates a hole which cannot be used by Windows, which may mean "Out of memory" messages elsewhere.

Multitasking options

How your program runs in relation to others, with two levels of splitting CPU time between processes. There is an overall division between Windows and DOS applications, which can be adjusted from within Control Panel, and you can change the time allocated to each DOS Session, adjusted here. Put simply, increasing the foreground properties and decreasing the background ones gives more time to a foreground DOS application.

Background Priority

How much time the application will receive when in the background. This is ignored if *Execution, Background* is not checked in the first screen. The range is 0-10,000, and the default is 50. Increase to 100 for DOS comms programs.

Foreground Priority

As above, but for the foreground. The range is 0-10,000, the default is 100.

Priorities concern the *System VM* against this application, so with the default figures of 100 against 50, whichever program is in the foreground will receive 67% of processor time, while the other will get 33% (100 + 50/100). With two DOS applications running, the figures become 50% for the foreground process and 25% each for the others (100+50+50/100). Widen them out to get better performance—try 1000 instead of 100. You have to look at these settings in *all* of the programs running.

Windows plus any Windows applications are treated as one for this purpose.

Detect Idle Time

Many programs not written for a multi-tasking operating system waste a lot of CPU time looping, typically polling the keyboard for activity. Checking this box stops Windows allocating excessive time to a program that appears to be looping, and give that program's timeslices to another. Turn this off for increased speed when the program is in the foreground, at the expense of background applications. This, however, may depend on the type of application; a CPU intensive program may give the impression of doing nothing useful, when in fact it's very busy!

Do not check this for communications applications, especially those working as 3270 or 5251 emulators. Clear this option when troubleshooting.

Memory Options

You only need to check these if your DOS applications cause GPFs or SIVs. Locking memory ensures that it can be accessed during interrupt time.

EMS Memory Locked

EMS memory will not be swapped to disk, keeping application data in one place. It increases system performance, but other applications may not be able to load.

XMS Memory Locked

As above.

Uses High Memory Area

Whether the application should have access to the first 64k of extended memory. Normally No, since DOS is usually there already.

Lock Application Memory

When checked, the application will not have its conventional memory space swapped. This will increase system performance, but other applications may not be able to load. Not required for most applications.

Display Options

Monitor Ports

Lets Windows monitor whether the application is using the same values as the video adapter for display, allowing for situations where an application may switch an EGA card into a different mode under software control, but not tell Windows. This setting should be off mostly for increased speed, as the CPU has fewer overheads. If you have a VGA card, they should be off anyway, as they are not affected.

- **Text** should be checked if the screen shows inaccurate text displays. Tells Windows to monitor ports when the application is in text mode.
- **Low Graphics** tells Windows to monitor ports when the application is in low resolution graphics mode. Only use if the application has trouble switching in and out of CGA display.
- **Use High Graphics** for an EGA display.

- **Emulate Text Mode** will frequently speed the screen display, but at the expense of available video memory. If the screens become distorted when transitioning, you will need to uncheck this box.

- **Retain Video Memory** will keep as reserved that extra video memory used by the application; Windows won't release it for use by another application, which will usually help all other applications from crashing. As above for performance.

Allow Fast Paste

Some programs can't cope with accepting data when pasted at a reasonable speed, and this checked helps a program cope with it. It actually allows Windows to choose the best method.

Allow Close When Active

Closes the program down when Windows is closed down, otherwise you just get a warning message that a program is still active when you try. In other words, lets you quit Windows without having to close each application. Alternatively, it closes the program when you close the window it's in—dangerous, this! It's still up to the application to close its own files! Don't use it for databases, and especially be careful if your program uses FCBs.

Reserve Shortcut Keys

Makes sure Windows doesn't use keys that the application needs to use—the classic is **Prt Scrn**, which does not work automatically with a DOS Session, because Windows uses it to capture screen displays into the Clipboard. If you want to use **Prt Scrn** (or anything) from a DOS Session, check the box here.

Application Shortcut Key

What shortcut keystrokes will bring the application to the foreground. Just press the key you want to insert it here.

Eliminating the EXIT prompt

Insert the line:

```
DOSPromptExitInstruc=Off
```

in **[386enh]** section of **system.ini**.

Adjusting Environment Space

Insert the line:

```
CommandEnvSize=#
```

in the **[NonWindowsApp]** section of **system.ini**.

Data Exchange

Windows has excellent data exchange capabilities which can markedly increase productivity, or simply provide a measure of convenience. It's all part of the trend towards *compound documents*, which means that your work is document, rather than application based. Quite how the software houses see this is another question, as it means an amount of anonymity for their products, as their importance (relative to the documents) fades in to the background. A compound document contains data from varying sources, which can be modified without worrying where the data comes from.

Data sharing between programs is done with cutting and pasting (with the Clipboard), DDE, OLE and DLLs.

Clipboard

The Clipboard is a quick and easy way to copy and paste data from one application to another. It is a simple memory buffer (not an application), and its contents are overwritten when other data is inserted. It is non-programmable, and not always used the same way by applications. Windows for Workgroups uses a Clip*book*, for a series of pastings.

Data in the Clipboard is often available in a variety of formats; it will be stored in as many as possible, because the Clipboard doesn't know where it's going. However, it will make a default assumption on your behalf (hint: to find out what this will be, select *Paste Special...*, or the Clipbook Viewer).

Word 6 will use up to ten, so a wide choice is available, with as much formatting information as possible; e.g. *Rich Text Format*, which will have codes for bold, italic, and the like. *Unformatted* assumes the format of the destination, so although text will retain its formatting when it goes into the clipboard, it might not when it gets to where its going; this usually depends on the receiving application.

If Clipboard succeeds in screwing up your picture, you could try pasting the contents as an *object* (covered shortly), or pasting into **notepad** first, and then (via the Clipboard) into the destination. If you need to, you can save the contents of the clipboard (use the clipboard viewer). If you copy large amounts of data regularly, it's worth checking what's in the Clipboard if you get *Out of Memory* errors; old data takes up space!

DDE

Cutting and pasting is repetitive if you do it often between the same programs; changes to original documents are not passed on, so you keep having to repaste as you make changes.

DDE, which started with Excel, creates dynamic links between applications, so changes in one (the Client) are reflected in the other (Server). Quite useful if you're a project manager, and have several people updating reports for you. You can make your master document reflect changes made in sections of it every time data is saved.

DDE links, therefore, allow applications to communicate with each other. The data is stored in a portion of memory which is constantly monitored, and documents updated when changes happen. When it is opened, a DDE application transmits messages about itself and data files to others that may be running, who can at any time request that messages be routed to their data files. At that point, a Client/Server relationship is established between the two.

You can either **Paste|Link** with the Clipboard, or use a *Remote Reference Formula*. For example, in Excel you could enter a formula based on this format in a cell:

```
app|doc!locn
```

The first part is the DDE name, the middle is the path and the last the location, or cell/range/field address, depending on the application. Example:

```
FOXPRO|'C:\path\filename.ext'!'Field1'
```

There should be an **Edit Link** function if you want to change it later.

Mostly, the source application must be open; if it isn't, you will be asked if you want to open it, which may have resource implications.

You do require a fast(ish) machine to run DDE; it's better with 8 Mb. If you move the original file, or rename it, you will get an error message. DDE is implemented differently between applications, including Word and Excel. Don't expect much from Organiser.

OLE

OLE, or *Object Linking and Embedding*, can share application resources as well as data; whereas DDE needs two separate files to work, OLE can have one file living inside another. The idea is that one application can use another's resources as well as data—you can *link* or *embed* an object (e.g. a complete program/document, or part thereof).

OLE was jointly developed by Microsoft in conjunction with Aldus, Lotus, Micrografx and many others. Its protocols are implemented through DLLs used with other Windows programs. The intention is to allow *programs* to seamlessly use the services of others; up until Windows '95, OLE implementation was left to applications. Only NT used it as part of the operating system ('95 short cuts are OLE links).

As with DDE, linking means that the data resides in another document, and is referred to when needed. Embedding includes that data in the *container document*. Although DDE is used by OLE, the difference is that the data can only be edited by the application that created it, and not the one whose document it currently resides in. You double click on the object concerned in the *client application* to access the *server application*, which doesn't need to be open. This means that, for example, you can edit text in a CAD document, even if the CAD application has no text editing facilities.

Another difference is where the changes are saved. With linking, all changes are made to the server file, and the client refers to it for information; your changes are reflected in the original file as well as the packaged one—whereas the object has the ability to show the data, it does not contain the data itself. With embedding, on the other hand, the client *saves a copy* of the pasted data, which is opened when you double click on it.

Because of this, you don't have to worry about losing the server. When editing an embedded object, the original file is not changed; changes are reflected in the packaged copy.

When you double click on a graph in a wordprocessed document, or select **Insert|Object** from a menu, the wordprocessor refers to the *Registration Database* (see below) to find out where the source for the graph is, or what type of object you want. The program then starts in the background to allow negotiations for menus, etc to be displayed as and when appropriate; with OLE2, you should see icons in toolbars change as you go from one element of the document to another; try this with Word and Excel—if you insert a Excel object, Word (the client) will continue to handle file and window operations, while Excel (the server) will handle editing.

OLE 2 is a set of protocols that allows two Windows applications (or parts of the same one) to communicate using an object-oriented interface (in simple English, you will notice button bars changing). In this way, wordprocessors can turn into spreadsheets when the appropriate code is stored in the document, or your database can suddenly get a spellchecker without writing any new code.

The action that any server performs having been invoked is known as a *verb*; double clicking invokes the primary verb, most commonly *Edit*. You might also come across *Play* or *Rewind*, amongst others. The Edit menu will change to reflect this.

Two DLLs allow client/server communication; **olecli.dll** interfaces to clients, while **olesvr.dll** interfaces to servers. **Shell.dll** queries and maintains the Registration Database.

The formats and their order within the clipboard determine how an OLE object is treated by it. The order determines whether the object can be linked, embedded, or both. The first acceptable format found by the client application is the best format for it to use as an embedded object. If possible, an application will try not to embed; for example, Word will not embed RTF data, but simply include it as text.

Compound Documents

The future is document orientated; instead of opening a program and then searching for a document to work on, you double-click on the document which launches the applications concerned. Instead of files, you will be using objects, inside folders (as opposed to directories).

A *compound document* can contain formatted text, graphics and data from a spreadsheet or database; in other words, content created in more than one program. It can also contain icons to run sound recordings or play multimedia devices. A spreadsheet with a graph is a compound document. For example, you can double click on a picture (represented by a metafile) embedded in Excel, which will launch Paintbrush, allowing you to edit the picture directly (this doesn't update, so choose **File|Update**).

Embedding a sound file in a document is another idea, so you can explain the mistakes in your spreadsheet! Embedding the icon representing that sound file (or anything else) is called *packaging*.

The steps are:

- **Enable sound card**, or PC speaker (Drivers in CP).
- **Edit|Insert Object**, and choose Sound, which opens Sound Recorder.
- **Edit|Insert File**; anything .wav.
- **File|Exit|Yes**. You will see the microphone icon in the relevant position in the file.

You can *link* objects with OLE, as you can with DDE, where a graphic representation of the linked information is displayed on screen and the source file has to be referred to; the difference is that the server will occupy its own window rather than sharing that of the client. This makes for a smaller "compound document" as only the path and metafile are included. Also, the linked object can be maintained separately, without having to buy a copy of the client software. If you send a compound document to somebody, they can see and print any objects, thanks to the metafile that represents it, but if they want to edit it, they will need a server capable of editing the data. This doesn't have to be the identical program—in theory, it's possible to have Quattro edit Excel files. If OLE doesn't work, you might want to reconstruct the **reg.dat** file, which we will look at more closely below.

There are three elements that help you take advantage of OLE:

- The Object Packager
- The Registration Database
- File extensions

All of which we will now take a look at.

Object Packager

This is the program that enables you to embed a package into any document, in conjunction with the Registration Database and associated file extensions.. Here's and example of how to embed Calculator into a Word document:

- Open Object Packager, select Content.
- Edit|Command Line
- Select or name object to be packaged, then Appearance.
- Insert Icon.
- Edit|Label, and give description.
- Edit|Copy Package.
- Switch to target application, select area, then Edit|Paste Special.

Registration Database

This is a binary file called **reg.dat** (**user.dat** and **system.dat** in Windows '95), where programs register their data exchange capabilities with Windows, including DDE and OLE; when an application installs, it "signs in" with the *Registration Database*, with a **.reg** file, which gets merged in; a server application will also query the database each time it loads to check its registration is still valid. It's a cut-down version of The Registry used by NT to store details of the operating system, the users, the PC's hardware configuration and loaded applications, to name but a few. **Reg.dat** is created by **shell.dll**. Windows '95 makes full use of it as well, for replacing many of the parameters in **ini** files.

The registration database allows servers to let clients know of their capabilities, such as the type of objects they can create (via the *ClassName*), and allows the server to be found from a container document.

Many programs (mainly those supporting OLE) store a lot of information in the registration database, so they can find out about each other's capabilities. If you double click an embedded graphic in a Write document, for instance, Write uses the information from the Registration Database to launch Paintbrush and manipulate the OLE information in the document directly.

Otherwise, you can:

- Open a file by double clicking it, which will open the relevant application (the [extensions] section of win.ini does this as well, but the Registration Database overrides it).
- Place a file as an icon in a group (drag it from File Manager).
- Print by dragging the file to print manager from File Manager, or its icon if you've previously created one.
- Embed something as a packaged object by dragging to another icon.

It's a good idea to keep a copy of **reg.dat** in case you get programs that hog it and you want to go back to what you had before.

Also, the Registration Database occasionally gets corrupted, and you won't get OLE facilities. If this happens, you may need to reconstruct it.

There are various ways that programs register with the Database:

- Self-registration, done when the program is run for the first time.
- Merging a Registration File. A program will have a .reg file which can be merged into the database by double clicking on it or by running regedit (see below).

A key and a value is placed in the database that shows which OLE protocols a server supports. These values are used whenever a client or **.dll** needs information about a particular object and the application it came from.

Reconstructing the Database

This can be done in the following way:

- Rename the old reg.dat file.
- Rem out each line of the [embedding] section of win.ini, so this information isn't used in the reconstruction.
- Restart Windows.
- Select File|Run, and type the following command line:

```
regedit /u c:\windows\system\setup.reg
```

followed by:

```
regedit c:\windows\system\ole2.reg
```

This deals with the **.reg** files that come with Windows. Now repeat with all your programs (the surest way is to reinstall every one). For self-registering applications, start up **regedit** and remove any reference to them before starting. Reg files that come with applications make assumptions about your path structure, so you may need to alter the reg.dat file directly, before merging. Look for this string:

```
<WindowsDir>
```

and replace it with the proper one. On a network, you would need to include the whole path.

Editing

You shouldn't need to do this, but you can edit the Registration Database by typing:

```
REGEDIT
```

through **File|Run**. Double click on an entry to edit it. You can add a new file type by copying an existing one and modifying that, or creating a new one. Don't delete blank lines; they may contain **reg.dat** entries not displayed due to incompatibility with OLE 2.0. The following information is required:

- Identifier; a unique keyword of up to 63 printable ASCII characters which is used by Windows to identify the file type.

- File Type; the text description that you use to identify it in dialogue boxes.
- Action, Open or Print.
- Command and switches to be executed (or DDE message to be sent) to perform the above action, e.g.

```
pbrush.exe %1
```

Check the *Uses DDE* box if the application sends DDE messages to execute the Open or Print actions. You can also specify the DDE message and application string, and the DDE topic associated with the command. For example:

```
(FileOpen(%1))
```

to Windows from Word is the equivalent of the Open box.

Advanced

You can edit the Registration Database in more detail by typing:

```
REGEDIT /V
```

which will display it in *Verbose* mode. This is for advanced users and should not be fiddled with lightly!

A registry entry is called a *key*, which is similar in status to a file or directory. You can have sub-keys as well, just as you can have sub-directories. It doesn't matter what order they're in, but you might want them listed alphabetically.

If **reg.dat** becomes corrupted, or you lose it, you can recreate it by deleting the original and restarting Windows, since if it doesn't find it, it automatically recreates it, based on the **[Embedding]** section of **win.ini**.

Next, merge all the **.reg** files dotted around your hard disk.

Open File Manager, select **File|Associate**, enter **REG** in the Files with Extension text box, then select OK. Then, using File Manager again, find every .REG file on your hard disk (enter ***.reg** in the *Search For* text box, having selected **File|Search**. Start from C:\, and check the *Search All Subdirectories* box). Select everything in the *Search Results* window.

In fact, you would only open this program to confirm that your **reg.dat** file is actually corrupted, otherwise you would never know, unless you are alert to files mysteriously disappearing, or getting error messages instead of the application when you double-click on files.

Automation

This can take place in several ways:

- Visual Basic/Word Basic
- Macros in applications
- The Recorder
- Batch files

The Recorder

Recorder provides macros for Windows. It is limited, but free (it was actually written by Softbridge). You can use its facilities for specific applications, or have them apply to all, by having a generic file that contains all application-specific macros in one file—make sure that playback can be to any application (you can only have one file open at a time).

It has a couple of idiosyncracies, though, which you may have to work around, and we will look at these in due course. One is that Recorder must be running for you to use its macros, but you can concoct a command line to run one, such as:

```
recorder.exe -h ^+c macros.rec
```

which will launch the file **macros.rec**. **-h** means run the macro immediately, while the **^** means the **Ctrl** key and **+** the **Shift** key (**%** means **Alt** keys). This will run the macro in **macros.rec** associated with **Ctrl-Shift-G**. You can also do this from the command line when you run Windows.

The generic form is:

```
[application name] -h[shortcut key] [filename]
```

Recorder can't load itself more than once, so you will have to keep loading **.rec** files if you change apps a lot, or want to reuse an icon, where you would have to reload **recorder**. If you want to assign a macro to an icon, abbreviate the command line like this (Windows will associate the filename with the application):

```
macros.rec -h+c
```

As mentioned, one bug, er, feature, of **recorder** is that if you run a macro from an icon, you can only perform the operation once; to repeat it, you will have to reload **recorder**. It's not easy to close **recorder** with a macro, since you need it to close the macro down, but you could include opening Task Manager as part of the macro and getting Windows to close down **recorder**. Once you get the list of running processes, select **r** (the first letter of **recorder**) and **alt+e** (End Task). Again, the problem here is that you need **recorder** to be running in order to save the macro, so create a dummy application (rename some **exe** file), also beginning with **r** that you can use this time around, then delete it before you use the macro in anger.

Limitations

- You can't record in DOS sessions, but you can play back to them.
- You can't ask for user input, but you can create a macro to run a search routine for all references to a highlighted name.
- You can't use Recorder to close down Windows.
- Recorder macros can't run in the background.

Screen boxes

Record Macro Name

Up to 39 characters, including spaces and punctuation marks.

Shortcut Key

The combination of keys you want to launch the macro. The usual warnings about making sure no other program is using them applies.

Playback

- To: Either Same Application or Any. This is always in the current Window.

- Speed. Normally, fast, but you may be doing a demo, in which case play it back at the same speed it was recorded.

Continuous Loop

Restarts the macro each time it finishes.

Enable Shortcut Keys

For including the shortcut keys of other macros, so you can use a macro when recording another. You can include up to 5.

Record Mouse

Whether or not mouse clicks, drags and movements are included. Only include this if you are absolutely sure that your screen display won't change (and this includes the resolution); if you do, maximising the window will cut down on errors. Select *No Mouse* for normal use.

Relative To:

Affects the playback of mouse movements. If your macro applies only to one application, select *Relative to Window*; otherwise *Relative to Screen* will do for a macro that switches between applications.

Editing Macros

Basically, you can't! You have to get your macro right first time, otherwise you have to start again. However, there are ways of viewing what you've done, so you can at least get an idea of the area in which you've gone wrong.

Hold down the **Shift** key whilst selecting **Macro|Properties** menu, which should get you a listing of events recorded in it.

Points to note

Don't rely items in a list to be in the same places every time.

Remember that check boxes toggle; you might turn something on once, then off the next time.

Miscellaneous

What if the mouse doesn't work?

Here are a few suggestions:

- Plug it in! The mouse must be present when Windows starts. If you remove it once Windows has started, and then plug it back in again, it will be lost.
- Is the trackball clean?
- Is there a conflict? COM 1 uses IRQ 4 and COM 2 uses IRQ 3. The PS/2 mouse uses IRQ 12.
- Do you have the latest driver? Version 9 is more or less current for Microsoft Mice. Logitech are on version 6 at least.
- Does it work in DOS? mouse /f will force the driver to check all available ports.
- Conflicting statements in config.sys or autoexec.bat? Two mouse drivers?

The **/y** switch for the mouse driver might be needed, which disables the hardware cursor.

Changing direction of menus

Add the line:

```
MenuDropAlignment=1
```

to the **[Windows]** section of **win.ini**.

Help Files

These are easily created with the help of a word processor capable of producing *Rich Text Format* (Word, for our purposes). The Microsoft Help Compiler (or similar) acts on it to produce a help file. Note that Microsoft controls RTF, and their help compiler works best with its own products.

Rich Text Format is a replacement for ASCII as a bridge between incompatible applications, but used for transferring formatted text. For example, backslashes begin control words and brackets to identify groups of text; **\b** means bold on, and **\b0** means off. In Windows, it is the standard clipboard format.

Each topic in the help file document must have a separate page. Each word you want underlined in the help document (e.g. that jumps to another topic) must be double underlined in Word, and each word to have a dotted underline (that is, opens a quick help box) must have a single underline. Next to each double underlined word must be a code word, *with no spaces in*, in hidden text *immediately afterwards*. The code word must relate to a footnote in the topic concerned; the footnote is marked with **#.**

Save as **.rtf**, compile with help compiler. Don't forget the project file (**.hpj**) which is a text file the compiler checks with to get its instructions.
This is a dead simple one:

```
[Options]
Title=Help File
Compress=0
[Files]
hddbw.rtf
[Bitmaps]
[Map]
```

The **[files]** section contains the name of the file(s) to be used in the process, and the **[options]** section gives you the title to appear in the active bar.

Fonts

The more fonts you have, the longer Windows takes to load and perform tasks, aside from the overhead you get in terms of system resources and memory. More fonts means more files to open and close, and scaling of fonts can also be intensive. More than 150 in memory (in 3.x) really starts to slow things down, so you need to keep the font list small and manageable (adjust through Control Panel). In fact, to ensure True Type remains stable, you need at least 2 Mb of memory for the fonts. 100 fonts also needs 4 Mb of disk space, so for 100 users, you will be getting on for 50 Mb.

How much memory is consumed depends on what a program does with a font. Only the Global and GDI Heaps are concerned, and GDI has only 64K to play with in Windows 3.x. The GDI heap gets used up as you load more fonts, particularly as True Type has to create a screen and printer version of each one you load. However, the bitmap created comes from the Global Heap.

Each True Type font needs three elements:

- .TTF file, in whatever directory you choose.
- .FOT file, in \system. This is a resource file, created when you install a font, telling Windows where to find it.
- The [fonts] section in win.ini, which explains which of the above two go together. It's worth commenting out fonts in this section that you don't normally use, or even having a batch file that copies various win.inis containing different fonts:

```
CD \WINDOWS
REN win.ini WIN.SAV
REN WIN.TTF win.ini
WIN
REN win.ini WIN.TTF
REN WIN.SAV win.ini
```

Arial and Times New Roman are expected by some packages; be wary when deleting them.

To speed True Type rendering, try setting a setting of 300 (default 256) in the *HeadlineThreshold* line in the **[TrueType]** section of **win.ini**.

Problems

System Resources

Small areas of memory used for Windows housekeeping. The **Help|About** menus in Program Manager give you a quick look at how they are doing, but that's not the whole story; it's just the lowest figure of the percentage of memory left in various system heaps, which are part of the core internal structure of Windows.

The percentage resources figure reflects memory usage by:

- **krnl386.exe**, which loads and executes files, etc. Often known as the Global Heap.
- **gdi.exe**, which looks after graphics and printing, e.g. bitmap images, fonts, pens, brushes, palettes, etc. This is the one most frequently depleted.
- **user.exe**, which caters for user input/output, including the keyboard, mouse, sound driver, time, communications ports and window management (e.g. dialogue boxes and menus).

gdi has one and **user** has three 64K storage heaps, which contain lists of where in memory portions of the interface are stored; remember, this is based on real mode limitations; memory can be seen 64K at a time, so for performance reasons, it was better to keep such data in one segment than try to span more. Every window and sub-window needs **user** and **gdi** local heap space (free space in a data segment), but Program Manager icons don't use User heap space; they are handled separately.

The *local heap* lives in the application's address space, and the *global heap* belongs to the system. As an application asks for more memory, its address space is increased, whereas requests from the global heap are satisfied from the same place as all applications. Exhaustion of a local heap only affects that application, whereas exhaustion of a global heap affects the system.

You can lose resources unwittingly; although Print Manager might use only 2% when loaded, it might use up to 50%, which could also get stuck if it can't print for any reason and has to abort.

Whichever of the remaining **user** and **gdi group** heaps has the smallest reading will dictate the free resource percentage, which is actually a relative number, that is, relative to how much was free after the system started.

Another restriction on resources is the number of *selectors*; a selector is a memory pointer consumed with each memory allocation made by a Windows application. Windows 3.1 has a fixed number of selectors (4096 in standard mode, 8192 in 386 enhanced mode). If too many small data objects are allocated, you can run out of selectors and still get out-of-memory messages.

In theory, Windows applications take up system resources until they are closed, but many programs, including *Ventura*, *Corel Draw*, *Powerpoint* and *Excel* don't tidy up after themselves properly and release the resources they took up in the first place. As a result, after opening and closing several programs, you could find yourself severely short of resources. It may be better to keep applications open in some circumstances, subject to the capabilities of your machine, and licence metering.

If you're using a high resolution screen driver, don't be surprised if you regain another 10% by going to standard VGA. Printer drivers are culprits, too. You will get problems when you get down to about 20%. Whether you just get an out of memory message, or Windows crashes, depends on how the program using the resources was written, and the error checking it does.

Remove unneeded fonts (frees **gdi**) and drivers (**user**). Also get rid of wallpaper (takes up 512K).

Symptoms of low system resources

- Icons won't display; Group files cannot be larger than 64K, so if you increase screen resolution, the icons get bigger.
- Groups won't display
- Can't run multiple copies of programs
- Text becomes distorted
- Toolbar icons disappear
- Modem transmission rates slow down
- True type becomes disabled
- Windows suddenly slows down.

Errors And Messages

Error messages can come either from Windows or applications.

Access Denied

Not enough file handles. With File Manager, a file is already open when you want to do something to it. The full path name of the file could be over 63 characters. There might be too many files in the root directory (limit 511).

What to do

- ❑ Close the file.
- ❑ Shorten path names.

GPF

Otherwise known as UAEs (*Unrecoverable Application Errors*) in Windows 3.0, these are specially timed to appear just when you're about to save your work! They are caused by a filename at a particular memory address in a module.

They're not predictable, because they aren't supposed to happen. The problem with GPFs is not that they happen (they occur even in Win '95) but that they could stop the whole system by corrupting other programs or data; there isn't that much protection from them, in other words.

The essential cause is that memory was accessed improperly; either an application has written to an area it doesn't own, or it has actually overwritten itself, or it tries to store more data than it has allocated to it. Alternatively, invalid parameters may have been passed to Windows or an application during data transfer or exchange (a memory pointer may have been overwritten). Lastly, there may be a corruption; this has been known to occur because of hard drive cables that are too long.

Address Space (as it relates to memory) is that which any program can see. DOS, for instance, has 1 Mb of address space, so any byte can be read from or written to by any program, since they all share the same space.

With 32-bit operating systems, no task can see the memory of another task without its permission, including the OS, which runs separately to other tasks (this is what protected mode is all about). With Windows 3.1, all programs share the same address space and run at the same privilege level. This includes the core Windows programs (**kernel**, **user** and **gdi**), so any program can get hold of a bit of, say, **kernel** code, and overwrite it. In enhanced mode, all the Windows programs run in their own Virtual Machine, sharing their own address space, separate from DOS Sessions, which is why it's difficult to share data between DOS and Windows applications.

Sharing data is one of the benefits of sharing the same address space, at the risk of overwriting another program's code.

kernel is roughly 64K in size, while **gdi** is over 200. A GDI device driver is **vga.drv**, for example. Whatever the reason for a GPF, it all boils down to corrupt code somewhere; the module will give you a clue. **krnl.386** indicates memory. **gdi.exe** indicates video or printer drivers, while **user.exe** indicates sound drivers or I/O devices (e.g. keyboard/mouse). Random errors will be hardware-based, while more consistent ones will be down to software. If you get GPFs from more than one application, it may be that the Windows core files have become corrupted. If replacing these doesn't work, think about reinstalling.

What to do

- Note down the name of the program, plus line numbers and memory address information in the dialogue box. Also, if you can remember in the panic, what you were doing at the time. You will need this if you get on to the programmers.
- Note how many times the same application names turn up.
- Open Task Manager; **Ctrl-Esc**, or double click on the desktop. Choose *End Task*, which might at least give you a temporary file, if not a properly closed one. Alternatively, open every other running task, and close them down properly.
- It's sometimes possible to continue on after a GPF, but I wouldn't advise it, since the nature of the error means a corruption outside a safe area.
- **3-fingered salute**. If you have to use it, should bring up two error messages:
- *System has either become busy or unstable*. Less than fatal; press a key to return to Windows, then wait a few minutes.
- *This Windows App has stopped responding to the System*. Try **Esc**—if you get returned to your application, save your work, then close down properly. Otherwise, try **Enter**, which will at least give you a chance to save work elsewhere.
- Salvage files. Look for **.tmp** files, or those beginning with **~**. Check the dates for the most recent. Some programs Autosave, but be aware that some (e.g. Word) don't save all of the file all of the time; they just save increments until you finally quit, although you can turn this off.
- Reinstall software; drivers and fonts.

Prevention/Troubleshooting

- Make sure your machine is capable (e.g. as required by your software). Is it running at the right temperature? Dust all over the insides causing overheating?
- Make sure your program has been updated for Windows 3.1/3.11.
- Have you got the correct machine type in himem.sys and setup?

- If so, are you using the correct OEM version of DOS (e.g. Compaq)?
- If you're using a third-party memory manager, try himem.sys/emm386.exe instead.
- Check incompatible TSRs. Loading keyb or smartdrv twice?
- Check the environment size. Try 2048 with the /E: parameter with the shell command in config.sys. Try more files open (files=60 should be enough).
- Check for the latest network driver (e.g. vNetWare.386).
- Make sure your \temp directory is big enough (and empty!). You need at least 2 Mb, and more for graphic and fax files.
- Try a temporary swapfile.
- Don't use a compressed drive.
- Don't run Windows from a shell or menu system.
- Try using Standard mode.
- Try without win.ini.
- Use as basic a hardware setup as possible, e.g. VGA, no mouse, etc.
- Check/Eliminate background apps.
- Don't run screensavers or wallpapers, etc.
- Eliminate unsupported applications.

Divide by zero

Conflicting programs, corrupted files, or bugs.

What to do

- Reboot, check .tmp files.
- Go to basics, restore facilities one by one.

Call to Undefined Dynalink/Can't find Dynalink

Outdated or corrupted **.dll**, or one that has been or overwritten by a newer one which an existing program can't use. If you reinstall the program, the setup routine will likely assume the new version is correct, so the only way round the problem is to remove or replace the offending .dll (if you know which one it is; check the **setup.inf** file).

Making sure you've got the correct version is quite important if you're installing many applications which may overwrite newer ones with older ones—this is particularly important with runtime versions of Video for Windows, where the software using it doesn't check to see if you've already got a version. Always keep a spare current version somewhere, or put all your **dll**s in a separate directory and include it in the path.

One of the problems with **.dll** files is that, although they are not officially part of Windows, they've been used for so long their presence is taken for granted; a typical example is **vbrun.dll**, which is used for running Visual Basic programs (the latest is **vbrun300.dll**). Another is **ctl3d.dll**, which is often used to create 3-dimensional effects on windows and dialogue boxes.

What to do

- ❑ Restart Windows
- ❑ Replace .DLL

Cannot find a device file......

....needed to run Windows in enhanced mode. Something specified in **system.ini** was not found at start up.

What to do

- ❑ Edit **system.ini** as appropriate

Insufficient memory to run this application. Quit one or more...

Windows applictons, then try again. Often not to do with memory as such, but resource areas of 64K relating to **user** and **gdi**, possibly not enough memory below 1 Mb for Windows to load programs with, already discussed in the *Memory* section.

For resources, however, the setting shown on the Help screens is a percentage based on the lowest amount of free memory available to either **gdi** or User heap. The **gdi** heap looks after handles and pointers to graphic objects and some printing facilities, while the User heap takes care of the Windows interface; the more Windows that are open, the more this heap will need. System resource indications are based on the heap that has been used the most.

The normal limit to icons per group is 50, but the memory used by them must not exceed 64K. Icons are bitmaps of a certain file size, but are adjusted to suit the current video mode, so the more colours you have available, the more bits you need to represent each pixel, and the more memory is required to show each one. Thus, in high-colour mode (i.e. 64K), you can get no more than 28 icons, reducing to 15 with 24-bit, or true colour.

The error message suggests quitting one or more applications as you have run out of available memory. This won't help, and neither will fixing blacked out icons with **File|Properties**.

What to do

- ❑ Shut down other apps.

- ❑ Reduce icons displayed
- ❑ Check clipboard
- ❑ Enlarge swap file

Segment Load Failure

Windows (or more precisely, DOS) uses loads programs into memory in 64K segments, which can be marked as Fixed, Moveable or Discardable. The latter are paged out to disk as and when required. This message appears when segments can't load, because of bad sectors, high fragmentation, or lack of resources (because there may not be enough DOS file handles). Corrupt binary files may also be a problem.

What to do

- ❑ Run scandisk or chkdsk
- ❑ Run defrag
- ❑ See GPFs.

An error has occurred in your Application. If ....

...you choose Ignore, you should save your work in a new file. If you choose Close, your application will terminate. An incompatibility between the Clipboard and video.

What to Do

- ❑ Try Ignore first, then close the application.
- ❑ Check the Clipboard for data you could save.
- ❑ If happens when scrolling, check your video drivers.

System Integrity Violation

Occurs when running DOS programs under Windows, or you get a problem with 32-bit File Access during certain read functions. Otherwise, it's similar to a GPF, in that a DOS program has tried to get to memory it doesn't own, or it has tried to access a hardware device directly.

Some software checks the exact colours of the pixels on screen, so if your video driver gets them slightly wrong, you might get odd behaviour.

The COMx Port is currently assigned

to a DOS application. Do you want to reassign the port to Windows?

Occurs if the machine does not recognise a specified COM port. This error message may also occur if you have a BIOS that does not search for serial devices on COM ports 3 or 4, in which case, you can use Control Panel to register the devices. Originally, there were only 2 COM ports, although there was space but no support in the BIOS for 2 more, and they were accessed in different ways, although the POST scanned for ports and put their details in the BDA (*BIOS Data Area)* for programs to use.

DOS-based comms programs access the COM ports directly, without posting their port address to the BDA, so if you have no serial device on COM 1, and the comms program is using COM 2, it will still use the default IRQ for COM 2. Windows comms programs, on the other hand, access the ports through the comm driver, *using the BDA*, so a modem at COM 4 (for DOS) would be the third serial port for Windows.

According to Microsoft, the problem occurs when your machine BIOS packs addresses before posting them to the BDA. Windows reads the BDA sequentially, assigning the default IRQ for COM 1 to the first entry it finds, the IRQ for COM 2 to the second entry, and so forth. For example, if you have a device on COM 2 but not on COM 1, and your system BIOS packs addresses, the COM 2 address "shifts" into the BDA slot for COM 1. Consequently, Windows assigns IRQ4 (the default for COM 1) to the device that is actually on COM 2.

To remedy this situation, you need to familiarize yourself with the BDA. This is detailed in the Windows Resource Kit, page 346. Insert the correct settings with these lines into the **[386enh]** section of **system.ini**:

```
COM3base=3E8h
COM4Base=2E8h
```

Validation failed at phase xx,xx

Normally indicates that the hard disk controller and the CMOS do not agree with each other about the characteristics of the hard drive. This error may cause **krnl386.exe** not to be loaded. You may have ***wdctrl** loaded twice, or together with a third party driver.

Packed File Corrupt

DOS gets loaded high these days, which can confuse some programs which expect to see it in the bottom 64K of base memory. DOS has a command called **loadfix** which should cure this.

The server application, source file or item canot be found.....

Make sure the application is properly installed and that it has not been deleted, moved or renamed. There may be an incorrect entry for the application concerned in the Registration Database. Try removing and re-registering.

Fatal Exception Error 0x:xxxxxxxx

These are similar to **emm386** exception errors and are usually due to faulty RAM. Windows 3.1 doesn't use much 32-bit code; any it does have lives at the low end of physical memory, inside the first 4 Mb.

Windows 95, on the other hand, runs it all over the place, so you may get more Fatal Exception errors than with Windows 3.x, simply because the code was not run in faulty memory.

What To Do

- ❑ Replace the RAM and/or motherboard.
- ❑ Alter Memory Wait States in the BIOS.
- ❑ Disable the L2 cache

32-bit File Access

Problems are almost always due to hardware and its incompatibility with ***wdctrl**. A permanent swap file must be available, and **ifshlp.sys** should be loaded into conventional memory.

- ❑ Check the references to vcache.386 and vfat.386 in system.ini match their locations on the hard drive. Check the disk compression version (not compatible with DOS v6.0 version of Doublespace).

- ❑ Max cache size to be set in Control Panel is 24 Mb, but Microsoft do not support amounts greater than 40 Mb should you edit system.ini directly.

Speeding Windows up

- ❑ 32-bit File Access can boost performance by 10-45%.

- ❑ Use a permanent swap file—temporary ones can't use 32-bit Disk Access, take longer to load and are slower anyway.

- ❑ Don't use Smartdrive with 32BFA enabled, unless for a CD-ROM.

- ❑ Enable primary and secondary caches on the motherboard.

- ❑ Turn the turbo button on!

- ❑ Match screen drivers to the video card; use 256 colours, or less.

- ❑ Set up wait states in your BIOS correctly.

- ❑ Remove unneeded device drivers, such as DOSKEY, ANSI.SYS, etc.

- ❑ Make enough space on the hard drive to give Windows elbow room.

- ❑ Watch defragmentation.

- ❑ Get enough memory.

- ❑ Turn off FileSysChange= in the [386enh] section of system.ini, so File Mangler isn't updated every time applications make a change.

- ❑ Restrict usage of buffers. 10 is enough if you're using Smartdrive.

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Windows 9x

Windows 95 is a combination of DOS 7 and Windows 4. It has *pre-emptive multitasking* for 32-bit applications and *multithreaded execution*.

Multithreading means that a program can execute "tasks" as separate "threads", and are most important for communications. Threads are independent bits of code within an application that share its resources; a spreadsheet could calculate while printing, for example; instead of each complete *program* in 3.x being multitasked, each *task* that a program needs to do can be multitasked in '95 (or OS/2, or NT.....), and given a priority between 0-31, the latter number being the highest. Once a high priority thread has read all its messages, the next ones in line gets a chance, which is how nothing gets left out. One system thread is used for fault handling only, to help cope with problems.

'95 is "32-bit", although there is 16-bit code deep inside it, as it's an evolutionary product rather than revolutionary. Microsoft say that DOS isn't required, but what they mean is, you don't buy it separately.

In fact, v7.0 of DOS still loads, but behind a pretty screen so you can't see it (just press **esc** to get rid of it). If you don't believe me, just run **mem /c /p** and see **command.com** somewhere in there. The DOS bootup files have also been combined into **io.sys** (**msdos.sys** is now a 32-bit text file) – both are now the equivalent of **config.sys** and **autoexec.bat**.

The one big problem about still having DOS as the basis of Windows is that 95/98 handles long filenames, and DOS doesn't. Whatever you type as a filename over the usual 8.3 style is kept in a separate place, the VFAT, which is an extension to the FAT. When a filename is shortened to suit DOS, IFS adds a tilde (~) and consecutive numbers for identification (you can change the tilde if you want to). The real implication with this is that if you somehow lose the VFAT entries, as you would by starting in real mode without any drivers, or defrag with a DOS program, DOS won't be able to find your files again. Reformatting your drive and reinstalling 95 will not keep the long name associations. There is a file called **lfnbk.exe** on the CD which backs up long filenames in emergency.

VFAT first came along with WFW 3.11, and is part of the *Installable File System* (IFS), which also controls how 95 connects to other Network Operating Systems, since it treats them as different file systems. It grabs all the INT21 requests from applications wanting to use the DOS file system – the VxDs in **vmm32** are designed to work with it.

It uses an extra INT to store a long file name with an alias pointer, then tells DOS how to treat the file. The name is split into a sensible short file name and a remainder, which is associated with the alias pointer. IFS keeps all the file's parts together, including the name and any fragmented parts, which may be anywhere on the disk.

Version 2 of Windows '95 (identified with a B suffix) is a collection of bug fixes and minor upgrades, which has a hard disk format (FAT 32) which avoids the wasteful cluster problem and allows drives bigger than 2 Gb to be formatted as one partition (do this with **fdisk**). FAT 16 is faster, as its information is kept completely in memory (FAT 32 pages to disk when required) and has less management to do.

A flat 4 Gb address space is used, in which reside the code, drivers and applications; each (32-bit) application thinks it's the only one there, in the range 4 Mb-2 Gb. Windows '95 code lives above 2 Gb, and between 2-3 Gb are Ring 3 DLLs used by programs; above that (3-4 Gb) are the '95 Ring 0 components (i.e. the most privileged). The range between 2-4 Gb is mapped into the address space of every 32-bit application, as are those areas below 4 Mb, which is how the code is shared.

16-bit components also live in the 2-3 Gb area, where they can cause just as much trouble as they did with 3.1! **user.exe**, for example, which has most of the windowing and messaging code, is 16-bit, and it's still used extensively.

There is plug-and-play hardware support; Microsoft won't issue the "Windows-compatible" logo to hardware that doesn't use it, or to software that doesn't uninstall itself. Microsoft says "It's as fast as 3.1".

Separate files are loaded for different machine configurations, so if you upgrade your memory, reinstall. The **ini** files are used for backwards compatibility as most of their information is now in the Registry.

Although 16 Mb is the minimum amount of memory to use with '95, the best *improvement* after an upgrade is shown on less well-specified machines, such as a 386SX with 4 Mb, because of better procedures, such as swapping in and out of memory for device drivers that aren't wanted. Of course, it's still not a good idea to use such a machine!

Where 3.1x loads device drivers that stay in memory whether or not they are required, '95 loads **vxd**s when it needs them, *all* of them in the directory, even if they're not wanted.

You can also have *user profiles*; where different users can have different screen colours, facilities, etc. No security, though!

There are hidden copies of system-critical **dlls** in the **\windows\sysbckup** directory, which are compared with those in **\windows\system** as Windows ’95 starts. If they don’t match, the ones in the **system** directory are overwritten.

Much of Windows '95’s (or ‘98's) operation is automated, and needs less looking after. It is often quite impressive; add some new hardware, even a printer, without telling it, and you'll probably find that Windows not only finds it, but knows its name and number and offers to install the driver for you! Having said that, it's not foolproof, and you may find some answers here.

As explained before, Windows 3.x doesn’t use much 32-bit code. Any it does have lives at the low end of physical memory, inside the first 4 Mb, which doesn't give the other memory you have much exercise, and explains a sudden increase in the detection of parity errors when you upgrade.
Windows 9x uses all the 4 Gb virtual address space provided by the 386, and different components are kept within fixed boundaries. It's the VMM's job (that is, the *Virtual Machine Manager*) to shoehorn this lot into available physical memory.

The lowest 1 Mb is for the currently executing DOS VM; although they can be anywhere in the 2-3 Gb region, they are mapped here when needed.

4 Mb is the default load address for 32-bit applications.

Fonts

The font limit for Windows 9x varies, depending on the length of the font filenames and the name of the font itself, but generally it’s about 1000. In 9x, the Registry and GDI both store font data. The problem is that the font names are kept in a Registry key, which may not be more than 64K in length. It gets worse if the font is not where it should be and you have to include the pathname as well. In GDI, 10k is reserved for font filenames.

Swap Files

Although a dynamic swap file is used on the system drive, that is, one that varies in size according to the system's requirements, a minimum size helps prevent fragmentation as it changes (anything not used is taken for cacheing). Setting a maximum size can also be beneficial; **dlls** and the like can actually be reloaded from their original files, which is only marginally slower than reading them in from the swap file; the difference is that they don't need to be written in the first place.

Another good tip is to create a permanent swap file on a separate drive or partition, which also stops resizing.

System Monitor (**sysmon.exe**) helps to keep track of virtual memory activity. Aside from size, it will also show what's actually in use, which will naturally fluctuate.
There's not much you can do, in fact, except add memory if you find a lot of *page-outs* and *discards* taking place amid a lot of paging activity.

Disk Cacheing

Although automatic, you can help it along by telling it what your PC's major role in life is, such as *Desktop Computer*, *Network Server* or *Portable Machine*; do this with the *My Computer|Properties* sheet. The Desktop setting assumes you have 8 Mb of RAM, so if you have less, try the Portable.

Set the read-ahead portion to a multiple of the cluster size on a compressed disk, as whole clusters are decompressed at a time. Unusually, in '95, this is still set from **system.ini**, in the **vcache** section. *MaxFileCache=1024* seems to work best on an 8 Mb system.

Installation

You'll be better off with a CD-ROM rather than floppies, if only because you get a few extra utilities, and Microsoft suggest that you run **setup** from within your original copy of Windows (better hardware detection), though it works fine from DOS. Consider whether you want '95 installed over your existing Windows, or in a separate directory. The former takes up less disk space, but the latter gives you a dual-boot option, so you can use the old system.

The upgrade version requires a previous copy of DOS or Windows (it actually only looks for **win.com** and **winver.exe**). The full version requires an empty hard disk, but if you just delete **win.com** it will work.

If you get a system failure, don't use **ctrl-alt-del** or hit the reset button, but turn the machine off, then on again. A log is taken of every action during setup, and the Smart Recovery process will autodetect that you had a problem and try again. Network setup is done with **netsetup** rather than **setup /a**. In the Registry, **hklm\software\microsoft\windows\currentversion\setup** contains a **SourcePath** entry, for the folder or drive you have all the '95 files in. Change this to a network drive if all the files are on a server.

95 can read **.grp** and **.ini** files from a Windows 3.x installation and convert all Program Groups to cascading menus. You should still back them up, though.

The installation phases are:

- running setup for the startup and information-gathering
- scandisk.exe

- check for extended memory and run XMS memory manager, check for incompatible TSRs
- Hardware detection
- Copying and expanding files. **extract** is used to expand files earmarked during hardware detection
- Creating a Startup Disk. This is for troubleshooting – it will not start the computer in DOS mode for regular use. The assumption is that Windows is present, but not starting for some reason, so it doesn't contain everything.
- Final System Configuration. This is the point of no return for previous 3.x installations.
- Reboot. Prior to this, the previous system files are replaced.
- First restart, where the registry is backed up and new files used, and 3.x groups and program items are converted.

Log files are kept of the whole process, mostly in **setuplog.txt** or **detcrash.log** if there's a crash (it's deleted if successful). **setuplog.txt** is used to bypass previously successful entries so you don't have to reformat the disk and start all over again. These are the log files you might find in the root directory:

```
setuplog.txt  setup sequence and pass/fail
detlog.txt    hardware detection
netlog.txt    networking setup
detcrash.log  hardware detection failure/crash log
bootlog.txt   success/fail first boot sequence – hidden.
```

They can all be viewed at once with **logview.exe** in **\other\misc\logview** on the CD.

Setup switches

/?	List of switches
/d	Don't use existing version of Windows
/id	Don't check for minimum hard disk space requirements
/is	Don't run scandisk first. Not normally recommended, unless tight on memory, or strange disk compression software.
/is	As above, but use if you are running setup from DOS.
/nostart	Copy the minimum 3.x dlls needed setup, then exit to DOS..

Check Hardware

Can your hardware run the software? *Is it reliable?* An overnight test with a repeating **xcopy** loop will be a good check. Is there enough hard disk space? Windows '95 should have about 60

Mb free *before* you start, more for swap space if you have low memory - a *push install* will stop if you don't have enough room.

Also, it's best to copy the files from the CD into a separate partition, because if the primary has to be formatted for any reason (it will), the files are still available. See *Starting Over*, below.

CHKDSK/SCANDISK

Run one of these, as defragmentation (below) won't happen if there are cross-linked files or lost clusters (parts of files that don't have a corresponding entry in the File Allocation Table; cross-linked files exist where the FAT allocates the same disk space to more than one file, and are more likely to be reported if you run **chkdsk** from inside Windows).

Scandisk is a better bet if you've got it. It may not get everything, as some error correction takes place independently of DOS, and **chkdsk** only tidies up the FAT—it doesn't tidy up the hard disk! For that you need....

Defrag

Which joins all the files up together again, and maybe compact them to get the most space available in one area. The swap file should be kept well clear and in contiguous space for best performance.

Backup Files

Make copies of all your **.ini** files, and **config.sys** and **autoexec.bat** as a minimum. Microsoft suggests these:

- ini files.
- dat files (for the Registration Database).
- pwl files (password lists).
- DOS-based real-mode drivers in config.sys and autoexec.bat.
- config.sys and autoexec.bat.
- network configuration files and log-in scripts.

Ideally, do a complete backup. Maybe copy 3.x to a different directory before installing '95 over it, so you've got a spare.

Uninstall software

Particularly antivirus programs, or maybe **qemm** or **highscan**. Edit your initialisation files and **rem** out anything non-critical. Check the **[incompTSR]** section of **system.inf** and check what TSRs are unpopular before you start (**subst**, **join**, **mode**, etc). Reboot to make sure the machine is working after all that surgery.

Starting All Over Again

When Windows crashes (it will), broadly, the procedure will be to:

- ❏ Create partitions on the disk
- ❏ Format the partitions
- ❏ Copy the Windows files from the CD to a directory on the hard disk
- ❏ Run Windows setup from that directory, not the CD ROM

With the CD should come a booklet with a *Certificate of Authenticity* and a *CD Key* on the front, a long number that you have to input during installation, sometimes containing the letters **oem** as the second group. There should also be a floppy disk with all the software the computer needs to see the CD-ROM drive, but these have a habit of getting lost, so here's a list of the minimum files needed on a boot floppy in case you need to make your own (don't forget it needs the system on as well, but it doesn't necessarily need to be Windows '95):

```
config.sys
autoexec.bat
CD device driver (looks like idecd.sys)
Mscdex.exe
fdisk.exe
format.com
xcopy.exe
xcopy32.exe (if running '95)
```

config.sys on the startup floppy should contain at least these lines:

```
device=idecd.sys /d:mscd0001
lastdrive=z
```

substitute **idecd.sys** with the driver for your CD drive. The **lastdrive** entry is there to cover you if you have lots of partitions – DOS itself stops at E. You can safely leave it out if you only have Drive C: to contend with. If you have a SCSI CDROM, you need the drivers appropriate for your SCSI card.

autoexec.bat should have at least this line:

```
mscdex /d:mscd0001
```

The **/d:xxxxx** part of the commands should be the same in both files. For reference, the diskette that comes with the CD contains the following files:

```
io.sys
msdos.sys
command.com
```

```
autoexec.bat
config.sys
drvspace.bin
deltree.exe
edit.com
edit.hlp
fdisk.exe
format.exe
mscdex.exe
scandisk.exe
scandisk.ini
xcopy.exe
xcopy32.exe
```

There is also a directory called **btccdrom** containing the CD stuff:

```
btccdrom.sys
cdplay.exe
manual.txt
manual.wri
qig.txt
qig.wri
```

Boot the PC with the floppy so you can use **fdisk** to create partitions on a new hard drive, not bigger than 2 Gb each with the FAT 16 system, so if your drive is larger than this, make a Primary, then an Extended partition, then create Logical Drives in the extended partition (if you don't need to create partitions, go straight to the *Format* section below).

fdisk

From the A: drive, type:

```
fdisk
```

From the **fdisk** opening screen, choose selection 1, which is *Create DOS Partition or Logical DOS Drive* and press **return** in answer to every question thereafter (select *N* (No) to the prompt that asks if you want a 32-bit disk partition before you get there – it's too much trouble, and FAT 32 is slower. Why? Well, on a 4 Gb hard disk, for example, FAT 16 would use a cluster size of 32K and a maximum FAT size of 128K, which means it can sit in memory. FAT 32 would require 4 Mb, so will mostly reside on the drive, hence paging, hence lack of speed. The 4K cluster size also means more accesses to the FAT, and fragmentation won't help). Be that as it may, the above will give you a Primary partition which will only be made active if you have used all the drive space available. If you have used less than this, perhaps because you want more than one drive letter, you will have to make the Primary partition Active so that DOS can use it to boot from. From the opening screen, choose *Ser Active Partition* (choice 2) and make the appropriate choice.

To create an extended partition, choose option 1 from the opening screen, then 2 from the next screen. Then return to the opening screen (press **Esc**) and create one or more logical DOS drives in the extended partition, maximum 2 Gb each. There are sound reasons for creating a second partition, mainly to do with not wasting disk space, but also for safety for the Windows files, which will be explained later.

Quit **fdisk**, reboot from the floppy, then format all the partitions.

Format

From the A: drive, type:

```
format c:
```

followed by **Return**. You will see:

```
WARNING, ALL DATA ON NON-REMOVABLE DISK DRIVE C: WILL
BE LOST!

Proceed with Format (Y/N)?
```

Press "Y" followed by **Enter** to format the disk. When the formatting is complete, the screen will display something like:

```
Format Complete
xxxxxxx bytes total disk space
xxxxx bytes in bad tracks
xxxxx bytes available on disk
```

If you created more than one partition, you must format the others before you can use them, always using the appropriate drive letter, of course. If you are going to install Windows '95 from an OEM disk, that is, has *For distribution only with a new PC* written on it, you don't need to place the system on drive C when formatting it, as it will stop **setup** from working if an operating system is detected.

You shouldn't need to reboot at this stage, because the CD drive letter should have been correctly allocated, but it will do no harm (the CD will have the next drive letter after the last partition). Test by inserting the Windows CD and running the **dir** command. Once the CD-ROM drive is recognised, copy the **\win95** directory from it onto the hard disk. To do this, issue this command from the A: drive:

```
xcopy d:\win95\*.* c:\win95\
```

Substitute **d:** above for whatever letter your CD-ROM drive is (if your hard drive is large with several partitions, it could be as high as F- the **lastdrive** setting in **config.sys** above has been set to Z because DOS left to itself only goes up to E). The new directory on the C: drive should be created automatically if you have included the backslash at the end, otherwise you will be asked if you want to create a file or a directory – just press D in response. If you have a second partition, say, drive D:, copy the files to it instead, so if you ever have to format the primary partition (you will), they are on the hard drive automatically.

This makes the installation faster and avoids the annoying situation where Windows forgets where the CD-ROM drive is halfway through (true!). Also, when you need drivers later, they are available when you don't necessarily have the original disks or CD-ROM to hand.
Then change to the **\win95** directory on whichever drive you chose, using the **cd** command:

```
cd \win95
```

Your screen prompt should look like this:

```
C:\WIN95>
```

Type:

```
setup
```

(followed by **Return!**) and proceed with the installation. Although you should have any diskettes supplied with your hardware to hand, it is always best to do a basic installation first (e.g. standard VGA instead of anything exotic) and add the extras later. This will save you starting all over again if you get a problem and Windows can't find the files it needs. As I said before, it has a habit of losing drives, and if you skip files, you're never sure whether you've got everything.

At some point, you get a choice of installation types:

- Typical. This is easiest, but you may have to add things later.
- Portable; for notebooks, but useful for machines with low memory.
- Compact; just uses 10 Mb. Again, you may have to add things later.
- Custom; this is best, because it gives you most control, and is needed to load Windows into a different directory than standard.

Otherwise, you can safely leave Windows to carry on. The machine will reboot and carry on with setup by itself. The printer installation can safely be skipped in the interests of speed (just press the **Cancel** button).

That should be it, for the basics anyway! Now you can perform the finishing touches, like adding the drivers for any devices that Windows hasn't already autodetected.

After Installation

If you have selected a dual-boot system, re-add **\windows** and **\windows\system** to your **path** statement in **autoexec.bat** so you won't necessarily have to reinstall your software (**exe** files need to find all their auxiliaries). You won't need to do this if your applications keep all their files in one directory.

Check the correct protected mode drivers have been installed, as '95 often uses the 16-bit versions by mistake. More often than not, it installs protected mode ones, but neglects to remove the others. One way is to compare the resulting **config.sys** and **autoexec.bat** files with the contents of *Device Manager*, which you can get to by clicking on *Properties* for *My Computer* (or whatever you decide to call it). While in Device Mangler, check for little yellow circles with exclamation marks in them that indicate the device is not working properly.

Often a device gets installed as an “other device” (in a section with a question mark). The trick is to remove the devices, and restart Windows, and they should be autodetected into their proper places.

Exchange Password

Make sure you change this, which has the effect of enabling it. When '95 converts your old Mail files to the new format, it may ask for several passwords, namely the one for Windows '95, the one for the network and the one for MS-Mail, but it doesn't enable password protection for the new mail file, so anyone can get in. *You have to turn on the password manually*, through *Change Password* under *Properties* on the Personal folder file of Exchange's **Tools|Services** menu.

Rescue Diskette

This is one with essential system files and utilities that will boot the machine again so you can reinstall Windows or at least get at your data. Without wishing to sound Nannyish, this is so important, and arguably more so than having backups, that I recommend you stop reading this and make one *now*, through the *Add/Remove Hardware* icon in Control panel, and the *Startup Disk* tab. It won't necessarily end up with the right files for your system (see below), but click on the **Create Disk** button to start the process, and use Explorer to copy any others over afterwards. Alternatively, you can go to a DOS prompt and type:

```
format a: /s
```

which will both format the diskette and place the system on it, after which you can copy over the files mentioned below. You can't just copy the system files over – for one thing they have *hidden*, *system* and *read-only* attributes which mean they can't be seen or copied anyway, and secondly, they must be in a particular place on the boot disk because the computer looks for them there when it starts.

When you've finished, tape it to the machine so it doesn't get lost.

Change User Name

The *RegisteredOwner* and *RegisteredOrganisation* values are in:

HKEY_LOCAL_MACHINE\Software\Microsoft\Windows\currentVersion key.

Change File Source

Look for:

HKEY_LOCAL_MACHINE\Software\Microsoft\Windows\CurrentVersion\Setup\SourcePath.

Hide Screen Tips

In **HKEY_CURRENT_USER\ControlPanel\Desktop**. The first character of the value *UserPreferenceMask* needs to be changed (it contains four groups of two characters). Replace A with 2, B with 3, C with 4, E with 6 and 8 with 0.

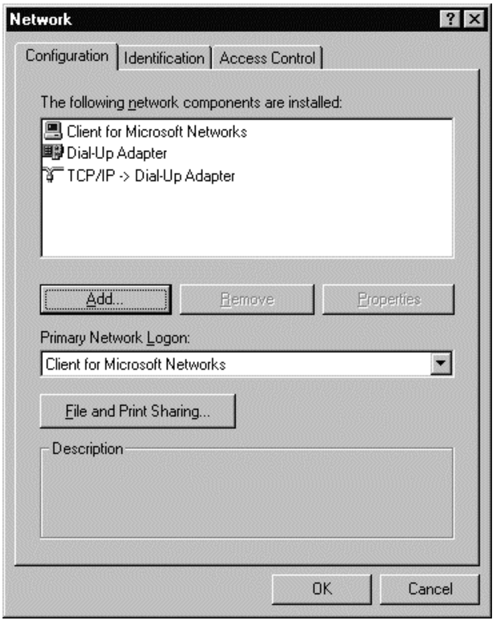
DialUp Networking

Assuming you have a modem, go to *Settings* through the *Start Menu*, select *Control Panel* then double click on *Add/Remove Programs*. Click on the *Windows Setup* tab, click once on *Communications*, then the **Details...** button. Click once on the little box to the left of the words *Dial Up Networking* so you get a tick, then click on **OK**. You will be asked for certain Windows disks or the CD-ROM, and Windows may restart once or twice. While it's doing all that, collect together the following information from your ISP:

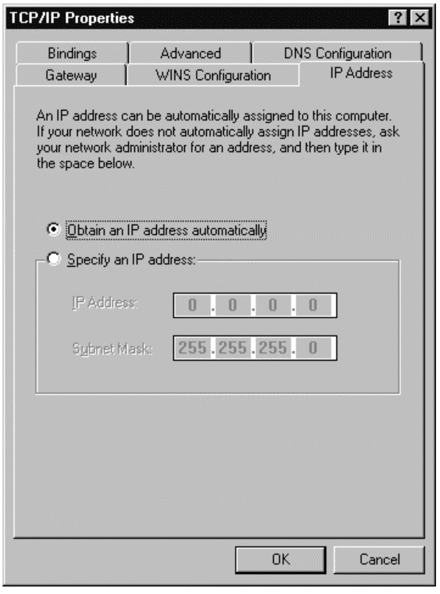
Domain name servers	204.161.142.2 and 204.161.142.3
Default gateway	194.153.2.1
ISP telephone number	0181 276 6234
Subnet mask	255.255.255.0
Username	
Password	
Support phone number	0181 276 6251

The numbers above are examples only. When Windows restarts, you should be back in Control Panel, so open the *Network* icon, select **Add**, double-click *Client*, click on *Microsoft* in the *Manufacturers* list, and double-click *Client for Microsoft Networks* in the list of Network Clients. If you don't have *Dial-Up Adapter* in the list of installed network components, select **Add** and double-click on *Protocol*. Click on *Microsoft* in the list of Manufacturers, then double-click on TCP/IP.

You should end up with a screen looking a bit like this:



Click on TCP/IP and select **Properties**. The next screen will have six tabs along the top:



Select the *IP Address* tab, click once on the little circle next to the words *Obtain an IP address automatically*, so it becomes black. Click on the *WINS Configuration* tab and ensure that *Disable WINS Resolution* is selected.

Click on the *Gateway* tab, enter the Gateway IP address, if you have one, then click **Add..**

Click on the *DNS Configuration* tab and select *Disable DNS* (if you need to put your ISP's details in, do it in the *Dial Up Networking* properties section). Disable everything under the *Bindings* and *NETBIOS* tabs. Under the *Advanced* tab, set *Use IPX Header Compression* to *No*, which gets the modem to handle compression. Also set *No* to *Record a Log File*, and enable *Point-to-Point IP*. *Packet Size* can be left on Automatic, but *Small*, *Medium* and *Large* correspond to 576, 1000 and 1476 bytes, respectively. Your ISP can probably tell you what size they use, but you can also use **ping** several times to find out *before* you set your MTU, or *Maximum Transmission Unit*, properly (described overleaf).

Installing Dial Up Networking

Refer to the *Internet* chapter.

Start Me Up

io.sys reads **config.sys** (only to check for real mode drivers), then **msdos.sys** to which it passes control. **command.com** then takes over and reads **config.sys** properly, although most of its functions are in **io.sys** anyway (in the A+ exam, the first read of **config.sys** probably doesn't happen). Then you get **win.com**, **vmm32.vxd** (creates the virtual machine and installs VxDs) and **system.ini**, followed by **system.dat** (the Registry), **win.ini** and **user.dat**. Finally, there's **kernel32.dll**, for the main 95 components, and **krnl386.exe** for 3.x device drivers, **gdi**, **gdi32**, **user** and **user32**.

io.sys contains commands to load **himem.sys**, **ifshlp.sys**, **setver.exe** and **dblspace.bin** (or equivalent), plus other **config.sys** settings, such as these defaults:

```
device=c:\windows\himem.sys
devicehigh=c:\windows\ifshlp.sys
devicehigh=c:\windows\setver.exe
files=60
fcbs=4
buffers=22
stacks=9,256
lastdrive=whatever
```

The above can be overridden (as long as they are higher) inside **config.sys** itself.

I know **devicehigh** is used without **emm386.exe**, but maybe it's clever!

While we're at it, these lines are a default **autoexec.bat**:

```
prompt $p$g
path c:\windows;c:\windows\command
set temp=c:\windows\temp
set tmp=c:\windows\temp
```

Here are some switches for starting windows:

`/B` Creates a **bootlog.txt** file

`/W` Restores **config.sys** and **autoexec.bat** from **config.wos** and **autoexec.wos**, created when you open a program that requires MS-DOS mode and you've specified a new configuration. The files are deleted after '95 starts, so it could get stuck in an infinite loop of restarting if you use this in **autoexec.bat**.

`/WX` As for /WX, but reboots without prompting.

`/D` **:F** Forces all drive accesses through the Real Mode Mapper.
:M enables Safe Mode. Equivalent to F5.
:N Safe Mode with Networking. Equivalent to F6.
:S Stops '95 using ROM space between F000-FFFF. Equal to **SystemROMBreakPoint=False** in **system.ini** (see above).
:T starts '95 in something like "setup mode", that is, with no FastDisk, internal or external vxds, and no EMS page frame. Use for Fatal Exception errors
:V The ROM routine should handle interrupts from the hard disk controller. Equal to **VirtualHDIRQ=False** in **system.ini** (above).
:X Excludes upper memory from '95's sticky fingers when searching for memory space. Same as **EMMExclude=A000-FFFF** in **system.ini**.

Windows '95 boots up behind a picture, which can be got rid of by pressing **Esc**. If you have a previous version of DOS (that is, you installed with dual boot), you can press F4 to go to it. Alternatively, press F8 to get a menu with these choices:

Normal What you would get if you hadn't pressed F8.

Logged As above, with a **bootlog.txt** file in the root directory, which is an ASCII file logging all attempts to load drivers, and results. A file called **detlog.txt** contains a log of the most recent boot-time hardware detection.

Command Prompt Only Gives you MS-DOS 7 in real mode.

Safe Mode Loads no protected mode drivers, including network software. Useful for diagnostics.

Safe Mode with Network Support As above, but you can load software from the network when troubleshooting.

Safe Mode Command Prompt Speaks for itself.

Step-by-Step Configuration Asks before loading each TSR.

Previous version of MS-DOS If you have a dual-boot setup, allows you to use what you had before. This is only available if you have installed '95 into a separate directory, in which case, there will be a **BootMulti=1** entry in the **msdos.sys file**. Talking of which.....

MSDOS.SYS

This used to be the name of one of the hidden binary files that previous versions of DOS would boot up with, but now is a 32-bit text file for Windows '95 (the name was kept for install programs that check the DOS version). It has System, Hidden and Read-Only attributes which will need to removed before you can edit it. Here are the settings in the **[options]** section:

`BootMulti=1`	Allows booting from previous version of DOS.
`BootDelay=n`	Time allowed to press F8 or F4 when loading previous DOS. n=the number of seconds (def 2).
`Logo=0`	Removes the pretty picture when you boot up.
`BootGUI=0`	Loads Command Prompt Only. 1 starts GUI.
`BootMenu=1`	Gives you the boot options menu.
`BootMenuDefault=8`	(for example). The number is the same on the menu.
`BootMenuDelay=5`	The delay (secs) before going to the default.
`BootKeys=0`	Disables Function keys during bootup, for security. The effect is that most of the above are ignored.
`BootSafe=`	Starts Windows in safe mode.
`BootWarn=`	Displays safe mode warning message.
`BootWin=`	Sets default OS. Enabled, loads '95.
`DblSpace=`	Loads **dblspace.bin**.
`DisableLog=`	Enabled (1), presumably disables bootup log file.
`DoubleBuffer=`	Loads double-buffering for SCSI drives.
`DrvSpace=`	Loads **drvspace.bin**.
`LoadTop=`	Loads **command.com** at the top of memory. Maybe use with NetWare, or memory managers.
`Logo=`	Enables animated logo.
`Network=`	Enables safe mode with network support.
`SystemReg=`	Presumably disables processing of the registry. In the **[paths]** section:
`HostWinBootDrv=`	The drive letter where '95 is installed, or the host drive if this is compressed.
`WinBootDir=`	The name of the directory where startup files are placed by **setup**.
`WinDir=`	The name of the Windows home directory. Also sets the default values for environment variables.

If you have a dual boot system and want to edit it from "normal" DOS, note that this file is copied and renamed **msdos.w40** (and back) as '95 loads and unloads. If you get binary garbage on screen, you're editing the wrong file.

The Registry

Refer to *The Registry* Chapter.

DOS Applications

To use DOS applications on a Windows '95 machine, you can:

- ❑ Start your previous version of DOS with F4 as '95 boots (assuming msdos.sys settings are correct). You will have to reboot to go into '95 later, though, and you will have had to install '95 into a separate directory to get the multiboot feature.
- ❑ Press F8 on start up and select Command Prompt Only. If you regularly want this, edit msdos.sys and insert the line BootGUI=0.
- ❑ Use a DOS Session, as with Windows 3.1x. This supports long filenames, and some commands will run differently. you can also run a Windows program directly with the start command.
- ❑ Shutdown and select MS-DOS mode, thus using '95 in Real Mode, or Single Application Mode, similar to 2 above. DOS applications will therefore get full access to your hardware, and '95 will start again once you quit. Unfortunately, you don't get as much conventional memory; you lose about 3K, because a bit of a loader program is left running so you can type exit to return to the GUI. To get rid of the 3K of code, edit msdos.sys to include the line bootgui=0, which will ensure you get the DOS prompt on start up (make win the last command in the autoexec.bat file to ensure that Windows '95 is run as normal). Also delete logos.sys; when you shut down, win.com displays the bitmap it contains to tell you it's now safe to switch off, and effectively redirects all keystrokes to NUL. If the bitmap isn't there, you get the DOS prompt.

Although '95 in theory doesn't need one, it's worth keeping an **autoexec.bat** file handy, so **command.com** is loaded before **win.com** (**command.com** is needed to process the file). Indeed, it would appear that you cannot exit to DOS unless this is done. The loading order also means that **command.com** doesn't have to be run for each DOS box.

PIF Files

These are not used with Windows'95, or they are, but in a different way. They are now *Property Sheets*, which are mostly point-and-click, but you may have your own **config.sys** and **autoexec.bat** settings to type in. Such files are automatically created when you create a short cut for a DOS application.

Once you've invoked the property sheet for the program, select **Program|Advanced|MS-DOS Mode**, and copy and paste the settings you want from any sample files you may have. There is a check box for MS-DOS mode, which will run '95 as non-GUI, so you can specify **config.sys** and **autoexec.bat** entries.

Don't leave a blank line or any other non-printing character after the last line of **autoexec.bat**, otherwise you will only see a DOS prompt; none of your settings will run automatically.

Resources

Windows '95 has 5 heaps, with three belonging to **user32.dll** and two to **gdi32.dll**. The former store internal information about active programs (like menus) and the latter relate to graphics, including fonts, brushes, etc. Although the 32-bit heaps are 2 Mb in size, each **dll** has a 64K 16-bit one which is generally the source of bottlenecks and resource problems. Unlike Windows 3.x, which relied on programs releasing memory they took up, 9x keeps track of resources used by 32-bit programs and releases them on termination – resources allocated to 16-bit programs are only released when every 16-bit program has closed down. It follows that you will get most problems from applications that lurk around in memory, particularly from startup.

You should start off with about 85% resources free, with no applications loaded. Windows '95 will show about 95%, but not because there are more facilities in the 16-bit **user** and **gdi** heaps; it's because the calculation has changed to reflect resources available *after* Explorer and one or two other programs have started.

mkcompat.exe

Undocumented, this comes with Windows '95 and can be used for Windows programs that have problems running; it is especially useful for installation programs that check for 3.1 (*see Lie about Windows Version Number*), but don't forget that you need to reverse the changes if you use other programs with the same name. It lives in the **\windows\system** directory and essentially is a series of tick boxes in a dialogue box, starting with 5 for the basic options and 31 for the Advanced section. The former are actually incorporated into the latter.

Changes aren't made to the files, but incorporated into the **[compatibility]** or **[compatibility32]** section of **win.ini**, depending on what sort of program it is, and the program patched on the fly, as it were.

Basic Settings

Don't spool to enhanced meta files	Stops Windows spooling to an Enhanced MetaFile before sending them to the printer. Use for printing problems.
Give application more stack space	Allocates more memory for stack space. Use if you get Out Of Memory or Out of Stack Space errors. Can help with GPFs.
Lie about printer device mode size	Forces Windows to provide information in an older format, just in case apps can't understand modern printer drivers. Use with printing problems.
Lie about Windows' version number	Use if your application is too stupid to run under '95.
Win 3.1 style controls	Use for display problems. It makes the display conform to 3.1 standards; use with some Lotus applications.

Advanced Settings

Average width metrics	
Always send NC_PAINT	Forces Windows to send a message to an application to repaint its window whenever you move it.
Delay comm handshake	Use with modem connect problems, or when modem not detected.
Disable 16 color brush cache and 55 ms timer	
Disable EMF spooling	Same as *Don't spool to enhanced meta files* under *Basic Settings*. Use if application has problems printing.
Disable font associations	
Don't attach input thread when journaling	SetActiveWindow ==SetForegroundWind.
Don't enum device fonts	
Don't send calcsize on WM_MOVE	
Don't Shutdown/Ignore certain faults/dequote commandline	
Enable 3.x UI features	Same as Win 3.1 style controls under Basics.
Enum Helv and Times Roman fonts	Forces '95 to list its Ariel and Time (New Roman) fonts as Helv and Tms Rmn, as Windows 3.1 knows them by (some programs have the names hard coded in).
Force extra window words	
Force printer text to new band	Stops Windows sending text and graphics in the same band. Helps programs that can't print graphics in landscape mode under '95.
Force TT fonts to graphics band	
Force win31 printer dev mode size	Same as Lie about printer device mode size under Basic Settings.
Global hooks only called for Win16 apps	
Ignore discardable segment attributes	
Ignore raster fonts	
Ignore topmost windows	Lets Windows lie about which window is on top, as some applications make presumptions about this (e.g. cc:Mail) and cause problems if you use them when they are not on top.
Increase stack size	Same as Give application more stack space.
Lie about device caps/no SetDiBits validation	
Lie about Windows version	Same as Lie about Windows' version number under Basic Settings.
Mirror fonts in win.ini	Use if the application has problems using the fonts supplied with '95.
Module specific hack	
No HRGN 1	
One graphic band and use print escapes	
Subrtract clip siblings	
Support multiple printing bands	
TT fonts are device fonts	
Unused3	
Windows 3.1 palette behaviour	Use if colours are displayed wrongly.

Remove Internet Explorer from Windows 98

First, you need a legitimate copy of Windows 95, because you are going to replace some files, specifically those concerning shell and window management. If something goes wrong, you will need to replace the Registry, so make a backup first, and the files from the CD-ROM. These are:

```
explorer.exe (in the \windows directory)
comdig32.dll (\windows\system)
shell32.dll (\windows\system)
notepad.exe (\windows)
wordpad.exe (\windows)
```

You can still use a browser after this, but you won't have to use memory and CPU cycles for the ability to type a web address from any window, though you can no longer use the Windows Update or the System File Checker.

After changing the files, delete the IE directories (in \Program Files and \Windows), and run RegClean or similar to clean up the Registry. Your system should now run faster and be a lot more stable.

Table Of Contents

The Registry

This is a file, or cellection of files, that contain most of the information pertinent to running your computer in Windows, being an equivalent of the Bindery in NetWare 3.x. In 3.x, it consisted of little more than DDE instructions for printing and associating files with programs, but in ’95 and ’98, most of the information in the various **.ini** files (including **config.sys** and **autoexec.bat**) was moved into a new expanded version, except that required by older (16-bit) applications, who use the **ini** files for backward compatibility, although doing this takes over twice as long. Windows NT has always had its own version which, apart from a superficial resemblance and total lack of documentation has very little in common with its relatives. Whereas **ini** files were text-based, the Registry isn’t, although it can import to and export from text files. This means you need a special way of getting to its contents, in this case through the **regedit** program, which can be used remotely in Windows 98 over the same NT or NetWare network, provided you have Remote Registry Services installed (on the CD).

Registry accesses can take place at the rate of over 40 a second, and one mouse click can cause over 500! The registry files can also get very large - 2 Mb is not uncommon. This is because any deletions you make are simply marked as not valid and not actually deleted, the same as a file’s space is marked as available on a hard disk instead of it being removed. You can use the DOS version of **regedit** in Windows 95 OSR2 to trim its size – previous editions apparently have a bug.

Always take a backup before you do anything! At the very least, export its contents to a text file, which you can re-import later on. Otherwise, you can change the attributes on the files and simply copy them somewhere safe.

In Windows, the Registry is made up of 2 main files, **user.dat** and **system.dat**, plus a few that are created when Windows starts, which have hidden, system and read-only attributes, so you shouldn’t be able to see them, let alone tinker. When you invoke **regedit.exe**, the registration editor, their information is combined, so it look like you are only using one. There are two (or more) so that networking is easier; you can log on to multiple machines this way, with your own **user.dat** and another machine's **system.dat**, or, conversely, you can have multiple users on a single machine. **user.dat** contains entries that point to Start menus and desktop folders.

Fortunately, most entries are changed through a combination of the Explorer, Control Panel, or similar (only 32-bit programs can write to the Registry), but there are some tweaks that have to be done manually. If you want a printout, by the way, it will take over 100 pages.

When Windows opens correctly, a copy of both files is made (also hidden) in the **\windows** directory, and given a **.da0** extension, which can be renamed and used again if you get a problem with your current session. In other words, they can be used as a recovery device (mostly automatically, by Windows itself), but you will lose any changes you made since Windows started. You will also find copies with a **.1st** extension (i.e. **system.1st**) which are simply copies made at the time Windows was originally installed, which are not updated.

Registration Database

This is a binary file called **reg.dat** (**user.dat** and **system.dat** in Windows '95), where programs register their data exchange capabilities with Windows, including DDE and OLE; when an application installs, it "signs in" with the *Registration Database*, with a **.reg** file, which gets merged in; a server application will also query the database each time it loads to check its registration is still valid. It's a cut-down version of The Registry used by NT to store details of the operating system, the users, the PC's hardware configuration and loaded applications, to name but a few. **Reg.dat** is created by **shell.dll**. Windows '95 makes full use of it as well, for replacing many of the parameters in **ini** files.

The registration database allows servers to let clients know of their capabilities, such as the type of objects they can create (via the *ClassName*), and allows the server to be found from a container document.

Many programs (mainly those supporting OLE) store a lot of information in the registration database, so they can find out about each other's capabilities. If you double click an embedded graphic in a Write document, for instance, Write uses the information from the Registration Database to launch Paintbrush and manipulate the OLE information in the document directly.

Otherwise, you can:

- Open a file by double clicking it, which will open the relevant application (the **[extensions]** section of **win.ini** does this as well, but the Registration Database overrides it).

- Place a file as an icon in a group (drag it from File Manager).

- Print by dragging the file to print manager from File Manager, or its icon if you've previously created one.

- Embed something as a packaged object by dragging to another icon.

It's a good idea to keep a copy of the **.dat** files in case you get programs that hog it and you want to go back to what you had before.

Also, the Registration Database occasionally gets corrupted, and you won't get OLE facilities. If this happens, you may need to reconstruct it.

There are various ways that programs register with the Database:

- Self-registration, done when the program is run for the first time.

- Merging a Registration File. A program will have a .reg file which can be merged into the database by double clicking on it or by running regedit (see below).

A key and a value is placed in the database that shows which OLE protocols a server supports. These values are used whenever a client or **.dll** needs information about a particular object and the application it came from.

Reconstructing the Database

This can be done in the following way:

- Rename the old **reg.dat** file.

- **rem** out each line of the **[embedding]** section of **win.ini**, so this information isn't used in the reconstruction.

- Restart Windows.

- Select **File|Run**, and type the following command line:

  ```
  regedit /u c:\windows\system\setup.reg
  ```

  followed by:

  ```
  regedit c:\windows\system\ole2.reg
  ```

This deals with the **.reg** files that come with Windows. Now repeat with all your programs (the surest way is to reinstall every one). For self-registering applications, start up **regedit** and remove any reference to them before starting. Reg files that come with applications make assumptions about your path structure, so you may need to alter the reg.dat file directly, before merging. Look for this string:

```
<WindowsDir>
```

and replace it with the proper one. On a network, you would need to include the whole path.

Regedit (3.x)

You shouldn't need to do this, but you can edit the Registration Database by typing:

```
REGEDIT
```

through **File|Run**. Double click on an entry to edit it. You can add a new file type by copying an existing one and modifying that, or creating a new one. Don't delete blank lines; they may contain **reg.dat** entries not displayed due to incompatibility with OLE 2.0. The following information is required:

- Identifier; a unique keyword of up to 63 printable ASCII characters which is used by Windows to identify the file type.
- File Type; the text description that you use to identify it in dialogue boxes.
- Action, Open or Print.
- Command and switches to be executed (or DDE message to be sent) to perform the above action, e.g.

```
pbrush.exe %1
```

Check the *Uses DDE* box if the application sends DDE messages to execute the Open or Print actions. You can also specify the DDE message and application string, and the DDE topic associated with the command. For example:

```
(FileOpen(%1))
```

to Windows from Word is the equivalent of the Open box.

Advanced

You can edit the Registration Database in more detail by typing:

```
REGEDIT /V
```

which will display it in *Verbose* mode. This is for advanced users and should not be fiddled with lightly!

A registry entry is called a *key*, which is similar in status to a file or directory. You can have sub-keys as well, just as you can have sub-directories. It doesn't matter what order they're in, but you might want them listed alphabetically.

If **reg.dat** becomes corrupted, or you lose it, you can recreate it by deleting the original and restarting Windows, since if it doesn't find it, it automatically recreates it, based on the **[Embedding]** section of **win.ini**.

Next, merge all the **.reg** files dotted around your hard disk.

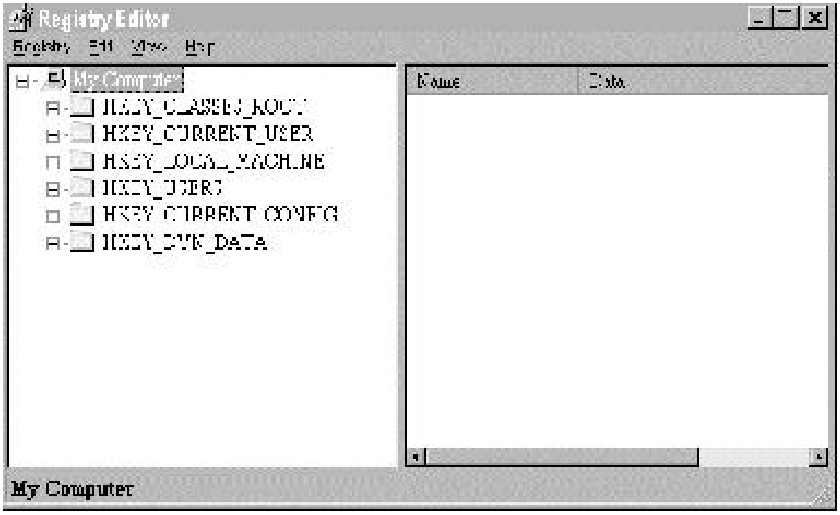
Open File Manager, select **File|Associate**, enter **REG** in the Files with Extension text box, then select OK. Then, using File Manager again, find every .REG file on your hard disk (enter ***.reg** in the *Search For* text box, having selected **File|Search**. Start from C:\, and check the *Search All Subdirectories* box). Select everything in the *Search Results* window.

In fact, you would only open this program to confirm that your **reg.dat** file is actually corrupted, otherwise you would never know, unless you are alert to files mysteriously disappearing, or getting error messages instead of the application when you double-click on files.

Regedit (9x)

This can be run either from the GUI or in MS-DOS mode. It gives you a view of the keys on the left (such as **current_user**) and the value name and contents on the right:

Each key (folder) has a subkey (subfolder) with *value entries* (files) and *data* (contents); the



items in brackets represent the equivalent in Explorer, since the displays are similar. If you use **regedit** to make changes, you won't see the effects until Windows is rebooted, so if you can, try to alter things with Control Panel, or whatever, since the effects will mostly be immediate.

Value entries themselves have three parts; a name, data type (e.g. binary or ASCII) and up to 64K of data. For example, the subkey:

```
HKEY_CURRENT_CONFIG\Display\Settings
```

might contain the data 1024, 768 under the **resolution** value - when Windows '95 starts, this information is used to initialise the video display. Other hardware is treated the same way. The values relating to the keys (that is, the data they contain, in the right pane) come in three varieties; *string*, *binary* and *dword*. String values are text, in quotes, binary values are settings, never actually shown that way, and dword values are to programs what strings are to you – they come in 4-byte unspaced hexadecimal format, and will have the decimal equivalent in brackets afterwards.

Only the (six) root keys are displayed on first opening. There are two main ones (*Local Machine* and *Users*) containing information about the whole system, which supply information to three others that relate to parts of the machine actually operating, as set up for a particular person (*Classes Root*, *Current User* and *Current Config*). Changes made by applications are recorded in them and transferred to the main keys. *Dyn*(amic) *Data* fills up from system memory when the machine is started, and its contents never get written to the hard disk.

There is a *Find* Command on the *Edit* menu to help you find what you need.

The six root keys are:

HKEY_CLASSES_ROOT

A copy of the entire registration database, and a duplicate of (or shortcut to) HKEY_LOCAL_MACHINE\software\classes, containing data on OLE, shortcuts, drag-drop, etc. If you double-clicked on a document, this bit would be consulted as to what program it belongs to and how it would be treated (you can remove the **IsShortcut** value from the **Inkfile** and **piffile** keys to get rid of the arrows in shortcut icons). The information here is what you would find in the Windows 3.x Registration Database, so any 16-bit application under the impression it is using it would write information here (and the other place, of course), so this bit is purely here for compatibility.

There is a ProgID subkey for each file type (e.g. batfile), a subkey for each extension linked to that file type (further down) and two special ones labelled * and CLSID.

The default value of an extension key contains the name of an associated ProgID, while the ProgID contains a file type's name and characteristics; that is, the **.bat** key points to the **batfile** ProgID. There are several subkeys underneath a ProgID. **Defaulticon**, for example, describes the icon used to identify that file type. Shell would describe the actions taken, those in the context menu, usually edit, open and print. CLSIDs are Class IDs, and are unique 128-bit numbers in a 8-4-4-4-12 format, issued by Microsoft. They are associated with a particular **.dll** or **.exe**, and are part of the *Component Object Specification*, which is part of OLE2, and are intended to help with code reusability and reduce name collision - it might be possible, for instance, for two **dlls** to have the same name, so the numbers identify a type of object, which is matched to an internal database that contains information about what that object can do, or not, as the case may be. The number is issued by Microsoft; the first 8 are randomly generated, the next four concocted out of the date and time, and the last 20 depend on your machine's characteristics. All are listed under the CLSID subkey.

HKEY_CURRENT_USER

A duplicate of the current user's subkey in HKEY_USERS, as it contains data from the current **user.dat** - having a duplicate assists in maintaining different user profiles, so you will find details on sounds, colour schemes, keyboard settings and wallpaper, to name but a few. Recently used documents are kept here as well, albeit in hex, together with the equivalent of private **.ini** files for applications, not always deleted when you get rid of the software. This key gives Windows 98 compatibility with applications using the NT Registry structure.

HKEY_LOCAL_MACHINE

Otherwise known as the **system.dat** file, this is the largest file in the Registry, and contains all the information about your computer, such as hardware devices installed and their settings. In other words, "non-user-specific information about the host system", like hard disks, modems, port settings and drivers, time zones, whether the system is networked or docked, etc. The Hardware branch is where the Plug and Play system keeps data.

HKEY_USERS

Contains details about all people using the computer and how they want the machine set up. You will find their profile name as a subkey, which will contain their **user.dat** file; profile data will be found in their subdirectory under **\windows\profiles**, although if your machine is not set up for multiple users, you will only have one subkey named **.default**, which is always present. You can’t alter another’s settings unless you log on as that person, since the details are only held in memory.

HKEY_CURRENT_CONFIG

Information on currently attached hardware (or the current hardware profile), like printers or displays. Duplicate subkey of **HKEY_LOCAL_MACHINE\config\xxx**, where *xxx* represents the current hardware profile.

HKEY_DYN_DATA

Stored in memory for speed, contains details of all devices that have been installed or loaded, successfully or otherwise, plus data on performance (viewed with **sysmon**), PnP and Virtual Device Drivers (VxDs). The Registry is implemented in **vmm.vxd** (virtual machine manager), which is the first **vxd** loaded, so it can be accessed by the others. Also, you will find installed fonts. The **\software\classes** subkey is where **hkey_classes_root** gets its information from, being an alias.

Removing Hardwired Icons

hklm\software\microsoft\windows\currentversion\explorer\desktop\namespace contains the CLSID key for each item's icon. Simply remove the CLSID to delete the icon. If you want to change its name, edit the **hkcr\clsid** entry's default value, but you will have to get the CLSID from the former location first, though to find it in the latter.

Edit Flags

We mentioned under *Initialisation Files* the problems that arise if you add **bat** (for example) to **[extensions]** in **win.ini**, but don't delete the **bat** entry from **programs=**; instead of opening up Notepad to edit the file, it is run as a batch file instead.

Edit Flags stop people tinkering, and if you were to inspect batfile's EditFlag entry, you would see **d0 04 00 00**. If you zeroed all these you can change any batch file settings, including changing the File Types setting.

You need to be careful; if you zero out EditFlags for System IDs, the File Type will completely disappear! (Use 02 00 00 00 instead). Zeroing is used for ProgIDs linked to extensions.

Edit Flags are displayed in hex (e.g. d0 04 00 00 for batfile), but used in binary, and read from right to left for each bit, so the above would translate to 1101 0000 0000 0100. Read each set of eight from right to left, and you will see that bits 5, 7 and 8 are on in byte 1, and bit 3 on in byte 2. Bits 4, 5 and 6 of byte 2 apply only to protected actions; if byte 1, bit 1 is 0, the action is protected. If 1, it is not.

This is how they all decode:

Byte 1

- **Bit 1** removes the file type from the master list in the File Types tab if it has an associated extension, under Explorer's View|Options.
- **Bit 2** adds the file type to the File Types tab if it doesn't have an associated extension.
- **Bit 3** identifies a File type with no associated extension.
- **Bit 4** greys out the Edit button in the File Types tab.
- **Bit 5** greys out the Remove button in the File Types tab.
- **Bit 6** greys out the New button in the Edit File Type dialogue.
- **Bit 7** greys out the Edit button in the Edit File Type dialogue.
- **Bit 8** greys out the Remove button in the Edit File Type dialogue.

Byte 2

- **Bit 1** stops you editing a file type's description in Edit File Type.
- **Bit 2** greys out the Change Icon button in Edit File Type.
- **Bit 3** greys out the Set Default button in Edit File Type.

- **Bit 4** stops you editing an action's description in Edit Action.
- **Bit 5** stops you editing the command line in Edit Action.
- **Bit 6** stops you setting DDE fields in Edit Action.
- **Bit 7** is always zero.
- **Bit 8** is always zero.

NT

As with Windows, the Registry is the central repository for all information concerning a particular installation, server or workstation, software and hardware. In other words, it's on every machine running NT. Of interest to intruders is the fact that access control information is kept there, and it is possible to protect Registry keys in the same way as you can files and directories, as we will see shortly. Although it can be accessed as many as forty times when you try to get an application to do something, it must always be in a recoverable position should the machine crash at any time. A tricky balancing act, to be sure.

Although it looks like much less, on disk, the Registry consists of several files called *hives*, each of which contains a Registry tree, under which the subkeys live. However, the number of hives doesn't correspond the the number of keys. Something called the *Configuration Manager* creates the root keys as logical objects and relates them to hives internally. In addition, some hives are temporary and only exist in memory. All are stored in **%systemroot%\system32\config.**

Hives are split into 4K blocks, the first being called a *base block*. The Registry itself is organised into cells, where keys or values are kept, for example, the most important, HKEY_LOCAL_MACHINE, which contains five keys:

- **SAM** and **SECURITY**. These contain information on user rights, user and group information for the domain (or workgroup), and passwords. The keys are binary (for security reasons) and are typically not accessible unless you are an Administrator or in the Administrators group.

- **HARDWARE**. A storage database of throw-away data that describes the hardware components of the computer. Device drivers and applications build this database during boot and update it during runtime (although most of the database is updated during the boot process). When the computer is rebooted, the data is built again from scratch. It is not recommended to directly edit this particular database unless you can read hex easily. Hardware has three subkeys. The Description key has describes each hardware resource, DeviceMap has data in it specific to individual groups of drivers, and ResourceMap tells which driver goes with which resource.

- **SYSTEM**. This contains basic operating stuff like what happens at startup, what device drivers are loaded, what services are in use, etc. They are split into ControlSets with unique system configurations (some bootable, some not), with each ControlSet containing service data and OS components for that ControlSet. The Last Known Good configuration is a ControlSet stored here.

- **SOFTWARE**. This has information on software loaded locally. File associations, OLE info, and some miscellaneous configuration data is located here.

- **HKEY_USERS** contains a subkey for each local user who accesses the system, either locally or remotely. If the server is a part of a domain and logs in across the network, their subkey is not stored here, but on a Domain Controller. Things such as Desktop settings and user profiles are stored here.

HKEY_CURRENT_USER and HKEY_CLASSES_ROOT contain copies of parts of HKEY_USERS and HKEY_LOCAL_MACHINE, respectively.

The major hives and their files are as follows:

Hive	File	Backup File
HKEY_LOCAL_MACHINE\SOFTWARE	SOFTWARE	SOFTWARE.LOG
HKEY_LOCAL_MACHINE\SECURITY	SECURITY	SECURITY.LOG
HKEY_LOCAL_MACHINE\SYSTEM	SYSTEM	SYSTEM.LOG
HKEY_LOCAL_MACHINE\SAM	SAM	SAM.LOG
HKEY_CURRENT_USER	USERxxx ADMINxxx	USERxxx.LOG ADMINxxx.LOG
HKEY_USERS\.DEFAULT	DEFAULT	DEFAULT.LOG

Intruders will look for the **sam** file, with **sam.log** as a secondary target, as it contains password information. And talking of which....

Registry Security

When you open **regedit32**, find the key you want to protect and use the options in the *Security* menu, in the same way as Explorer. Microsoft's recommendation is to keep people in certain parts of HKEY_LOCAL_MACHINE\SOFTWARE, particularly **\Microsoft\WindowsNT\CurrentVersion**.

Stop NT storing DUN passwords in HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\RasMan\Parameters, with a REG_DWORD entry called *DisableSavePassword*. This helps secure your network from intruders as the passwords are kept in a place that's easily accessible.

Windows NT

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Windows NT

This is a spin-off from OS/2 development, which Microsoft used to do with IBM. In fact, it used to be OS/2 v3.0, the network server version, taken over by Microsoft while IBM carried on with v2.0 for desktops. It comes in two flavours; *Server*, which is for serious networking and aimed directly at Novell, and *Workstation*, which is for you and me. Workstation is mostly the same as Server, but the latter has more security and networking utilities, and the priority for multitasking goes to networking tasks, using long timeslices (Workstation prioritises the foreground application, with short timeslices). It also supports 32 processors as opposed to 2, and is more expensive. In fact, although they both technically use the same kernel and many components, whether you get one or the other is actually controlled by Registry settings.

NT was written by people who created DEC's VMS (and, allegedly, its initials, WNT bear the same relation to VMS as those of the 2001 computer, HAL, do to IBM). It is very resource hungry, but not in the light of '95's requirements. It looks and works like Windows, but doesn't need DOS as it's a complete 32-bit operating system in its own right. It was designed for businesses, with no allowance for backwards compatibility (it can use several filing systems and platforms) and performance is sacrificed for reliability where necessary, so it has a reputation for being stable (it is preemptive).

Because the software is abstracted from the hardware, some comms and fax programs have problems communicating with serial ports. Neither can it run DOS programs that communicate directly with hardware, DOS device drivers or 16-bit Windows drivers. Windows programs run in their own WOW (Windows on Windows) box, so they're OK. The OS runs separately from applications, with 16-bit ones in special protected address space.

NT operates on the Domain principle. A domain contains many servers that can all be accessed by anyone logging into the domain, and which share a common database and security policy. When you log on to a Domain account, the controllers authenticate your name and password against the directory database, or SAM database. Although you can have only one server in a domain, it's still a good idea to have a backup, even if it is only a workstation running NT with a copy of the security information on it. Although Workstation can "run" a network for machines directly connected to it, you need Server to administrate a domain. However, you can specifically include Workstation into a domain. Server also supports Macs.

A domain is therefore one or more servers running NT server with all of the servers functioning as one, and serving clients running NT Workstation, Windows for Workgroups, etc. The user and group database covers all resources of a domain. Domains can be linked together with a trust system, which means a person only needs one account and password to get to resources across multiple domains, and administrators can centrally manage the resources.

A workgroup is simply a grouping of workstations that do not belong to a domain. In a domain, the user and group database is "shared" by the servers. NT workstations in the domain DO NOT have a copy of the user and group database, but can access the database. In a workgroup, each computer in the workgroup has its own database, and does not share this information.

On installation, your Server can be either a PDC, BDC or member server (standalone). These generally cannot be changed, although a BDC can be promoted to a PDC if the original is offline.

There is one PDC in a domain, which stores accounts and security information in the master copy of the directory database. It is the only onre that directly receives changes. On the other hand, you can have multiple BDCs (up to 20 with NT 4), which have a read-only copy of the database, with which they can share the load of authentication (watch your network traffic). Windows 2000 Domain Controllers, by contrast all hold a read-write copy, so you can make changes on any copy. In fact the PDC/BDC designations don't exist.

The BDC synchronises fully on first setup, and partial changes are made regularly thereafter. If it gets out of sync (by going down) you need to resynchronise manually with Server Manager.

Also done with Server Manager is promotion of BDC to PDC. After replication takes place, the PDC is demoted and you can take it offline, although a domain can function without it for a short time anyway, during which you can still authenticate. Having promoted a BDC with the PDC offline, demote the original PDC so it can replicate before promoting it again.

Minimum Requirements

Type	CPU	RAM	Free HD Space
Workstation	486DX/33	12 Mb	110 Mb
Server	486DX/33	16 Mb	125 Mb

NT Security

Revolves around:

Local Security Authority (LSA)

Also known as the *Security Subsystem*, this is the central component of NT security. It handles local security policy and user authentication. LSA also handles the generation and logging of audit messages.

Security Account Manager (SAM)

SAM handles user and group accounts, and provides user authentication for LSA.

Security Reference Monitor (SRM)

SRM enforces access validation and auditing for LSA. It checks user accounts as the user tries to access various files, directories, etc, and either allows or denies access. Auditing messages are generated as a result. The SRM contains a copy of the access validation code to ensure that resources are protected uniformly throughout the system, regardless of resource type.

User Interface (UI)

An important part of the security model, the UI is mainly all that the end user sees, and is how most of the administration can be performed.

User Authentication

When a person logs on, NT creates a token object that represents them. Each process run is associated with this token (or a copy of it). The token-process combination is refered to as a *subject*. As subjects access objects such as files and directories, NT checks the subject's token with the *Access Control List* (ACL) of the object and determines whether to allow the access or not. This may also generate an audit message.

Passwords

These are in **\winnt\system32\config\sam** which is usually world readable by default, but locked because it's used by system components. NT passwords are therefore only as secure as the **sam** database - there may, unfortunately, be readable **sam.sav** files lying around, and **sam** data can be in all sorts of places – for example, during installation, a copy of the password database is put in to **\winnt\repair**, which initially will contain only the Administrator and Guest accounts. It might also be on a variety of storage subsystems during normal operations, although this will usually require a user's intervention.

Passwords are not actually kept on the server, or in the password database, but exist as a one-way hash, of which there are two - a Lan Manager password, and one for NT. The former uses 14 bytes, so if it is less than that, it is filled with 0s. It is also converted to upper case and split into

7-byte halves, from which an 8-byte odd parity DES key is constructed (if the password was originally only 7 characters or less, the second half is always 0xAAD3B435B51404EE). Each of these is encrypted with a "magic number" and the results are concantenated into a 16-byte one way hash value.

The NT password is derived by converting the user's password to Unicode, and using MD4 to get a 16-byte value.

The NT Server 4.0 Resource Kit has a utility called **passprop** that enforces random passwords.

By default, since logging is not enabled on failed attempts, and the administrator doesn't get locked out from false attempts, different passwords can be tried for the administrator account, whether brute force or dictionary attacks.

You can also get to the **sam** key in the Registry outside the System account by using the NT Scheduler to start **regedit32** at a specific time, because Scheduler has full authority under the user security context.

Lost password

You can recover Admin passwords (on NT 4, anyway) by shutting down and rebooting with a DOS disk. If your partition is NTFS, you will also need **ntfsdos** to get to the installation directory. Rename **logon.scr**, then copy **command.com** to **logon.scr**. Reboot, then wait about 15 minutes to get a DOS prompt, through which you have full Admin access. You can then add a new administrator or change the present password with either the command prompt or User Manager, rename **logon.scr** back again and close the DOS window.

File and directory security

Since files and directories are considered to be objects (i.e. the same as services), the security is managed at an "object" level.

An *Access Control List* (ACL) contains information that controls access to an object or controls auditing of attempts to access an object. It begins with a header contains information pertaining to the entire ACL, including the revision level, the size of the ACL, and the number of access-control entries (ACEs) in the list.

After the header is a list of ACEs. Each ACE specifies a trustee, a set of access rights, and flags that dictate whether the access rights are allowed, denied, or audited for the trustee. A trustee can be a user account, group account, or a logon account for a service program.

A security descriptor can contain two types of ACLs: a discretionary ACL (DACL) and a system ACL (SACL).

In a DACL, each ACE specifies the types of access that are allowed or denied for a specified trustee. An object's owner controls the information in the object's DACL. For example, the owner of a file can use a DACL to control which users can have access to the file, and which users are denied access.

If the security descriptor for an object does not have a DACL, the object is not protected and the system allows all attempts to access the object. However, if an object has a DACL that contains no ACEs, the DACL does not grant any access rights. In this case, the system denies all attempts to access the object.

In a SACL, each ACE specifies the types of access attempts by a specified trustee that cause the system to generate audit records in the system event log. A system administrator controls the information in the object's SACL. An ACE in a SACL can generate audit records when an access attempt fails, when it succeeds, or both.

To keep track of the individual object, a Security Identifier (SID) uniquely identify a user or a group.

A SID contains:

- User and group security descriptors
- 48-bit ID authority
- Revision level
- Variable subauthority values

A privilege is used to control access to a service or object more strictly than is normal with discretionary access control. Privileges provide access to services rarely needed by most users. For example, one type of privilege might give access for backups and restorals, another might allow the system time to be changed.

NTFS

The NT Filing System is built with security in mind, that is, security of data. For example, there is a rollback system that can restore the system to a previous configuration if a crash occurs. Files changes are kept in the *Transaction Log*, which is used to undo or repeat an action should it be necessary. This doesn't help, though, if the entire disk fails, so duplexing or mirroring is still a good idea for fault tolerance.

Instead of a FAT, NTFS uses a *Master File Table* (MFT), which lists every file on the volume, and the record can contain about 1500 bytes of data as a field, which makes it quicker to find files if the data is small enough. If not, then the field is used for a list of cluster numbers for the rest of it. If it still isn't big enough, extra MFT files can be created with the same information.

The MFT also contains details of who owns the file and who else has access to it, but this only works when NT itself is the operating system – if you can boot with DOS or Windows and a utility that reads NTFS partitions, you can access the files directly. Windows 2000 uses EFT (*Encrypting File System*) to get around this, which pretty much does what it says by making data unreadable. Data is encoded and decoded on the fly to and from the disk. EFS requires a Recovery Agent, who is empowered to decrypt files without knowing the owner's private key.

Obviously, this person must be trustworthy. As encryption takes place on the server, the file is sent over the network in clear so anyone with a good enough sniffer can see what's inside. You will not be surprised to hear that Windows 2000 can also encrypt network packets.

Installation

One of the first things to decide is whether you want NT to co-exist with another system. If you do, the most obvious disadvantage is using up more disk space, and the next is that your current settings won't necessarily be picked up automatically (there is no automatic upgrade path from '95 to NT).

Create a small FAT 16 partition for Windows '95 (say 100 Mb), another one for the NT system (250-500 Mb), and format the rest of the disk under NTFS. This gives you a faster startup, and better protection for your data files, plus the ability to troubleshoot the boot partition with DOS utilities. The reason for having '95 is so you can install hardware under the PnP system and check what resources the machine allocates so you can tell both copies of NT all about them (you can load a minimum copy of NT to help with recovery should the main one crash, preferably on a second hard disk. Don't forget the backup software).

If you want the whole disk to use NTFS, bear in mind that NT formats the disk first as FAT, then converts it later in the installation process, so the naximum size you will get is 4 Mb, and even this is because NT supports 64K clusters, otherwise you would only get 2 Mb. To get around this, format the drive on another NT computer or use a third party program to do the job.

Check Hardware

Can your hardware run the software? *Is it reliable?* An overnight test with a repeating **xcopy** loop will be a good check. NT does not use the BIOS, as '95 or 3.x do (via DOS), so check the Compatibility List (it comes with NT). See **www.microsoft.com/hwtest/hcl** (and have a look at **/windows/thirdparty/winlogo/default.htm** for software).

Is there enough hard disk space?

CHKDSK/SCANDISK/Defrag

As appropriate.

Backup Files

Afterwards

Once installed, change the CD ID to R: so that any other disks you add don't upset the drive system – many installation routines like to remember where they were installed from. Then install the lates Service Packs (certainly a minimum of SP3 if you want to add a decent display driver) and enable DMA.

DMA

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\atapi\Parameters\Device0 (or whichever channel you wish) under the *DmaDetectionLevel* key allows you to force DMA on, choosing 0x0, 0x1 or 0x2. The first value is disabled, and 0x1 allows for DMA to be turned on if the hardware is detected. 0x2, however, forces it on.

Hard Disks

UDMA devices should be together (that is, on the same chain).

Memory

You need a minimum of 128 Mb, and a swap file is required at all times. However, the swap file will always take account of your original memory, so when you upgrade, you have to adjust the page file as well.

Microsoft's recommendation for the swap file is RAM + 12Mb, because NT is designed to dump memory to it if you get a crash. However, other considerations arise, particularly if you are running a large system and have a large SAM (user database). For 96 Mb or less, try RAM x 2. Over 128 Mb, try RAM x 1.5, and the Microsoft route if you have over 256 Mb.

Initial and Maximum sizes should be the same, so that it stays in one place, or at least, doesn't expand if you have the Initial setting too low and cause fragmentation, as NT gets enough of that already.

To find out your machine's requirements, look at the Commit Charge section under the Performance tab in Task Manager. Under *Peak*, you will see the total amount of memory used (i.e. system and swap) during this session, so you want to keep the machine on as long as possible when you do this, giving it your normal usage pattern. Peak should not be higher than your total limit, althugh it can be slightly lower than physical RAM (but not below 50% - try for it to be more than this, to reduce virtual memory usage).

The best place for the paging file is on the outside tracks of any disk, simply because more square footage goes under the head per second as the drives rotate at constant speed (Norton will move it there). If you split it, don't do so across partitions, but across disks, as NT can make multiple simultaneous I/O calls to hardware, and partitions on the same disk cannot be handled that way. With IDE, therefore, split them across multiple chains. Use NTFS, at least for the swap file.

Cache

If you have a direct-mapped L2 cache, you can tweak NT's Registry to make sure it is used properly.

NT can figure out the size of any set-associative L2 cache, using its Hardware Abstraction Layer. If it cannot for any reason (say you have a direct-mapped cache) then it assumes 256K. To change this to your true value, go to **HKLM\System\CurrentControlSet\Control\Session Manager\Memory Management\SecondLevelDataCache**. Open a DWORD editor window, change from Hex to Decimal, then insert your L2 cache size in Kb.

If you have 128Mb, with SMP (but try it anyway if you haven't!), also set **IOPageLockLimit** (look under the same Registry key as above) between 8192-16384Kb, in decimal. Otherwise, start with 1024 Kb, and raise it by the same amount using a benchmark program until you see an optimal performance figure. As before, change from Hex to Decimal, then change the value to your preferred allocation size in Kb.

Paging

Some NT code is pageable, making it slower to run. You can stop this at the expense of physical RAM. Go to the **DisablePagingExecutive** value in the key above, and change the value to 1 in Decimal.

Also, rename **os2.exe**, **os2ss.exe**, and **psx66.exe**. They may not give you any performance advantage, but if you'r not using OS/2 or POSIX stuff, they are redundant.

Getting Rid of NT Later

To get rid of NT later on, just **sys** the hard drive from a '95 boot floppy, which will remove the NT boot loader, then remove the NT partition with **fdisk**. Also delete these hidden files:

```
boot.ini
bootsect.dos
ntdetect.com
ntldr
pagefile.sys (if present)
```

Boot Floppy

Format from NT desktop. You need **ntldr**, **ntdetect.com**, **boot.ini**, **bootsect.dos** and **ntbootdd.sys**.

Registry Stuff

Bypassing the logon screen

Go to **HKEY_LOCAL_MACHINE\software\microsoft\windows NT\current version\winlogon**.

In right hand pane look for *DefaultDomainName*, *DefaultPassword* and *DefaultUserName* (add if not there). Enter your password into the "Value Data" text box. Right click the right hand pane, pick *New – String Value* and enter a new key called *AutoAdminLogon*. Set its value to 1.

Networking

Remove unnecessary services (Control Panel).

Reducing Broadcast traffic

Especially across slow WAN links. A lot of this occurs when the Primary Domain Controller (PDC) ensures that the Backup Domain Controller (BDC) are up to date, typically done every 5 minutes. For example, the browser service generates about 12% of total traffic.

hkey_local_machine\system\CurrentControlSet\Services\Netlogon\Parameters has a *pulse* value (in seconds) that can be used to increase the gaps between synchronisation, thus reducing traffic. The PDC replicates only information that has changed (to 20 BDCs at a time), and keeps the details in a change log, which is 64K dy default and equivalent to about 2000 entries. If the change log gets full, however, a full synchronisation takes place and defeats the object, so if you want to increase its size, add a REG_DWORD value called *ChangeLogSize* to the **Parameters** key above.

Similarly, every BDC has a 128K memory buffer that keeps note of the changes sent to it by the PDC. If it gets full, it has to wait for the next synchronisation. Sometimes receiving all the changes may take all day if you are doing a lot of admin, so you won't be surprised to hear you can change the size of this as well. Look for a **ReplicationGovernor** entry which specifies the amount of bandwidth that synchronisation traffic uses. You would reduce the percentage setting if the link you use takes other traffic and you want to leave some room for it. Microsoft recommends no lower than 25%, or your BDCs will always be out of date.

Also in the **Parameters** key above is a *PulseConcurrency* value that alters the number of BDCs that are transmitted to in one go. A smaller number reduces network bottlenecking. If there is no information to update, the PDC doesn't send any messages, but lets the BDCs know it's still alive. The *PulseMaximum* entry defines the interval the PDC waits before it sends keep alive messages; the default is 2 hours, or 7200 seconds. Increasing this will reduce traffic, especially across ISDN routers.

Browsing

This is what happens when computers on a network look for another one to talk to, in this case with relevance to deciding which one is in charge. Search packets are sent out approximately every 15 minutes, depending on the design, and the machine with the fastest CPU is lumbered with looking after the master list of available network resources.

This service helps the machines decide which one of them is to be the Master Browser on a network segment. It regularly advertises the server to the elected Master and maintains a list of servers available. Disabling this on Workstations reduces the number of potential Master

Browsers available, so there's less squabbling to be done. Only Servers should run this service, at least 2 of them, for redundancy purposes, although a Workstation can be a backup browser if you only have one.

Computers announce themselves to the Master Browser periodically with broadcasts (servers do it every 12 minutes). If the Master Browser doesn't hear from a Server for three consecutive announcement periods, which you can set, it removes it from the Serrver list. Each subnet has a Master Browser, because broadcast traffic doesn't cross routers, which is responsible for sending a list of its servers to the Domain Master Browser every 15 minutes, which compiles a complete list and sends it back to them all. For Server announcements, add an *Announce* entry to **hkey_local_machine\system\CurrentControlSet\Services\LanmanServer\Parameters**, and set it to the number of seconds you want between each broadcast. For Master Browser announcements, the key is **hkey_local_machine\system\CurrentControlSet\Services\Browser\Parameters**. This time, though, the entry to add is *MasterPeriodicity*.

Browsers are chosen by election amongst the machines themselves. By setting the *IsDomainMaster* value to *Yes* on a particular machine, you can force that to be the Master Browser and cut the chatter. To make it a non-participant, while still appearing in the Browser list, go to:

hkey_local_machine\system\CurrentControlSet\Services\Browser\Parameters\MaintainServerList

and set it to *No*.

A Master Browser can appoint up to three Backup Browsers (one for every 52 clients) to provide the server list to clients. New server lists are obtained by the Backups from the Master every 15 minutes, which you can increase if you like with the *BackupPeriodicity* entry. To specify a machine as a Backup browser, instead of leaving the system to its own devices, set *MaintainServerList* to *Yes*.

Server Service

Disabling this on Workstations acting as clients doesn't free up a lot of memory or resources, but it does give some protection against intruders when connected to the Internet because it is supposed to manages the sharing of files and directories. However, this does mean that other machines on any network it is connected to won't be able to, either.

Protocols

For each one of these you run, you get a Master Browser election contest and the corresponding traffic (see above). Behind the *Bindings* tab in the *Network* applet in Control Panel, you can alter the bindings and improve the way things work. If you have only one network card, for instance, you can give one protocol priority over the others, disable those not needed or allocate protocols to separate cards if you have more than one, assuming you don't duplicate the NETBIOS name of the Server.

Joysticks

Drivers are in **\drvlib\multimed\joystic\x86** on the CD.

PC Cards permanently on

HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\VxD\VCOMM. Set *EnablePower-Management* to 00 00 00 00.

Stopping Programs Running Automatically

HKEY_CURRENT_USER/Software/Microsoft/Windows/CurrentVersion. Look for keys called Run, RunOnce, RunServices, or similar. Look also under HKEY_LOCAL_MACHINE. In Windows '98, try running **msconfig.exe**.

Tweaking TCP/IP

It's best to leave NT to its own devices, as **NT 4.0** uses *PMTU Discovery* to find out the lowest common denominator packet size for the routers on the link you propose to use. Pre SP4, if you disabled this key in:

```
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Tcpip\Pa
rameters
```

you can force NT to use a smaller MTU, but this will affect all TCP/IP connections, not just RAS. Run **regedt32.exe** and navigate to the above key to add the value entry *MTU* of datatype *REG_DWORD* to the value of MTU you require (see Windows 9x chapter for more information). Try 576.

After SP4, the IPMTU key is for PPP connections and TunnelMTU for PPTP. You will find them in:

```
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\NdisWan\
Parameters
```

Add the value entry *TcpWindowSize* of datatype *REG_DWORD* to the value of RWIN you require (see rules above). Try 2144 (4x) or 3216 (6x).

Add the value entry DefaultTTL of datatype *REG_DWORD* to the value of TTL you require in seconds (see rules above). TTL stands for *Time To Live*, or a flag in a frame that indicates to a router how long the packet has been on the network, or, in other words, the maximum time an IP packet may exist on the network without reaching its destination, so as to limit the number of routers it passes through. 64 seconds is suggested.

WINS

This (together with DNS) provides *Name Resolution*, or a system of turning IP addresses into names, and vice versa. The idea is to help computers computers on different subnets find one another (because broadcasts to find machines don't cross routers, so only machines on the subnet the client is on will receive the message), and reduce traffic. Although in stands for *Windows Internet Naming Service*, it has nothing to do with the Internet, which actually uses DNS, or *Domain Naming Service* to suit its naming style – WINS operates only on NETBIOS-type names or, in othe words, internally to your network.

A WINS server contains a list of names versus IP addresses that changes automatically as IP addresses change, which is why it's often installed with DHCP. Because the requesting client addresses its query to the WINS server, which has a static IP address, the message isn't broadcast, and traffic is markedly reduced. The WINS database is consulted and the message sent directly to the machine concerned, over routers if necessary.

DNS

As mentioned, DNS resolves Internet IP addresses to names, and vice versa. However, it is possible to create a false website (amd steal your traffic) by using a corrupt DNS entry. To do this, an intruder can utilise the cache of your DNS server.

The intruder can add an entry to his own domain records to map your site to an address he owns. When your DNS server is queried to resolve the address of his site, your DNS server will query his DNS server and receive a record containing not only his IP address but the one he modified. This entry will be stored in the cache, so that subsequent queries for your domain name will be resolved from the cache, and be redirected to the intruder's site.

Blue screen of death is due to programs consuming too many handles and not giving them back.

Communications

Table of Contents

Introduction

Much of modern life would grind to a halt if computers couldn't talk to each other; this is done mostly over telephone lines, but sometimes they are joined directly, as you would when exchanging data between a desktop computer and a laptop.

Over the telephone, you can use the Internet to book theatre and airline tickets, check your bank statement, the weather, railway timetables or simply send messages to other people. Many companies provide similar facilities for their employees inside their buildings, known as *Intranets*, as well as providing web sites for interaction with their customers.

In addition, people with similar interests can join *newsgroups* for discussion purposes.

There are some disadvantages to all this, of course. One is that your co-respondent must be using the same system, and another is that you generally have to pay for it, but all the above variations boil down to one thing in the end, which is making one computer talk to another.

Potted History

The first real communications systems were telegraphs using heavy copper wires, built around the 1840s. Electrical signals weaken the further they travel, so the wires were split up into manageable sections, with people as repeaters, taking in and re-transmitting the messages every hundred miles or so (in those days, of course, labour was cheaper than the equipment). The Morse Code was also developed at this time.

Eventually, ways were sought to send the data mechanically, for which Morse Code wasn't suitable because of the varying lengths of the dots and dashes it was made of, so a Belgian, Emile Baudot, invented the *Baudot Code* in the 1870s which used *marks* and *spaces* of equal duration on paper tape to represent characters. All the operators then had to do was move paper between encoders and decoders on their desks.

The Baudot Code made the teleprinter possible, which is really a long-range typewriter, but the code's restriction of 5 marks and spaces per character meant that only 32 possible combinations of them could be used, which was not enough for the alphabet and the numbers and punctuation marks needed for everyday conversation. This was solved by using the LETTER and FIGURE SHIFT keys, which multiplied this by nearly twice—after either key was pressed, the following codes were treated as figures or letters until the key was pressed again.

Teleprinters were slow and cumbersome for many reasons, including slack mechanical linkages, starting and stopping of electrical motors and engagement and disengagement of clutches as each character was transmitted, which meant their maximum speed was between 30-70 characters a second. Obviously, these speeds are too low for computers, or they'd start getting bored and cause trouble!

In due course, technology replaced the marks on paper with holes, which allowed switches to make electrical connections through them. The teleprinter network eventually became the telex system, and was the origin of many of the standards used between computers.

The Basics

Every part of a computer communicates—the keyboard talks to the Central Processor, which in turn talks to the screen and other components inside, and the computer as a whole will talk to a printer, plotter or even another computer. This external communication between individual machines will be the basis of this book.

That done by single users can go from one extreme to the other, from linking two machines together on the same desk, to using the telephone system to get to the variety of services available all over the world. The former situation is known as *local*, and the latter *remote*, communications.

The first problem is knowing where to start. Obviously, some kind of connection is required, and traffic along this will need to be controlled but, going further back, we come across the signal itself, which is what the traffic's made of in the first place.

The Signal

You are no doubt aware by now that computers use *bits* to convey information, the word **bit** being made up from the first and last letters of **bi**nary digi**t**.

The bit takes the form of a signal that can be either on or off, which is particularly useful as the computer itself operates on the binary system, using only two characters, 1 or 0, to convey meaning—you can see how they dovetail nicely. It's no coincidence that electrical appliances use the figures 1 and 0 for *On* and *Off*.

The bits are assembled in various ways for transmission. A 5-bit method we have already seen, in the shape of the Baudot Code. There was a 6-bit one which didn't get anywhere, and ISO-7 was the original "International Alphabet", the American version of which is.......

ASCII

On a PC, eight bits make a *byte*, which is equivalent to a character on the screen, as a result of which the number of bits used for a character is often called the *Word Length*—7 or 8 data bits as a group are also referred to as ASCII 7 or ASCII 8 (for IBM PCs, but the word length actually depends on the computer and programming language you're using). ASCII 7 has become the lowest common denominator of the Internet or, in other words, the standard of transmission you can expect from most equipment on it. How do you send binary files on a system geared for text? See the *Internet* chapter!

ASCII (pronounced "ask-ee") is short for *American Standard Code for Information Interchange*, an internationally agreed standard (laid down by the *American National Standards Institute*—ANSI) which gives each character of the alphabet a number, translated by other equipment according to what country it thinks it's in. For example, the £ character is allocated the ASCII number 156. When a British printer receives the number, it prints the £ sign. You would get a # symbol in another country.

"Traditional ASCII" defined 128 characters, and only 7 bits were used for each one. The characters didn't actually start till well down the list, as the first few were used as control characters, like LF for Line Feed. *Extended ASCII* kept the original 128 and added 128 more, using up the eighth bit, to give you line drawing, foreign characters, etc. In fact, the first 32 are used as *control characters*, that determine how the computer is used, and are not displayable.

Because it is a common standard, the ASCII code is useful as a bridge between programs that want to exchange information, in the same way as Rich Text Format, but without frills. See also *Protocols*, as there are things you must know before you start sending ASCII files all over the place.

EBCDIC, or *Extended Binary Coded Decimal*, is an 8-bit code used by IBM, with many variations.

Analogue vs Digital

The *digital* on-off signals that a computer generates as bits arise from switches (that is, transistors) making and breaking contact several million times a second, forming electrical pulses in the shape of *square waves*, with a very sharp rise as the connection is made, a plateau as the switch is held on and a sharp fall as the contact breaks.

An *On* condition is recognised once the pulse reaches a certain threshold, and *Off* when it drops below. As further protection against spurious signals, the computer will only react to signals of a certain duration.

An *analogue* signal, on the other hand, is *analogous* to whatever it represents, and relatively smooth; the voltage over a telephone line, for instance, will rise and fall in sympathy with the loudness of your voice—the fluctuating size of the signal is what's actually measured. Compare this with a digital signal, which is noticeably jerky, and similar to tapping on a pipe to get a message through rather than using the flow of material through it. However, measuring 0s or

1s is considerably easier than measuring voltages (the word *analogue*, by the way, is often taken to mean "non-digital").

Different signals use different frequencies; for example, as far as the authorities are concerned, speech lies between 300-3000 *cycles per second* (or *Hertz*, as it's known in the trade). In other words, the human voice is considered to vibrate inside that area. Although the full range can be anywhere between 100-1100 Hz, anything outside the official one of 300-3000 Hz is ignored, because the equipment required to detect the full spectrum of voice and hearing (your ears can detect sound between 20-20,000 Hz) would be expensive, so they make do with the defined range mentioned above. It works well, because the bulk of the power in a voice is inside this area anyway; the fact that some of the frequencies comprising it are missing accounts for telephone voices occasionally sounding tinny.

As it happens, signals used inside computers are outside the voice range described above (a square wave needs to start at 0 Hz) and we shall see how they talk to the outside world despite this when we look at telephone systems and connections to it later.

Some signals are better for certain purposes—medium wave is good enough to carry voice and music, for example, because they don't occupy much space, but higher grade carriers are needed for television signals, due to the amount of information in them (TV signals need to occupy the same space as a thousand voice channels).

Bandwidth

Like a road, whatever you transmit over must be "wide" enough to carry the traffic you intend to send over it. The "width" of any signal is known as its *bandwidth*; voice signals, as we know, occupy 2700 Hz, or 2.7 KHz, which is 3000 minus 300. The upper and lower limits are known as *cutoff frequencies*.

A transmission medium will also have a bandwidth, and here, the term is twisted slightly to mean the width it is *able to provide*, rather than the width it occupies. The aim, when matching signals to media, is to ensure that the signal bandwidth does not exceed that of the intended link, or that your car is not too wide for the road. So officially, the bandwidth is the difference between the highest and the lowest range of frequencies that *a signal occupies*. Unofficially (and more commonly), it defines the amount of information that can be *carried by any media*, or signal, (that is, capacity) in a given time. It is not a good measure of potential transmission capability in bits per second – encoding and compression methods and the nature of the medium are more important. For example, for the same bandwidth, a higher bit rate can be obtained from fibre than for a radio link.

Any restrictions on bandwidth arise from the physical properties of the medium or the deliberate minimising of interference from other sources. For example, cable TV will use a 6 MHz channel in which to carry a 4.5 MHz signal, although where cables are concerned, the restrictions are more to do with the characteristics of the wires themselves; sending data too fast can change the nature of the signals and hence the information sent.

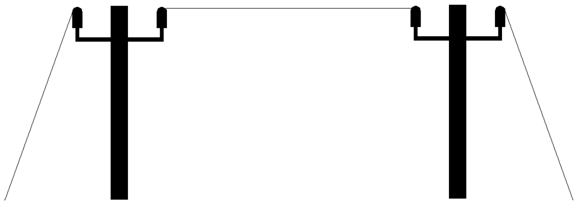
Transmission Media

Signals can be carried over anything, even microwaves, which radiate their energies freely into space unless waveguiding is used. A *waveguide* is a hollow metal conductor which guides Ultra High Frequency radio waves in a particular direction (in other words you send them down a tube).

Not only does the waveguide concentrate energy, it also reduces unwanted interference, so other systems use *bounded media*, which perform all of the functions of a waveguide, the most common of which would be either coaxial or twisted pairs of cable, or fibreoptics. There's more about cabling in the *Networks* chapter.

Twisted Pairs

Early telegraph systems used the earth itself for a signal return path:



but signal losses induced by weather (especially lightning) prompted separate wires for sending and returning, so you ended up with two. It was found later that twisting one wire with another tended to cancel out certain types of interference, which is where the name comes from. The end result looks a lot tidier than the name implies—the wiring is usually terminated in phone-type connectors (American-style RJ45) and plugged into telephone-type sockets. The more twists per inch, the less interference you get.

On a telephone system, twisted pairs are found only on local lines, that is, from your home to the exchange, otherwise the country would be swamped—trunk connections (that is, big ones between major exchanges) are made with equipment having a much larger bandwidth to take the extra traffic, which is combined along it, using *Multiplexing*.
Twisted pair cabling is easily bent around corners, and the bandwidth allows a reasonable rate of data transfer, but there are sound reasons as to why it has speed limitations.

For a start, every electric current has an associated magnetic field, which will rise and fall in sympathy with the current flow. If current tries to move too fast down a wire, the electromagnetic radiations from it will interfere with sensitive equipment nearby and induce a current in the next wire, which will be mistaken for pulses and therefore genuine data (known as *crosstalk*).

Twisted pairs can also act as receiving aerials, unless shielding is used to counteract it. STP (*Shielded Twisted Pair*) works best when properly grounded, and it's not a safe assumption that buildings are, as anyone who has had trouble with terminals will tell you—assuming it was properly connected in the first place, an older building may have moved, or had repairs done and had the Earth connection broken.

The speed of data transmission along twisted pairs is kept low to stop the above problems occurring. Coaxial cables don't suffer from them, as they have proper screening. Fibreoptics, of course, only use light.

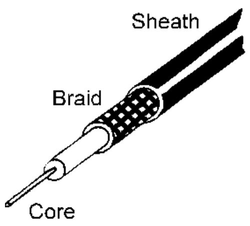
As with HiFi, cables come in varying qualities – some even have gold plated connections.

Connectors

RJ-11 for 2 pair, RJ-12 for 3 pair, and RJ-45 for 4 pair. The two former have the same plugs, and are commonly used with ArcNet networks, 3270/5250 connections and modems, so be careful!

Coax

Coaxial cable works on the same principle as twisted pair, except that the second wire is converted into braid and placed around the central one to act as a *screen*, which is more effective at keeping out interference. Coax needs to be handled carefully as, when it's crushed, it loses some of its screening ability. You will recognise it as that used to connect your TV to its aerial, but computer coax is of better quality. It has a BNC (*British Naval Connector*) connector at the end.



Fibreoptics

Light rays bend, or refract, when passing from one medium to another, caused by the slowing down of the rays at one edge of the beam at the crossover point, which is why anything under water appears to be displaced when viewed from outside. Because of this, light can reflect internally along a glass fibre and bounce along the inside (like stones skimming on the surface of the sea), giving the signals a longer effective range.

Every optic fibre (which is about the size of a human hair) consists of three strands, each inside the other. The centre one (the core) is a special low loss grade of material that has a constant *refractive index*; that is, its ability to bounce light along its inside doesn't reduce along its length. The next one (the cladding) and the outer one (the sheath) each have progressively lower refractive indexes (or is it indices?) which stop the light straying from the centre. The core should be made of glass for best results, but plastic-based fibre networks are used in modern cars.

As transmissions are unaffected by electrical interference and don't weaken so quickly, fibreoptics are good for long distances, especially as the transmission speeds are those of light itself—systems have been demonstrated that are capable of carrying over 4000 voice circuits per fibre and transmitting at rates in excess of 4 million bits per second over stage lengths of at least 100 km without repeaters.

Repeaters are needed, not because of *attenuation* (or weakening), but because the signal tends to get less concentrated, and spreads out. In fact, any loss of signal strength in fibres is due to:

- **Scattering** because of imperfections in the material, which can never be eliminated completely.
- **Absorption losses**, which occur when the angle of entry of the light into the fibre is larger than needed for proper refraction, whereupon the power it contains is used for digging itself into the coating rather than skimming along the insides.
- **Connection and bending losses**, which occur when the cable is not aligned properly; the ends of the fibres must be parallel to within 1 degree or less, or the light rays will not be started properly. The core must also be as concentric with the cladding as possible.

If you include fibres with opposing characteristics, that is, put in some cables backwards, these can be somewhat reduced.

Some advantages of using fibreoptics include:

- **Less maintenance**, because it isn't as fussy over its environment, so it doesn't need to be so watertight.
- **Noise immunity**, where external electromagnetic and radio fields don't interfere with the optical signals in the cable, and *vice versa*.
- **Security**. Optical signals in the cable can't be tapped by electromagnetic means.
- **Bandwidth** is high for its cost; the full availability is 25,000 GHz; one fibre could theoretically carry all the phone calls in USA at peak time, all at the same time.
- **High speed** over long distances.
- **Light weight**.
- **Grounding problems** are reduced.

Multimode fibre is used in networks, as it is thicker and sturdier than *single mode,* although its maximum transmission speed is around 500 Mbps. Single mode is so thin, you have to use acid to eat away the insulation before you connect it, rather than use wire cutters.

There is a plot to broadcast data as light signals over fibreoptic cables everywhere (similar to radio) and have your computer tuned to the particular frequency, or colour, of the data you require; this is really what the *information superhighway* is.

Disadvantages

As a vast investment has already taken place for present equipment, fibreoptics are only being installed as new plant is required (such as most new cable TV and associated telephone installations in the UK).

Every time light is split, the frequency is halved, so you need light amplifiers at all junctions. Electrical facilities are still therefore required to amplify and switch the signals, using photodiodes to convert them from light to electrical ones, switching, rearranging and generally interfering with them until they are reconverted with an LED or laser.

The main point is that once data at high speed hits an electronic switching device, you get a bottleneck. Switching light waves without converting them to electricity is called *photonic switching*, and is likely to be ready sometime next century.

Cable Installation

- Try and do it after the telephone company, because you can use their conduits!
- Once you start making cable part of the structure of your building, you need to call in the experts, which includes the fire prevention people. If you don't, at least make sure that corners are turned gradually, and you are about 4 feet away from elevator shafts or power cables. From fluorescent lights, dimmer switches and anything with a sort of coil, the distance should be around 1.5 feet.
- The work should be documented, so you can find it again.
- It should also be tested, ideally with a cable scanner.

Types of Communication

Multiplexing

When connecting computers (or buildings) together, your first instinct would probably be to join each one with its own cable, but this is expensive and inefficient, as the full capacity of it would probably never be used, and at least 45 cables would be needed to link only 10 machines together.

It's more economical to combine many channels together and have them share a single line—costs are saved by laying only one cable and the gaps caused by one person leaving the line idle could be used by others.

Multiplexing is simply the process of sending multiple signals down one channel, or even several channels down one cable, so a multiplexer is a concentrating device. This way, a large group of speech connections, say a hundred, can make do with something like 40 both-way circuits. Mind you, sending signals this way is a bit like driving along a congested highway—disastrous if you're not at the same speed and going the same way as the other traffic!

Multiplexing is a widely used approach to integrating voice and data traffic, and *bandwidth management* allocates resources to voice and data as required; *on demand*, if needed, to suit traffic that may come in bursts. Over fibre, you can multiplex light frequencies.

Multiplexing was (and still is) used with minicomputers to concentrate serial (i.e. RS232) keyboard and screen information into one cable, and a *terminal server* is used to sort out to what terminal or printer the data streams belonged to.

There are several ways of multiplexing, and the methods vary according to whether the signals are analogue or digital.

Frequency Division Multiplexing

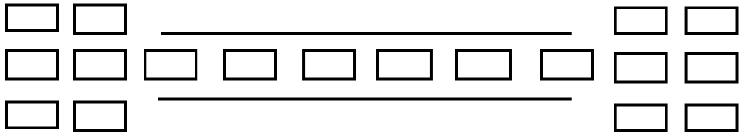
Because electrical circuits (like radio) can be tuned to particular frequencies, you can send several signals along one medium without them interfering with each other. With several channels available, this is referred to as a *broadband* system (the bottom channel is often called the *baseband*). If nothing is being transmitted, capacity is wasted.

When you're sending messages both ways at the same time, whatever bandwidth you have available needs to be split in half, so a *guard band* is inserted between two information-carrying frequencies to separate them and reduce the chances of overlap. They will carry no information, so will be easily identifiable. As guard bands take up space as well, the practical bandwidth for whatever channel you use is even more restricted. For example, cable TV channels have 6 KHz allocated to them, of which only 4.5 KHz is used.

FDM is used for limited numbers of constantly used low bandwidth channels where cost is a factor (such as long-distance connections on the telephone system, particularly with ADSL modems). It was cheaper than, but not as flexible as.......

Time Division Multiplexing

For multiplexing digital transmissions, little bits of data are sent in succession and the time on the link is sliced in strict rotation so the data is interleaved in frames that occupy a strict portion of time; in other words, each chunk of data is given a *time slot*. A good analogy is a contraflow, where vehicles gather at the start, are forced into a single line of traffic, and spread out again at the end.



Although it sounds fraught with difficulty, TDM happens so quickly that it looks as if a constant stream of activity is occurring on each circuit. As there is no need for guard bands, the entire channel bandwidth is used for each bit. When nothing is sent, zeros are transmitted to maintain synchronisation.

Although TDM was designed for digital systems, it can be used for analogue signals with the help of *Pulse Code Modulation*, a system which converts the smooth analogue signals to digital by sampling them several thousand times a second (8000, actually).

TDM is used for the Universal Serial Bus (see later) and many telephone systems, including ISDN and T1 lines.

Demand Multiplexing

With both systems (FDM and TDM), there will be empty capacity as some users become idle. *Demand Multiplexing* allocates empty slots as required to terminals that actually have something to send, but this is most often used on TDM.

Wavelength Division Multiplexing

From Fujitsu, this allows you to cram light frequencies down a fibreoptic cable. New frequencies are added by attaching a new laser and modulator/demodulator.

Concentrators

These concentrate transmissions from low speed devices into one high speed circuit, often called a *cluster controllers* or *terminal computers*.

Protocols

Having looked briefly at the signals and their carriers, we now need to establish some procedures. If you were telephoning somebody you didn't know very well, you might start by checking you've got the right number, then the right person, before saying what you need. You would also know that you're not supposed to talk to them until they've finished talking to you.

In computer terms, you would be establishing a *protocol*, or specific rules to follow when communicating (red tape, if you like). Each protocol consists of a *character set* (or alphabet, as used in a language) and specifies the order and priorities of the way information is exchanged using it; protocols may also have ways of detecting and correcting errors.

In other words, protocols sort out message and error handling, and status checking—even TTY (Teletype) had a protocol. Only devices using the same protocol can communicate directly with each other, and some of those available are fully explained later on. Protocol of some sort is needed for all types of communication, serial or parallel.

The use of protocols comes under all levels of the OSI model, and the processes range from the simplicity of sending an extra bit tacked on the end of each character, to the complexity required for satellite communications, which will incorporate methods of dealing with delays.

What's available will be discussed under *Telephone Lines* and *Network Protocols*, in the *Networks +* chapter.

Notes

Transmission Schemes

There are several ways of allowing movement around a communications circuit, but at least two ways of defining each! This is because one Standards Authority has said one thing and others something entirely different.

As with the OSI model, the movement of information between computers is similar to sending trains round a railway system. The computers (and any equipment attached to them) are the stations, and the links (cables) between them are the tracks. The information itself behaves like the carriages, but we'll leave the engines and guards' vans alone for a moment.

The ITU-T (remember them?) defines:

- **Simplex** as where two way transmission is possible, but only in one direction at a time (for you railway buffs, that's "one engine in steam", with only one line available and a single engine moving the carriages either way—one engine can't go both ways at once, so control is effectively handed over to the other direction at the end of each transmission). This is like using the radio where you press a switch to talk and say "over" when finished.

- **Half Duplex** as where simultaneous two-way transmission is possible (i.e. two lines for Duplex as described below are available), but the equipment only allows it in one direction at a time (like telex, which has the wires joined up, but can't use them), and

- **Duplex** as allowing full simultaneous two-way transmission with two channels, like a radio telephone, so you can send and receive at the same time all the time.

Everyone else in the computer industry, on the other hand (in line with North America), defines *Simplex* as allowing transmission in one direction only (which seems a bit pointless as communications should be two way to be effective), and *Half Duplex* (HDX) as where two-way transmission is possible but not at the same time, because only one path is available, like ITU-T Simplex (in fact, another name for it is *Two-Frequency Simplex*).

Full Duplex (FDX), though, is the same as ITU-T Duplex. Although, on the face of it, two links are being used for transmission, there may actually be four channels, two for the data and two for ground return. These could be either separate or multiplexed, and the reason for having this many is because the whole bandwidth was designed to be used in one direction only; as there were two wires in the first place, another two were used for the opposite direction. *Four-wire circuits*, as they are known, will tend to be restricted to lines not generally available to the public, that is, *leased lines*.

Where only one channel is being used for two way transmission, a special signal is required to hand over control to the other end so that transmission can go the other way. Again, just like a radio.

Synchronisation

For computers to start exchanging information, they have to know exactly when the first bit will arrive and when the last one has been sent.

The problem with teleprinters was synchronising several motors at each end of the line, all of which had varying amounts of slack in their linkages caused by wear and design problems, which is one of the technological reasons for sticking with the Baudot Code for so long, because the chances of error with only five bits per character were so much reduced.

Asynchronous Communications

As information couldn't be sent at a constant pace, it was sent at random intervals, with each side being able to stop the other if it couldn't keep up. The arrival of each character was acknowledged by the receiver sending a *receipt message*, so a new character could go any time the *stop bits* of the preceding one had been received.

To identify characters, extra bits are added to the basic 8; *start bits* at the front and *stop bits* at the back, so now we've got an engine and a guard's van. The stop bit is actually a positive low voltage (or *mark*) on the line which indicates an idle condition, and remains in force until the next character is ready, so as soon as the start bit is received (indicated by a high voltage condition lasting for one time unit), the receiver knows it has to get its act together and synchronise with the sender to receive the incoming character, which it does by starting its own clock. The use of a stop bit is not so much to signify the end of a character (although this is useful), but to provide as much contrast as possible between it and the start bit, so the start bit is actually recognised as one.

Although the transmission speeds of sender and receiver would be the same when a character is being sent (for obvious reasons), they couldn't be said to be in continuous synchronisation, hence the term *asynchronous communications*, which actually means "not synchronised". As they are actually locked in step when a character is being sent, a better description could possibly be "self-synchronised". Even better, "start-stop" communications, which it started off as, through start/top terminals.

The complete pattern of bits formed by start, character, parity (see Chapter 6) and stop bits is known as a *frame*. The number of stop bits actually started off as 2, to allow older equipment, such as teleprinters, to allow their mechanical parts to settle down. Telex terminals could get by with 1.5 stop bits, and computers only need 1. You've probably already guessed that the closer tolerances allowed by modern technology mean that the number of bits per character can be increased from 5 to 8, which allows computers to transmit ASCII codes comfortably.

Asynchronous communication is used over the telephone system because the calls may be routed anywhere, and proper synchronisation of everything would be impossible.

The main problem with adding start and stop bits is that fewer characters are actually sent in a given amount of time or, in other words, it takes longer to send your message. This isn't so important when you're at your terminal scratching your head and thinking what to say, but it could make you impatient when you just want to get on with sending large volumes of previously prepared data and the telephone company is sitting there clocking up the units.

Synchronous Communications

Synchronous communications are specially geared to fast and high rates of data transfer, because they are strictly coordinated, with the computers being locked in step from the start of the transmission stream. Data is sent in blocks, between easily identifiable control characters, with checking and acknowledgement. The modems do the synchronisation with phase patterns.

No start or stop bits are required, although others are added for counting purposes, so it's still important to distinguish between bits, characters and complete messages. This is done by simply counting the expected bits and ticking them off as they come in. As it's difficult to distinguish between individual bits unless the clock signal is available at both ends of the system, it's sent with the data.

Synchronous protocols were originally designed by IBM for its mainframes, the idea being (as with any development) to cheaply and quickly pack in more data per channel. Other manufacturers got on the bandwagon and those standards have become commonplace.
One of the first protocols was called BISYNC (*Binary Synchronous Transmission*). With it, data may be sent in ASCII, or any of two other character sets, in *frames*, each of which is marked by two special synchronisation characters. After these follow *header characters* (which contain identification codes) and the actual text followed by a *checksum* for detecting errors. A half-duplex circuit is sufficient for this, as messages are only sent one way at a time, but it will work on full duplex, even though it's inefficient in terms of cost relative to work done.

While BISYNC is character orientated, HDLC (*High-level Data Link Control*) is based on bits, and actually defined in the OSI model (it's used by ISDN, Frame Relay and X.25, discussed later, and by PPP on the Internet). In theory, the text of a message can be any length, but is usually restricted to multiples of 8 bits. The exact size will depend on the receiver.

BISYNC uses a special bit to indicate the number of characters in a message, while HDLC uses a totally unique code to indicate the beginning and end of it. This code cannot be mistaken for anything else and is called *The Flag*. It consists of a 0 followed by 6 1-bits and another 0 (01111110). Whenever the link is idle the flag is sent continually.

Although it effectively handles a byte at a time, HDLC is regarded as *bit based* because each one is scrutinised for anything that could be mistaken for The Flag. IBM uses something similar to HDLC, but with a few differences, which is called *Synchronous Data Link Control* (or SDLC).

The advantages of synchronous transmission over asynchronous are speed (anywhere between 20-30% quicker) and better detection of errors with more effective methods (see *parity*, later). One disadvantage is that many methods encode data as non-ASCII (e.g. EBCDIC), which is one reason why special translation facilities are needed for a PC to link properly with a mainframe.

Signal Distortion

We've already seen that signals can be affected by *attenuation* and *crosstalk*, but there are other nasties about.

Noise

You've probably heard it already—the crackling on the telephone line that sounds like somebody's frying eggs on it. "Noise" in electrical terms means unwanted and unpredictable impulses, breaks in transmission or extra signals, which can be thought of as extra electricity on the line, so you can see that a 0 could be made to look like a 1 if the noise level is high enough, and *vice versa*. Technically, it’s any low-voltage, low current, high frequency signal causing interference with normal transmissions.

Noise is measured in *decibels* relative to the signal associated with it, and the comparison of one to the other is known as the *Signal to Noise Ratio* (the decibel is named after Alexander Graham Bell). The scale of measurement is logarithmic, so a signal to noise ratio twice as good as another is actually only higher by 3 decibels.

Noise is always present in electrical circuits and there are many types. The Man-made stuff is easily detected and is more spontaneous; crossed lines, car ignition interference, fridges turning themselves on and off, etc. Other examples include static and the clicks and pops heard when tuning between radio stations. As such, it's only predictable within certain statistical limits.

There are two types you might encounter in networks:

- **EMI**, or *Electromagnetic Interference*, generated by lights, engines, industrial tools and radar.
- **RFI**, or *Radio Frequency Interference*, which comes from microwaves and other appliances.

Ways of preventing it include grounding the equipment properly, and careful placement of (shielded) cables.

Distortion

You can often hear a background hiss (or "rushing" noise) in between records on a radio, even when it's correctly tuned; this is noise being generated within the circuitry itself by all the collisions between the molecules and atoms as the signal moves.

The most common is a low background noise called *white noise* (or *thermal noise*) which occurs whenever there is resistance to electrical movement. It's called white noise because it covers a wide range of frequencies at a constant level, like white light. Unfortunately, amplifying the signal also succeeds in amplifying the noise.

If everything were perfect, the signal would travel at 186,000 miles per second (the speed of light) but, practically, this reduces to about 14,000 miles per second on ordinary twisted pair cable or 100,000 miles per second where microwaves are used, because of resistance.

There is a delay between sending and receipt, which can be allowed for, as the speed of transmission is known, but the length of the delay also varies with the frequency of the signal, being greater with lower frequencies.

This is OK when you're only sending one signal, but sending two at different frequencies (with the content of each dependent on the other) could mean some corruption if they're out of phase with each other at the receiving end. These constant effects can be simply calculated in accordance with known formulae and allowed for as far as possible in the design stages. Instead of merely allowing for certain effects, though, it's possible to do something about some of them. For example, one way of dealing with delays between two signals (*phase shift*) is to introduce some sort of *delay equalisation* that helps compensate. There's more about error correction later.

Notes

Error Detection

Fast transmission speeds aren't everything—your information is no good if it gets there quicker but is full of errors (assuming you typed everything correctly in the first place!).

Early transmission methods had no error detection. They knew very well when each part of a message had got through, because of the acknowledgements, but these told them nothing about whether what had arrived was what had been sent ("Lead us not into Thames Station...").

Part of the process of detecting errors is guessing what the signal should have been in the first place, which is done by adding other information to the basic message from which this can be deduced. Blocks of characters are statistically analysed as they are sent, and the results of that analysis are tacked on to the end of the message and sent to the receiver, where the analysis is carried out again and the results compared.

Parity

In addition to start and stop bits, another can be used for error checking, which is called the *parity bit* (actually not often used these days, because it used to be the eighth bit when ASCII used seven).

With *parity checking*, also known as *Vertical Redundancy*, the 1-bits making up a character are totalled up and, depending on whether the result is odd or even, another bit is added to make it the opposite. So, if the symbol contains an odd number of 1s, even parity would require another 1-bit added to make the number even (and odd parity would need the reverse). For instance, the character A (code 10000001) has two 1-bits. Odd parity would require the parity bit to be a 1 to make the total of 1s an odd one. C (code 10000011) having three 1-bits would have the parity bit set to 0 as the total is already odd.

The parity generating circuit (which is usually a dedicated chip) in the sending unit counts the number of 1s and sets the parity bit as required. The receiving unit does the same and calculates what the parity bit should be. If the two match, then no error is assumed. This works well enough, but unfortunately doesn't pick up everything—more than one error probably wouldn't be noticed, as the numbers can sometimes add up the same way, and the software rarely corrects automatically.

Both sides have to know what sort of parity is being used. The usual options are *Even*, *Odd* or *None*, with *Mark* and *Space* as oddballs that you probably won't come across (Mark parity is always 1, and Space always 0, a hangover from RTTY). You should set parity to *None* if you can get away with it, so if the eighth bit is used for anything strange (such as a control bit) without anyone knowing, it's left well alone, particularly when sending program, or binary, files. The parity bit must be set this way for 8-bit ASCII transfer.

Checksums and CRCs

Checksums and *Cyclic Redundancy Codes* are based on blocks of data rather than single characters, unlike parity checking.

A checksum is simply a summation of the ASCII values of every byte within a block, divided by 256 and the remainder discarded. The number is sent with the data and recalculated at the other end. If it's the same, all should be well, but you could get the same checksum for a different set of bytes. It's about 60% reliable.

CRCs include two bytes at the end of a block which are otherwise redundant, hence the name; we've already seen *Vertical Redundancy* in the shape of the parity bit. *Longitudinal Redundancy* is used in synchronous systems to check the length of the message; a Block Check Character does this.

These values are calculated by dividing the entire numeric binary value of the block by a constant figure (called a *generator polynomial*—no, I don't know what it means, either, but you get the general idea). The remainder of the division is transmitted at the end of the message and recalculated at the receiver. It's about 99% reliable.

CRCs can be used in conjunction with parity.

Error Correction

Since a bit can be either on or off, and valid even if it is an error, it would be much more useful if a system could describe exactly where an error is and correct it, rather than just detecting its presence, as the previously mentioned systems are only capable of doing. As far as correcting errors goes, commonly used systems are *Forward Error Correction* (FEC), *Backward Error Correction*, *Automatic Repeat Request* (ARQ), *Microcom Networking Protocol* (MNP) and *V.42*.

Forward Error Correction

The message contains extra information specially for reconstruction. Correction is done at the *forward* end (i.e. the receiver) so the message does not have to be repeated, and the next block can be sent without waiting for acknowledgements.

FEC uses *Hamming Codes* in place of ASCII, where 11 bits represent a character instead of 7 (or 8). The extra bits are redundant and are placed among the rest so the position of the wrong bit can be calculated from the remaining ones. Once that's been found out, that bit is inverted, since it can only be a 0 or a 1. However, like parity checking, this only provides protection against single-bit errors. It's actually more efficient to resend data than to try and fix it (see *Backward Error Correction*, below), so FEC is more often used where data can't be retransmitted, like on backup tapes, or with satellite transmission.

Backward Error Correction

Errors are still detected at the receiver, but the transmitter resends the offending data, so you actually get a form of error control, since bad data is not corrected, but discarded. A file is divided into blocks or frames and CRC check sequences are added to each block.

Automatic Repeat reQuest

With ARQ, a CRC or checksum is calculated for each block and added to it when transmitted. At the receiving end, the CRC or checksum is recalculated, and compared to the original checksum value. If the two agree, all is (theoretically) well. If not, a NAK (*Negative Acknowledgement*) is sent back to request retransmission. One common ARQ protocol is *Xmodem*, described later, under *File Transfer*. ARQ is often used as a synonym for.....

Microcom Networking Protocol

MNP, invented by Microcom, provides error correction between two similarly equipped modems by automatically sending erroneous data in packets until everything has been properly transmitted. Most MNP-equipped modems do this without you interfering.

MNP allows continuous data transmission—you don't need the extra bits to help identify each character. However, MNP doesn't work quite so well with high speed modems, due to the time required to recover from line noise. As a result, most use *Trellis Encoding*, or *Forward Error Detection* as well, where the receiving modem automatically detects and corrects errors before the data is passed on to the PC, effectively filtering out the line noise caused by faulty equipment.

Standard	Effect
MNP 1-4	Public Domain. Enough said, except to point out that the first two reduced throughput, level 3 improved things, and 4 automatically adjusted frame sizes.
MNP 5	Introduced data compression (at around 2-1) to boost throughput, but it is applied regardless, and can make pre-compressed files take longer to be transmitted.

Standard	Effect
MNP 6	Designed for high speed half-duplex connections between 4800-9600 bps.
MNP 7	As level 5, with better data compression.
MNP 9	As above, but with improvements when deciding optimum modulation levels and protocols.
MNP 10	An advanced method for adverse line conditions, reducing speed when conditions are bad, and vice versa, so is used for cellular transmission (e.g. mobile phones).
V.42	An ITU-T version of error correction, which means less royalties for Microcom, superseding MNP4. V.42bis provides data compression with autodetection for compressed files, so it doesn't try to do the same job twice.

Software

There are two types of system you are likely to connect to; those with a *scrolling display* (like your normal screen) and those with *Viewdata*. Viewdata, used extensively in Europe, combines text with basic colour and graphics to give the sort of display used by Prestel, travel agents and Teletext. It's not generally supported by American software.

The point about software is *automation*; that is, you should be able to get it to do most of the work; once you tell it what sort of modem you have, it should send all the right signals for you. For this, there ought to be an element of programmability, in the shape of a *scripting language* (macros, really) that should at least issue your ID and password when you log on to your destination. That used for graphical Internet work is dealt with under the *Internet* chapter. In most cases, though, automation will stop there, unless you go quite deeply into scripting.

Unfortunately, there's not enough time in the day for all that as well, so there are two types of program that will bridge the gap, which are often specific to their particular systems. The objective of both is the same; to make using On-Line services considerably easier and quicker, thus reducing phone bills, but they do it in different ways.

- An **On-Line Reader** issues complicated commands on your behalf, so where you would normally issue about three lines of gibberish to see what files are available for downloading, you might be able to choose them from a nice looking menu instead. In short, it helps you move around the system while on-line.

- An **Off-Line Reader** does the same, but you're only connected long enough to send and receive messages you prepared earlier; all your messages are uploaded and downloaded by the program automatically, as are lists of files available, so you can browse through them at your leisure. The next time you log on everything is done without you touching a thing. It types a lot faster than you can, and doesn't make any mistakes.

You may, of course, just have straight comms software with terminal emulation and a scrolling display and have to do all the work yourself!

Setting Up

You obviously need to know what settings the receiving computer expects, so you can to talk to it properly; luckily, speed detection on Bulletin Boards is usually automatic, and many modems can start at a high speed and work downwards (i.e. *fall back*) to a slower one until you're connected, so maybe try 28.8 or 14.4 first. You will need to know which COMmunications port your modem is attached to. A PC usually has two, COM 1 and COM 2, where COM 1 is commonly taken up by a mouse, just to make things awkward. If you're not sure, try each one in turn. If your computer freezes up, the COM port you have chosen is already in use by something else.

Your software needs to control your hardware in terms of:

- **Speed**, or the number of data bits transferred per second. Typical speeds range from 300 to 57,600 bps, but the telephone lines are not capable of handling more than 2400 on average without squeezing more bits per baud. With data compression, you can often get an *effective speed* higher than your modem would normally allow. You can connect at 57,600 bps with a 28,800 bps modem, if you use V.42*bis* at each end. Overleaf is a typical list of connection messages to illustrate this:

```
ATZ
OK
ATDT 0181 255 1771
CARRIER 28800
PROTOCOL: LAP-M
COMPRESSION: V-42 BIS
CONNECT 57600
```

- **Parity**, which is primitive error checking, and more or less out of date, so is usually set to *None* (other options are *Even* and *Odd*).

- **Data bits**; that is, the number of bits transferred at a time. If you remember, a byte consists of eight bits, so if you use Even or Odd parity (above), the eighth bit will be used for error checking, which means you can't transmit complex characters.

- **Stop bits**. Because only one cable is used, there needs to be some way of telling when each character sent comes to an end, which is what a stop bit is for. It's simply an extra bit that is immediately recognisable as not being a character, so the computer knows when the next one starts. If you like, stop bits give the computers a chance to synchronise with each other. Usually set to 1.

- **Handshaking**, or how the flow of data between each computer is to be controlled (that is, concerning the hardware only). There must be a way, for example, for the receiving computer to tell the sending one to stop for a while if it gets a problem. Usually, this will be CTS/RTS. Don't use XON/XOFF, because it prevents 8-bit transfers.

- **Protocol**, which is similar to handshaking, but used between programs (hardware-based handshaking is a personal matter between the computers). The best general choices are ZMODEM, YMODEM, XMODEM or ASCII, in that order, but see Chapter 10.

- **Type of dialling** (Tone/Pulse).

All the above can be set from within your communications software, usually at the same time as setting up the telephone number of the computer you want to talk to (look for *Settings*....).

Standard login is 8 bits, no parity and 1 stop bit, at whatever speed you select.

Modem settings

A non-Hayes modem, that is, one that is compatible but not made by Hayes, sometimes needs to be told to use a *reduced command set*.

MODE

Normally, your software sets up the serial port, but you could do it manually. The MS-DOS program that allows you to do this is called **mode.com** which, in addition to allowing you to alter the serial port settings, also covers the parallel port or the monitor. These are not our concern, though.

As far as the serial port is concerned, **mode** sets up the baud rate, parity and number of data and stop bits used by information passing through either COM 1 or COM 2. A typical command will look like this:

```
MODE COM 1:300,E,8,1
```

where COM 1 has been set to 300 baud with even parity, eight data bits and one stop bit, in that order. To change anything, alter the information between the commas (in the right sequence) or omit it, but you must still supply a separating comma if what you've missed out is in the middle—check out:

```
MODE COM 2:12,7
```

where COM 2 has been set to 1200 baud and seven data bits while the rest has been set to the default values of even parity and 1 stop bit (2 stop bits if 110 baud is used). The default number of data bits is 7. A baud rate must be specified every time, but you only need to supply the first two figures.

To use the **mode** command to redirect the printer output to the serial port (after the rest has been done), use:

```
MODE LPT1(2 or 3): = COM 1(or 2)
```

STAT

The **stat** command is used in CP/M mainly for checking on the status of various parts of the computer, such as the disk drives and the files on them. However, it can also carry out similar functions to **mode** in MS-DOS, except that it doesn't set up the parameters of the port you're using (usually done with a **configure** or **setup** program). What it does do, though, is allow you to redirect output to one part of the computer or another (if you've got a dead printer, check that you're sending data to the right port). CP/M always puts information out through four possible outlets, but we're only interested in what it calls a LIST Device (a printer, in English) or the CONsole. Just because a device is called LIST Device, the output doesn't actually have to go to one—you could actually send it to a modem that's occupying the space where the program thinks the printer should be. Provided the operating characteristics are the same, there should be no trouble.

This is all the program needs to look for, since CP/M takes the output and moves it to the real one. In other words, a program will look for a notional list device (that is, one that doesn't really exist), but CP/M will put it out to where it should be. This gives you some flexibility, as a program can remain standard for various machines, and all you do is call a device something else so the program thinks that what it's talking to. You can tell CP/M that whenever List Device is referred to by a program, what it really means is whatever you specify with **stat**.

One major difference between CP/M and MS-DOS is that the command syntax is usually back to front, and **stat** is no exception. For instance, to redirect output to the equivalent of COM 1, say:

```
STAT LST:=UL1
```

which really means that "the status of the list device is equal to User List 1", or in other words "the list device is now COM 1", if you were doing the same thing in DOS. If you recall your algebra and replace STAT with LET, it becomes easier—what you're saying is LET the List Device (LST:) equal User Port 1 (UL1).

File Transfer

There are two types of data that can be sent between computers; ASCII or Binary, and it's important to tell your software which one it's dealing with, particularly......

ASCII

The problem with data files saved in the format of the program that produced them is that "real" Carriage Returns are only found at the end of each paragraph. At the end of every other line is a *soft return*, which is put there by the word wrap procedure. Naturally, different programs have different ways of doing this, so confusion reigns if no particular standards are used, which is where ASCII comes in, as a lowest common denominator for the exchange of data between programs.

The term "ASCII" is often synonymous with "text", as an ASCII file contains no formatting instructions, such as where to start bold or italic printing, where the tabs are, etc; in other words, there are no hidden codes put there by the software; there's also a Carriage Return and Line Feed *at the end of each line*. Thus "ASCII file" = "text file".

Rich Text Format (RTF) files are accepted as a means of data exchange, but they contain formatting instructions, for bold, italic, etc, as laid down by Microsoft, who keep "updating" it.

It's not safe to assume that conversion to ASCII is done automatically, so you *must convert it before you send it*.

Binary Files

These are files consisting of program code. If they're not given special treatment, the odd byte in them may be misinterpreted as instructions at either end and thoroughly confuse the whole issue.

The classic example is the command sometimes used to denote the end of a text file, which is ^Z (**Ctrl-Z**). This can appear in a program file in an entirely different context, but will be taken to mean the end of the file, and the one you are transmitting will be cut short in its prime.

As long as you tell it what type of file you're dealing with, your software should take care of this automatically.

Protocols

A file, as you already know, is a block of data that is addressed as a whole, usually by name. Transferring files is process that takes the whole file and moves it somewhere else *undamaged*, and a protocol makes this possible.

A protocol can operate where the timing and sequencing of events is unknown and errors in transmission are expected, so it has quite a bit of work to do. It must inform the devices involved as to whether they are source or destination and identify the files involved. It must also establish whether the file will be stored anew or attached to an existing one.

The key elements of a protocol are *syntax* (concerning the format of the signals and their levels), *semantics* (information needed for communications) and *timing* (the speeds for the matching and sequencing of events). They send data in packets because they're easier to resend than whole files.

A *streaming protocol* doesn't wait for "correct receive" acknowledgements, but sends continually and aborts transmission if an error is detected (on the receiving side). This is useful where error correction is handled by other means, such as a modem using MNP or V.42, so streaming protocols are faster, because they do no error checking. They should be avoided unless your connections are 100%.

A protocol's *window* concerns the amount of blocks sent at a time without acknowledgements; a window of 4 means 4 at a time. Following is a list of the most common you may encounter, but a lot of them are programs in their own right. Note that your choice will depend on several things, not least the quality of the phone lines. Most are only capable of half-duplex, where transmission only takes place in one direction at a time.

ASCII

Starting with the basics, *ASCII transfer* simply means the process of typing characters and the receiver accepting them into memory—in other words, similar to a telex or teleprinter. There is no error detection, and it's difficult to save to disk. What's called *ASCII file transfer* just about makes it as a protocol, as it only uses Xon/Xoff handshaking. Only use 7 data bits with this.

HS-Link

Bidirectional, can be used just about anywhere, including on networks, when you need to send files in both directions at the same time.

Compuserve B+

Proprietary, used by Compuserve, which initiates data transfers by itself.

XModem

The original modem transfer protocol (written by Ward Christensen in 1977), which started as MODEM2 on CP/M, devised as a simple 8-bit error checking scheme for computers. As it's eight-bit, you can't use XON/XOFF, so you must either not need flow control, or have it hardware-based. Xmodem splits data up into 128 byte blocks and uses a checksum for error checking.

The sending machine launches the first block on receipt of a Negative Acknowledge (NAK) character from the receiving terminal (they are sent out every 10 seconds when in a waiting state). When the block arrives, the receiver checks the message by making sure that it has a Start Of Header character at the front, that the block number is the next in sequence to the last one received, that 128 characters actually were there and that the checksum at the end tallies with the locally computed one. If it's happy with that, it sends an *acknowledge* signal (06 hex) to the sender, which sends the next block when that is received. If it isn't happy, then a NAK is sent and the block is retransmitted. An *End of Text* character is sent at the end of the complete message.

The simplicity of Xmodem is also its main drawback, in that it's unable to detect noise bursts that are able to take out 12 or more bits at a go. Like Kermit (see below), it also requires one terminal to be identified as a sender and the other as a receiver, so a terminal is needed at each end with the setup being done manually (that can be a bit awkward at times).

It's also inefficient in its use of the line, in that it needs full duplex facilities to operate a half-duplex service, as it sends information on one line and waits for an acknowledgement on another (it can't hand over control of any lines to the other machine). Another problem is that it can transfer only one file at a time and the filename must be entered explicitly, with no wildcards.

Xmodem usually cannot be used over networks, multiplexed connections or X.25 circuits, because of the control characters it uses. It doesn't have a configurable block size and it alters the size of files, rounding them up to the nearest 128 bytes, the block size it uses (a CP/M limitation, this). Neither does it perform data compression. Still, it did serve as the basis for many other protocols.

Only use Xmodem when nothing else works.

XModem-CRC

As above, but uses a 16-bit CRC, so it's less likely to miss multiple errors, although it is marginally slower.

Relaxed XModem

Used when certain hosts can't maintain the strict timing Xmodem needs by simply multiplying the timing by a factor of ten; for instance, where Xmodem might wait 2 seconds for a character, Relaxed Xmodem will wait for 20.

Xmodem-1K

Sometimes confused with YModem (below); Xmodem with 1K blocks.

YModem

As for Xmodem-CRC, except that block sizes of 1 K are supported, and file names and lengths are sent along in a block before the data, so the receiver knows what size of file to expect. YModem was developed under CP/M by Chuck Forsberg as YAM, but by the time it got to PCs in 1981 had become an improvement on Xmodem. Be aware that not all Ymodems you get are the same; it might handle more than one file at once, but you may only get to send one at a time—see *YModem Batch*.

Use when the phone lines are fair to grim.

Ymodem Batch

"Batch" means you can send more than one file at a time, using wildcard characters for multiple files. Although the batch facility is part of YModem, it is sometimes implemented separately.

YModem-G

Sends data in 1K blocks as a continuous stream, with no error checking (it leaves this to hardware), so is a streaming protocol as fast as ZMODEM (below). Use with error-corrected links, or when the phone lines are good.

YModem-G Batch

As above, but can handle multiple file names.

IModem

Developed by John Friel. It performs no error checking, so only use it when the phone lines are good.

WXModem

Developed by Peter Boswell as a Full Duplex sliding window protocol that can send up to four Xmodem blocks before needing an acknowledgement. Can handle network flow control.

ZModem

Another creation of Chuck Forsberg, written in 1986, which can automatically set the receiving station into receive mode when the first data blocks arrive. Most hosts supporting this offer automatic transfer initiation. 32-bit CRCs are used, but no checking takes place or corrections performed until the whole file has been transmitted.

Zmodem is a streaming window protocol, but doesn't abort the transmission process if there's a mistake; instead, it just asks for a retransmission. Block sizes are automatically varied according to error rates; the more errors reported, the smaller the block size becomes. Best of all, it remembers where it left off, so it can even recover from aborted transfers (days later), or if you're using a satellite link.

It is fast, except with static, so use when phone lines are good.

JModem

A high-speed variation of Xmodem.

SEALink

This is a version of WXmodem, with a window of 6, developed by Thom Henderson of *System Enhancement Associates*. It's a *sliding window protocol* which basically means that unless an error is detected, data is sent constantly with no pauses. Because of this, SEAlink is very fast—15-25% faster than Xmodem, which makes it better for packet switched networks and satellite link-ups where delays are common in the system anyway; it can send up to six 128-byte blocks before requiring an acknowledgement. SEAlink passes a file's name, size and date when transferring it, and can be used in batch mode.

Telink

Telink, from Tom Jennings, is mainly found on Fido Bulletin Boards as it's commonly used with them. It's basically Xmodem, but also compatible with Modem7 (below) using CRC checking with an extra block sent behind the file name, but ahead of the file itself, containing its vital statistics, such as file size and creation date (for MS-DOS), so you don't get padded files. Again, this is a batch protocol, and you can use wildcards.

Modem7

A close cousin of Xmodem (using the same protocol, anyway) that passes the filename before starting the transfer, taking away some of the work—you don't need to waste time telling the receiver what it's getting. It's available on almost all CP/M and MS-DOS machines.

Modem7- compatible programs can transfer 1 or more files at a time, with full error-detection and correction. The main limitation under DOS is the original file creation time and file size are lost (but check out Telink above).

Mex

*M*odem *EX*ecutive, to give its full name, is a derivative of Modem7 used mainly with CP/M.

Kermit

The Kermit protocol is in a class of its own with special features that warrant giving it further attention. For one thing, it's available for just about every computer that exists, and acts as a lowest common denominator, so don't expect graphics or other fancy features (it can use 7-or 8-bit ASCII, so is good with mainframes that can only cope with 7-bit). There is also a sliding window version that uses Full Duplex (that is, you can send data continuously and get replies at the same time), and you can use Kermit when the lines are terrible.

Kermit has a limited terminal emulation facility which allows you to be a slave terminal to a mainframe.

Actually, Kermit is both a program in its own right and a protocol that has been incorporated into many other programs, in which case it will be much faster than the original. It's in the Public Domain, which means that the copyright remains with the author (Frank de Cruz/Columbia University in the USA) and the program may not be sold or altered without their written permission (the UK equivalent to Columbia University is the University of Lancaster, from where copies may also be obtained). You can freely copy it, give it away or whatever, as long as you don't charge for the software or anything based on its code.

Thus, any charges you may get involved with should only be for the cost of the media used to carry it; not much more than the price of a disk and postage. The support and documentation is very good, but there's so much of it (the text file that comes on disk for the PC version is 290 K long, takes ages to print out and uses a stack of paper), and if all you're using is a small PC, you don't need much of that at all to be effective.

Like all things, if you know why you're doing something, sometimes you don't need instructions at all, so assuming you have the main program (**kermit.exe** for an IBM), let's look at what's behind it all.

Kermit converts the data coming from either terminal into its own codes, and reconverts it at the other end. Like everything else, it sends data in packets, say, 128 bytes long, with control information added. Its particular strength is its error checking protocols. A length indicator and a "block check" are provided for detecting errors, but one slight problem is that if the last bit of data is not enough to fill a packet, Kermit will pad the rest out, like XModem does. To change this so the end of the file is actually marked at the end of the data, you need to use the **set eof** (SET END-OF-FILE) command, which is explained later.

Speeds and other parameters should be correct at either end, and once inside the program you can check what the settings are by typing **status**, which will provide a complete list of the default values your particular version has.

On most versions, you can set everything from within the program, but this can be time consuming if you use it on a regular basis. You can't do this at all with some machines, notably CP/M ones, where you have to set everything up *before* you invoke Kermit—see also the section on the **mode** and **stat** commands at the end of the previous chapter.

To have Kermit start up with your favourite default values, you need to make up an ASCII file called **mskermit.ini** (for MS-DOS computers, but check for your own make—and whatever it is, it needs to be in the same directory path as the main program) into which Kermit looks on start-up so it can set itself up how you want.

This file is merely a list of all your preferences, on separate lines, like these:

```
set baud 300
set parity even
```

To start the program, type:

```
KERMIT
```

at the system prompt (or ***kermit** on a BBC) and the computer will respond with something like this:

```
KERMIT>
```

This prompt can be customised, but that's a bit esoteric for us—in other words, you'll have to look up the proper reference manual for how to do it, as well as for the editing commands!

If you need it at any stage, Help is readily available by typing ?, and it's (sort of) case-specific. Usually it just consists of a list of available commands (what do you expect for free?).

Once inside the program, commonly used commands include:

Command	Explanation
SET	A parameter, like SET BAUD 300
SHOW	A parameter, like SHOW BAUD
STATUS	Enquiry about settings
SPACE	Enquiry about disk space
DIRECTORY	List of files on disk
SEND	File to other Kermit (add name)
RECEIVE	File from other Kermit (add the name)

Command	Explanation
CONNECT	To a remote system (Email, etc)
SERVER	Makes other terminal obey your Kermit
GET	File from remote server
FINISH	Shut down remote server
BYE	Disconnect from remote system
EXIT	From Kermit (or QUIT)
HANGUP	The phone

Most of these (I hope) are self explanatory, if a little cryptic. There are other commands which will be shown by invoking HELP. All of the above are LOCAL, meaning that they refer to your terminal.

However, by prefixing them with REMOTE, the same commands can be made to operate on another computer running Kermit which must previously have been designated as a SERVER (when doing this, use the prefix **local** with the above commands to avoid confusion).

Kermit File Transfer

In principle, this is simple. Well, at least it is if the computers are on the same desk, in which case all you need to do is get Kermit up and running at the right speed on both machines, tell one to **receive** the **file** you want and then the other to **send** the same **file** and voila! Kermit will transmit everything, checking for errors on the way.

In practice, however, there are one or two things that you may want to sort out before you start. For instance, some versions of Kermit like to know if they are sending ASCII or Binary files (not with MS-DOS), so you tell it before you start by saying

```
SET FILE-MODE ASCII
```

(or BINARY). Some Kermits may need files translated to 7-bit ASCII because of the formatting commands in 8-bit ASCII by some MS-DOS programs.

Also, certain MS-DOS programs (like CP/M ones) terminate a file with **Ctrl-Z**, which will cause things to hang if that command isn't present; the **set eof** (Set End-Of-File) command caters for this.

Actually, it's not strictly necessary to specify the filename for receiving unless you want to change it—Kermit will save it under the filename sent by the other end, and will even alter incoming filenames if there are illegal characters, or one with the same name already.

However, just to show Kermit's versatility, all of the above procedures can be done over the telephone lines from a remote computer with everything being controlled from your terminal.

Kermit has to be running on both machines, of course, but you can even start the other one from yours—here's how:

- ❑ Get Kermit running by using the procedure above and SET the parameters you require.

- ❑ Now type:

  CONNECT

  (C will do just as well), followed by **return**. Take a note of the Escape character shown on the screen (this can also be customised if you want), because this will allow you to regain control from your terminal later.

  Once everything is connected, your computer will become a dumb terminal of the other one, in which case you may need to enter IDs, Passwords and the like to make it recognise your existence (on the IBM PC, Kermit provides an almost complete emulation of the DEC VT-102 terminal at speeds of up to 19,200 baud, which terminal emulation can be changed). It is important to appreciate that you are *not in native Kermit mode* at the moment.

- ❑ All you need then do is type:

  KERMIT

  prefixed by whatever command is needed to run any program (such as R on a DEC mainframe, so you need R Kermit) and the program should start, showing a similar system prompt to yours.

You can either tell the other Kermit to **send** the **file** you want and while it's getting ready to do that, quickly **escape** back to yours (using the code) to **receive** it (or vice versa), or just reverse the two computers' roles—type **server** and the escape code will put you back in charge of your machine and talking to your Kermit with the remote machine serving your Master, shown by the appearance of your system prompt (assuming the other Kermit allows SERVER operation).

A **send** command from you automatically invokes a **receive** command at the other end (or alternatively, a one-stroke method of getting the remote machine to send a file is just to use **get**, followed by the filename you want, but this is only available for Server operation).

Once file transfer is running, the screen should change and a small table appear showing the name of the file to be transmitted. Resist pressing the Return key or otherwise trying to get some action while transfer commences, as it does take a few seconds.

Depending on your version of Kermit, you may be shown progressively the percentage transferred so far and to go, the number of kilobytes sent successfully, the number of packets sent and the number of retries.

A tip is to watch the retries—if there are lots, then check that the baud rate's not too high and the physical connections are OK.

Electronic Mail with Kermit

Using the same principles shown above, it's possible to log on to an Electronic Mail service using Kermit as the communications program. Again, start the program, set up the parameters and type:

```
CONNECT
```

Kermit should then take command of the modem (shown by the DTR light coming on) and show you an empty screen for your commands—you're in terminal mode here. You will have to log on manually but, then again, Kermit's free.

Bulletin Boards

A Bulletin Board is the electronic equivalent of a public noticeboard, where anybody suitably equipped with a modem and a computer can place or read messages. Some allow you to send and receive mail, or have areas (*forums*) for special interest groups. Others allow you to chat on-line, or download any software they allow you to get your hands on. In short, they are the equivalent of commercial Email services but privately run by amateurs, similar to radio hams (the word amateur here is not meant to mean "unprofessional", but "enthusiastic").

The first Bulletin Boards appeared in the late 70s, but were limited, in that only one person at a time could logon and use their facilities. Although large companies can run them as cheap Email and conferencing systems, we are mainly concerned with the smaller ones generally run on a non-profit making basis by a lone enthusiast using a micro and modem—in other words with minimal equipment (actually, some of it is not so minimal).

There is some etiquette involved. If you're not paying for the service, you shouldn't abuse it, which means treating all concerned with respect and courtesy (assuming you get it in the first place, of course). Obscene messages left lying around are not popular! Log on with care, be brief and read the "new user" messages that may be around, usually in the *Bulletins* section.

Logging on is quite simple. Most modems can start with a high speed and work downwards from that (known as *falling back*). The number of stop bits is usually 1, number of data bits 8 and parity none.

There may be a *ringback system*, for when there is only one line. Allow the phone to ring a couple of times, and if there's no answer, hang up and ring back (hence the name).

Once you're in, you will be asked for your first and last names, together with some information about your equipment, and be invited to register as a user (again, courtesy demands that you don't give them false details). You will need a password for future occasions so others can't pretend to be you, so have one ready. Usually, everything is organised by menus, so it will be quite easy to find your way around. There may be some instruction files you can download and read at your leisure, which will save you tying up the system while you find your way around (look under *Bulletins*). Many boards have the same basic layout and menus, mainly because they use the same software.

Sometimes boards go off-line for various reasons—Fido boards (see later) go off and talk amongst themselves at some unearthly hour of the morning (about 0230), linking up and transmitting messages to each other.

When you have to go, it isn't good manners just to drop the line when you get fed up (in fact, it's never a good idea to do it at any time with any program), so leave by the routes provided. Leave a thank-you message or some constructive criticism for the person who runs the board (who is known as the SYSOP, by the way, short for SYStem OPerator). It's his job to maintain things, register users, back things up and generally to maintain security.

Networking BBSs

FidoNet was developed in America to allow users to read mail on other boards. It started because the authors of the Fido BBS software needed to exchange modifications to their code on opposite sides of the country. They designed a system where the board would shut down nightly and exchange data back and forth. The utilities that did this gradually became part of the BBS package.

Put simply, FidoNet is a collection of Bulletin Boards that connect together for the purposes of sharing mail. The name comes from the fact that they originally used the same software (FIDO), but now anything compatible can join in. Each FidoNet has a central node (any BBS on the system), called the Hub, which collects and distributes any mail throughout the BBSs in its area. With *EchoMail*, your message will eventually appear at all BBSes on the network. It requires no special addressing, unlike netmail.

PCRelay does the same as Fido, but in a different way, using a different topology through third party comms programs, such as *Telix* or *ProComm Plus*.

Starting your own Bulletin Board

Before you do, it's only polite to your potential users to run one that's viable in the first place. The etiquette goes both ways—it's not fair to get them to log on and waste their phone bills while you muck around not knowing what you're doing. The viability of what you propose depends mainly on cost and the time you have available to run things.

The Hardware

A Bulletin Board can be very inexpensive to set up. The easiest way is just to rent space in one of the commercial systems, but otherwise all you need is a single computer with a disk drive (a hard disk is best), one or more serial ports, an auto-answer modem (Hayes compatible, preferably, with auto baud-rate scanning), a telephone line and some controlling software. For small scale boards, the Atari ST (or similar) can do a respectable job with just two 1 Mb floppy drives, which just goes to prove something, but I'm not sure what.

As a result, the whole lot could set you back less than you think (depending on the equipment used), without allowing for your own time to set the thing up, and the phone lines. Running costs will consist of electricity, telephone rental, backup media and time for maintenance—you'll need to take it off line sometimes to delete old messages, answer callers' questions and make general improvements as you go along. Concerning your time, allow about 120 hours learning how to set it all up and 10 hours per week maintenance.

You will find that a 4 Gb hard disk won't last long—you will need some disk space constantly free for uploads and workspace, which will mean a lot of weeding to get rid of unwanted files, which takes time.

Also, if you live in a built-up area, you will have to watch the power supplies during the adverts on TV as half the neighbourhood gets up to put the kettle on. You may need an *uninterruptible power supply* to keep things going.

A dedicated telephone line (not a real one, only in the sense of just being used for the computer) is almost a must, though some Boards are run by people telephoning in and asking the SysOp to plug in the modem! The main reason for a dedicated line is for people calling outside published operating hours and may not realise that you have answered the phone and not your equipment—unless you like your ears punished by modem tones, of course!

BBS Software

As with anything, get the software first, then the hardware to fit. The software will be determined by your reason for starting the BBS in the first place—will it be a full-blown Email system allowing interaction from callers, or will it be read-only? Different software has different strengths and weaknesses, but will certainly have to handle multiple tasks and users with a registration system for checking passwords and suchlike.

In its most basic form, the software will run on a dedicated PC with one modem attached to it. At the other extreme, there may be 250 lines, allowing more users at any time to participate. Core facilities include leaving public messages for as many people to read as possible, or private messages for individuals. Also, it needs to be able to accept incoming files and to send files to callers (uploading and downloading).

On the PC, names to look out for include: The Major BBS, Maximus CBCS, Oracomm-Plus, PCBoard, RBBS-PC, Remote Access, Searchlight, Spitfire, Opus, TBBS and Wildcat!, although these are by no means the only ones. You can handle more than one phone line with a multitasking OS (like Multiuser DOS) or **desqview** on top of DOS. Or even Windows!

For the Atari, try Michtron's BBS, which is reported to be quite user-friendly. If you're more experienced, try FoReM ST from America which is more complicated, but one way to find out what's good or not is to ask the SysOps of various operational systems and see what they think of theirs.

Security

This is the biggest problem with a bulletin board. If you're using a Hayes-type modem, the escape codes needed to revert to the command state can be accomplished by a remote computer just as much as yours. Any stored numbers and passwords are liable to picked clean by any hacker worthy of the name, so give some thought to storing these in your computer instead.

Packet Radio

This is an extension to the Bulletin Board idea which uses principles from packet switching, so it combines computers, software and radio systems into a full-blown communications system all on its own. The thing most in common with Bulletin Boards is the attitude of the people involved—those who set it up go into it for the fun and the challenge, although they can be used for hand held data entry round supermarkets, for instance.

Even the standards are the same or very similar; the AX.25 packet structure is highly equivalent to X.25. You need a different type of modem, though, called a *multimode data controller*, because no start/stop signals indicate the beginning or end of transmission. Modems supporting the **+W** extension to the Hayes standard are what to look for.

Using Packet Radio means that you don't need to pay for PSS, but you do need to pass the Radio Amateur's Licence and get your own callsign. Also, you can use the many PBBSs (Packet Bulletin Boards) without the added complications of the phone bill.

Ordinary comms programs can be used, because they only concern themselves with data going in and out of the RS232 port. Where it goes or comes from beyond that is not relevant, provided the protocols are the same at both ends. Otherwise, it's Half Duplex only and there's not the security as everyone monitors the net, but it is a matter of courtesy not to tamper with other peoples' messages.

If you're interested, you can get more information from your local Amateur Radio Group.

Packet Radio, by the way, is what Ethernet was based on when it made the transition to cable. It has recently resurfaced as WAP, or *Wireless Application Protocol*.

The ASCII Code

Binary	Meaning
00000000	Null
10000000	Start of message
01000000	End of address
11000000	End of message
00100000	End of transmission
10100000	WRU (Who are you?)
01100000	RU (Are you...?)
11100000	Bell (audible signal)
00010000	Format effector
10010000	Horizontal tabulation or skip (for card puncher)
01010000	Line feed
11010000	Vertical tabulation
00110000	Form feed
10110000	Carriage return
01110000	Shift out
11110000	Shift in
00001000	Device control reserved for data link escape
10001000	Device control

Binary	Meaning
01001000	Device Control
11001000	Device Control
00101000	Device control (stop)
10101000	Error
01101000	Synchronous idle
11101000	Logical end of media
10001000	Information separator
10011000	Information separator
01011000	Information separator
11011000	Information separator
11001000	Information separator
11011000	Information separator
11101000	Information separator
11111000	Information separator
00000100	Word separator (space, normally non-printing)
10000100	!
01000100	"
11000100	#
00100100	$
10100100	%
01100100	&
01110100	'
00010100	(
10010100	)
01010100	*
11010100	+
00110100	,
10110100	-
01110100	.
11110100	/
00001100	0
10001100	1

Binary	Meaning
01001100	2
11001100	3
00101100	4
10101100	5
01101100	6
11101100	7
00011100	8
10011100	9
01011100:	
11011100	;
00111100	<
10111100	=
01111100	>
11111100	?
00000010	@
10000010	A
01000010	B
11000010	C
00100010	D
10100010	E
01100010	F
11100010	G
00010010	H
10010010	I
01010010	J
11010010	K
00110010	L
10110010	M
01110010	N
11110010	O
00001010	P
10001010	Q

Binary	Meaning
01001010	R
11001010	S
00101010	T
10101010	U
01101010	V
11101010	W
00011010	X
10011010	Y
01011010	Z
11011010	Left bracket
00111010	Reverse slash bar
10111010	Right bracket
01111010	Up arrow
11111010	Left arrow
00000110	Unassigned
10000110	Unassigned
01000110	Unassigned
11000110	Unassigned
00100110	Unassigned
10100110	Unassigned
01100110	Unassigned
11100110	Unassigned
00010110	Unassigned
10010110	Unassigned
01010110	Unassigned
11010110	Unassigned
00110110	Unassigned
10110110	Unassigned
01110110	Unassigned
11110110	Unassigned
00001110	Unassigned
10001110	Unassigned

Binary	Meaning
01001110	Unassigned
11001110	Unassigned
00101110	Unassigned
10101110	Unassigned
01101110	Unassigned
11101110	Unassigned
00011110	Unassigned
10011110	Unassigned
01011110	Unassigned
11011110	Unassigned
00111110	Acknowledge
10111110	Unassigned control
01111110	Escape
11111110	Delete/Idle

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The Internet

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Introduction

Large companies and organisations, such as universities, connect all their computers together so the people using them can share each other's equipment or information, which at least saves them walking round offices –they just send whatever they need to over the cable.

If all those outfits shared their systems with each other, and allowed other people to join in as and when they wanted to, you would have the Internet, which is nothing more nor less than a giant network of computers, with some connected permanently, and some occasionally.

Your messages are split up into *packets* and sent over the phone line in the gaps between conversations, so they hitchhike around very cheaply. When they reach their destination, they are reassembled into the right order, which means you don't need to establish a long-distance connection from UK to, say, America – you can make a local call instead and your message's packets are relayed from computer to computer until they arrive at the other end (the IP part of the TCP/IP protocol does all this – the other bit, TCP, makes sure that what arrives is actually what was sent, amongst other things).

An *Intranet* is a private Internet, belonging to an organisation, which can be used in the same way over its own internal network.

People use the Internet for two reasons:

- **Keeping in touch** with people that have similar interests; you can send email through a local access point to its destination through various host computers. Note that a site "nearest" to you is actually one with the least number of *hops*, or hosts, in between, rather than being the least distance away. In some areas you can chat on-line (with IRC), and in others you can send video and voice signals.

- **Getting** information, from the storehouses of knowledge that are part of the system, typically by reading *Web pages* and using their hypertext links to jump from document to document, but you can also use it to chase updates and download files from companies who make computer equipment.

The biggest problem with both is *finding* anything (or anyone)! There is no phone book, but most people use search engines to do the job instead.

All this grew out of a system which linked four Universities in California to the University of Utah, way back in the sixties, which was designed to run if links were lost or added at random (as they would be in a nuclear war), so it assumes that no link is reliable; if one goes, the others take the strain. A site "nearest" to you is actually one with the least number of *hops*, or relaying computers, in between, rather than being the least distance away.

You don't join the Internet directly—you have to go through an *Internet Service Provider*, or ISP, which is a company with a permanent link to the Internet which they rent out to casual users. With your account, you will be given a *username* so people can send you messages. It may look like:

```
yourusername@isp.com
```

If you're a student, or part of an educational or government establishment, you most likely have an account already, and going through such organisations was originally the only way you could get on.

All computers participating in a network need a circuit card inside them to split your data up, and a cable for it all to be sent over. The average person at home, however, doesn't have these, but will have a modem for connecting to the telephone line. Windows can make your modem look like a network card so the other computers on the Internet can't tell the difference. To do this, it uses a program called **ppp**.

Each “network card” needs a separate identity, so they can be found, hence the use of those dotted names, which are converted to numbers, and issued at the point of entry to the Internet. They are recycled when you leave. Such numbers are known as *Dynamic* IP addresses, because they change all the time, as opposed to *Static* addresses which remain constant and are only used by systems with permanent connections.

As with anything else, the type of results you want determines what PC you use. You don't need a sophisticated one for basic access, as most of the Internet can only handle 7-bit ASCII anyway, but where you can get graphics and/or audio, you will need hardware to match, according to the normal performance requirements for any PC.

DOS/Unix experience is handy, because almost all of the Internet is based on it, in particular the TCP/IP protocol. The problem is that most programs used on PCs that use the Internet are not, and can't use the system directly. You therefore need a translation program as well, called a *Socket Service*, that can get IP packets to and from the Internet. A good one will be able to cope with more than one Internet application at the same time, which is handy when things slow down on one connection and you can get one with something else.

If you're using Windows 3.x, the most popular is *Trumpet Windsock* (*Wind*ows *Sock*et), and you can get more information from **www.trumpet.com.au/wsk/winsock.htm**.

You also need something to send packets over a serial link, such as SLIP (*Serial Link IP*) or PPP (*Point to Point Protocol*) - PPP is preferred. SLIP used to come with Unix, which is what the Internet started with, hence its initial popularity, but it couldn't cope with the many and varied ways of connecting with ISPs, and different scripts often had to be created for each one, or non-standard modifications were made, which confused everybody. Aside from being better anyway, PPP is at least standardised (ISDN may well use a modified version called MPPP). Windows '95 defaults to PPP, and can make a PPP connection without using a logon procedure.

One problem with TCP/IP and its initial creation for networks is the packet size, which defaults to 1500 bytes in Windows ‘95, which might be alright for Ethernet, but not for a dialup connection using SLIP or PPP, which works best with something a lot smaller.

The *Maximum Transmission Unit* (MTU) of a network is the largest packet size that can be transferred in a frame, including headers and trailers. It follows that if a too-large packet is sent, you get reduced performance as packets are fragmented and reassembled. In addition, when you start, smaller packets will be saved to fill the MTU size before being transmitted, slowing the build-up speed. The Internet standard is 576 bytes, but Windows ‘ 95 sets 1500 by default – ‘98 adjusts it automatically.

Here are some industry standard MTU sizes:

16 Mbit/sec Token Ring	17914
4 Mbit/sec Token Ring	4464
FDDI	4352
Ethernet	1500
802.3/802.2	1492
X.25	576

MTU (think of it as an envelope) is usually set in conjunction with:

- **MSS**, the *Maximumum Segment Size*, or letter inside the envelope, which must be smaller than MTU by at least 40 bytes, or the size of the headers and trailers (e.g. 536).

- **RWIN**, the TCP *R*eceive *WIN*dow, which is a global setting that determines how much data gets through at the receiving end (e.g. the size of the letterbox). It actually specifies the number of bytes a sender can transmit without receiving acknowledgements. If it is too large, more data is lost when a packet is lost or damaged. On the other hand, transmission will be very slow if it is too small. Its normal setting is 4x, but 6x (3216) MSS I have found to be better – you will have to experiment with this one. Whatever figure you use, it must be an even multiple of the MSS, or you will get fragmentation.

The settings are inside the Registry, and are not there by default; you have to put them specifically into the relevant section. Insert a **MaxMTU** key into:

```
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Class\NetTrans\0000
```

Assuming **0000** is your dialup connection (check all the others as well). Give it a value of 576. Also under:

```
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\VXD\MSTCP
```

alter the **DefaultRcvWindow** and **DefaultTTL** keys to what you want (see below). Try 2144 (536 x4) and 64 respectively (the defaults are 8192 and 32).

In **NT 4.0**, you need to run **regedt32.exe** and navigate to this key:

```
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Tcpip\Parameters
```

Add the value entry *MTU* of datatype *REG_DWORD* to the value of MTU you require (see rules above). Try 576.

Add the value entry *TcpWindowSize* of datatype *REG_DWORD* to the value of RWIN you require (see rules above). Try 2144 (4x) or 3216 (6x).

Add the value entry DefaultTTL of datatype *REG_DWORD* to the value of TTL you require in seconds (see rules above). TTL stands for *Time To Live*, or a flag in a frame that indicates to a router how long the packet has been on the network, or, in other words, the maximum time an IP packet may exist on the network without reaching its destination, so as to limit the number of routers it passes through. 64 seconds is suggested.

There are a number of other settings, too specialised to mention here, but information about them can be found in the Microsoft Knowledge Base. The above, however, should be enough to get you started and increase your surfing speeds.

As far as I know, a Mac is self-adjusting in this respect, as is NT5, sorry, Windows 2000.

Conversation

Conferencing is where groups of people can communicate on various topics without being hampered by such things as time or geography. First thought of by Richard Nixon, apparently, to enhance the productivity of the White House, but now offered by almost any online service.

One of the "services" using the Internet is *Usenet*, which is a system of distributed Bulletin Boards looking after discussion groups, or chatlines (thousands of them), who regularly gather, so to speak, to exchange views and comments. All members in a group will either share hard disk space set aside for them, or receive a regular newsletter based on the list of members (a *mailing list*). Usenet is not a separate Internet, but a collection of conferences that use the Internet for transport purposes.

Usenet Groups

Usenet has eight main categories:

Name	Activity
alt	alternative newsgroups; humour, controversy, etc.
comp	computer related.
news	announcements.
rec	recreational/hobbies.
sci	scientific.
soc	sociology.
talk	chatter and general debate.
mis	anything else.

Each is subdivided into its own specialist areas. You need *newsreader software* in order to participate.

(N)Etiquette

The Internet was originally used by professionals, or at least those who used it with serious intent. That doesn't mean to say they aren't helpful and courteous but, while ignorance can be understood, stupidity isn't (often). The point is that as they all came from similar backgrounds, and more often than not used Unix, they all thought and behaved in the same way, and life was in some way predictable. Indeed, you couldn't get on the Internet unless you were vouched for by somebody else.

As a result, many long-term users regard the net as their territory and can actually get quite grumpy with people who appear not to know what they are doing, although that often says a lot more about them than it does about you!

Common courtesy and common sense prevail, as it does with Bulletin Boards. If you join a factual discussion group, don't express opinions, and *vice versa*. Others may be more easy going, or even seem to be run by anarchists—there are rumours of users who are a PITA (Pain In The Neck) being sent virus-filled files as a lesson, which are known as *mail bombs*, and are actually more likely to be a *very* large file (a dictionary perhaps?) that will cost you a lot to download. If you're not sure about anything, look for a file containing the answers to FAQs (*Frequently Asked Questions*) first.

It helps other readers if, when you reply to a message, you include a bit from the one you are replying to (with a > at the beginning of each line), as many users delete messages as they go along to save disk space, and may not remember what you're talking about. Don't include all of the message, because it will just be something else to eat up disk space at the destination.

One 1K message sent to 10,000 users takes up 10 Mb of disk space somewhere, and bandwidth to get there, which is paid for by somebody, if not you. The replies generated may well take up 5 times that, particularly if you've said something controversial and others send *flames* in return (flames are messages of an incendiary nature).

Replies to replies will take up more, and so it goes on, resulting in large crashes due to congestion in the order of tens of megabytes per hour, on a fairly primitive system. One very good reason why advertising is not allowed!

Any advertising that does occur, BTW (By The Way), is called *spam*, which is the term for junk email. Stuff that nobody wants, but costs you in downloading time, which neatly describes advertising.

Remember that, although you might pay a fee to a service provider, the Internet is provided free by other people; you therefore have no rights! As there is no "police force", you are your own moderator and need to exercise your own self-discipline.

If you don't want to receive spam, you could email the following, using "Remove" as the subject:

```
remove@ntview.com
bizops@isp-inter.net
cancelbot@getback.hartley.on.ca
```

but don't hold your breath.

Smileys

There are aids to getting your message across, where you can't wave your hands to aid your communication. They come directly from your keyboard, and are inserted into your messages to lift the tone a bit. They are collectively known as *smileys* (look at them sideways):

Smiley	Meaning
:-)	Happy face.
:-(	Sad face.
;-)	Winking face.
:-{)	Happy face with moustache.

You could probably think of many others. Abbreviations are also used, for shorthand (BTW=*By The Way*, and there are more in the Glossary).

USE CAPITAL LETTERS WHEN YOU WANT TO SHOUT, but that's rude.

Addressing

The standard is:

```
name@service.somewhere.domain
```

For example:

```
frednurk@cix.compulink.co.uk
```

Names go from left to right, from the specific to the general. Each part is separated by a delimiter, commonly a full stop, or period, (the @ is only there for humans, and means "at"). The *host name* is the first part of an email address, and the *domain name* is the remainder, after @. The top level is at the end, such as **com** or **org**.

This is a readable form of IP addressing, which uses numbers less than 255 between the dots, described fully under TCP/IP in *Network Protocols*.

Your Own Domain Name

There are some benefits to having your own domain name. For one thing, it gives the impression that you're a larger company, and for another, your web address will likely be much shorter, for example:

```
www.mbnet.mb.ca/electrocution
```

can become:

```
www.electrocution.com
```

which looks a lot neater (if you don't have your own server, you will have to negotiate a *Virtual Web Server account* for the latter). These names are administered by *InterNIC*, who make sure that two people aren't using the same name, amongst other things, but it's important to remember that just because InterNIC approve your name for their purposes, it doesn't affect anything else, such as trade mark registration. InterNIC can be reached at:

```
www.internic.net
```

When you reach their web site, Click on *Registration Services*, then the *Template Guide*, which will give you a walk-through of the whole process. It's mostly self-explanatory, but…..

Before you start

You will need the addresses of a primary and secondary server to host your pages, which can be with the same ISP (yours will do). As you will also need to establish a *Domain Name Service* with your ISP for your proposed name (which may involve a fee), you may as well ask for these at the same time. Effectively, this is an alias, which converts all enquiries for the Domain Name you are going to register into your real email address with that ISP.

Once you've done that, go to the InterNIC site, go through the Template, which will require a name and address for billing and technical queries, and await results.

Provided no-one else has used your name, you will get the template you created back, which you must resend to **hostmaster@Internic.net**, in order to get an automatic reply with a tracking number that should be used in any further correspondence. At this stage, your request for a Domain name has not been processed, and you have to wait for another message with the confirmation, after you have replied to the acknowledgement.

The confirmation will then arrive from **domreg@internic.net**. If you registered before 1800 EST on a business day, your domain name will be included in that day's root server update at about 2200 (EST). Otherwise, it will be in there for the next business day.

Note: Registering a domain name does not confer any legal rights to it.

Lastly, you will get an invoice from **invoice@internic.net** for $100 US (don't worry, they take credit cards). A more comprehensive guide is at **http://rs.internic.net/help/domain.**

File Transfer

The *File Transfer Protocol* (FTP) allows file transfer between computers over the Internet. It comes as part of the TCP/IP protocol. **ftp** gets the files from where they live, places them on your access point from where you use normal downloading procedures to get them to your machine. The catch, therefore is two downloading sessions and bigger phone bills.

Binary files must be sent as text, because much equipment is pretty basic and can only cope with 7-bit ASCII. Conversion can be done with a *UUencoder*, with UUdecoding at the other end.

A UUencoded file will likely consist of several chunks of ASCII which need to be joined together, *using an ASCII text editor*. Each file will have a beginning and end statement, and you will have to delete the intermediate ones (between each section) to join the files properly.

The full file before UUdecoding should end up with two, one at the start and one at the end.

Here is a (very much abridged) sample UUencoded file:

```
section 1/2  file blond.jpg  [ Wincode v2.3 ]

begin 644 file.jpg

M_]C_X``02D9)1@`!`0```0`!``#__@!&0U)%
M+C`P("!2978Z(#,O,S`O.3,@(%%U86QI='D@
M,`K_VP!#``@&!@&!0@'!P)"0@*#!0-#`L+#!
M0(SB$?\`H5E6$A-XZ@=5-$39_"2JH@@FI=11
```

```
M=-V,4/9B^TCEM4Y)O1JILW(!J]?XV]U9Y.37
M!@D=:Z*XR(SQ7/WHR2*R1LS#N%XK,FR3DGYY

section 1/2  file file.jpg  [ Wincode v2.3 ]

section 2/2  file file.jpg  [ Wincode v2.3 ]

M_]C_X``02D9)1@`!`0```0`!``#__@!&0U)%
M+C`P("!2978Z(#,O,S`O.3,@(%%U86QI='D@
M,`K_VP!#``@&!@&!0@'!P)"0@*#!0-#`L+#!
M0(SB$?\`H5E6$A-XZ@=5-$39_"2JH@@FI=11
M=-V,4/9B^TCEM4Y)O1JILW(!J]?XV]U9Y.37
M!@D=:Z*XR(SQ7/WHR2*R1LS#N%XK,FR3DGYY
`
end
sum -r/size 44147/26814

section 2/2  file file.jpg  [ Wincode v2.3 ]
```

When you receive the file, all intermediate "section" lines (two above) should be removed and the code *joined with a text editor*. Alternatively, *Multipurpose Internet Mail Extensions* (MIME) can be used. MIME supersedes SMTP (see TCP/IP, in *Protocols*), which cannot handle anything more complex than text, or ASCII. You get unlimited line and message lengths (SMTP only allowed 1000 characters), formatting and multimedia, such as images, full-motion video and other binary elements.

FTP Commands

To move files from place to place, you use the *File Transfer Protocol*. Not all **ftp** commands are the same, but will be listed if you type 'help' or ? at the prompt. You might not need them if you can use and automated program such as **ws_ftp**. The following work on most systems, if you're using a terminal screen:

Command	Action
get	Copy a file from the remote computer to yours.
mget	Gets multiple files; * and ? are supported.
ls/dir	List the files in the current directory.
cd	Change directory.
binary	Switch to binary mode (for transferring binary files).
ascii	Switch to ascii mode (default).
bye	Logoff

The simplest way to initiate **ftp** is to give the command:

```
ftp system-name
```

at your service provider's system prompt, so you would use a terminal program, dial in, give your user id or password, etc and there should be a menu choice for *System Prompt*. The *system-name* is the remote system you are connecting to. After a short wait, you will be asked for your username. Taking the first example above:

```
FTP ftp.cso.uiuc.edu
```

If you don't have an account, some systems allow you to use the username *anonymous*, after which you are prompted for a password (use your real identity as the password). Other systems use *guest*, or similar. If you have problems, try using a dash (-) as the first character of your password; this will turn off continuation messages that may confuse your **ftp** client.
After that, you should receive the **ftp** prompt from the remote host on your screen:

```
ftp>
```

The interesting items will likely be in a directory called **/pub** (note the forward slash). To get to **pub**, use **cd/pub**, and you can use **dir** when you get there. Again, using the example above:

```
cd/doc/pcnet/compression
```

Before transferring non-text files, you need to type:

```
binary
```

although it doesn't hurt to transfer text files with the binary command in action. Next, type:

```
GET filename.ext
```

Unix is not restricted to eight letter file names (you can actually have up to 256), and file names can contain characters not allowed by DOS, so when retrieving a file to your machine you often have to rename it. They are also case sensitive, so if you want a **readme** file, you must type it like that. Similarly, you may also find directories and files with a mixture of caps/normal, so check that you're entering the text correctly.

You will see binary transfer is going on by a row of symbols (e.g. #) growing across the screen (every # means 1K). When finished, you will be back at the

```
ftp>
```

prompt. Get more files if you want, or type:

```
QUIT
```

Now you may have to get the files from your service provider on to your machine, so you'll have to refer to their instructions. Delete them afterwards as a matter of courtesy to save their disk space.

Telnet

This is used for logging in remotely, or to another computer you can control from your keyboard, assuming they give you permission. More specifically, it allows you to log on to another service from the one you are currently connected to, and use the new one as if you were connected to it directly, which is great if the one you eventually want is in Australia, since you will be connected at the local rate to the first one. Telnet, in other words, is a terminal emulation program which you can use to leap frog between routers. If you're away from home, you can use it to contact your computer.

You must know the name of the service you want to use, and be a member of it, but there may be a guest account. You would type:

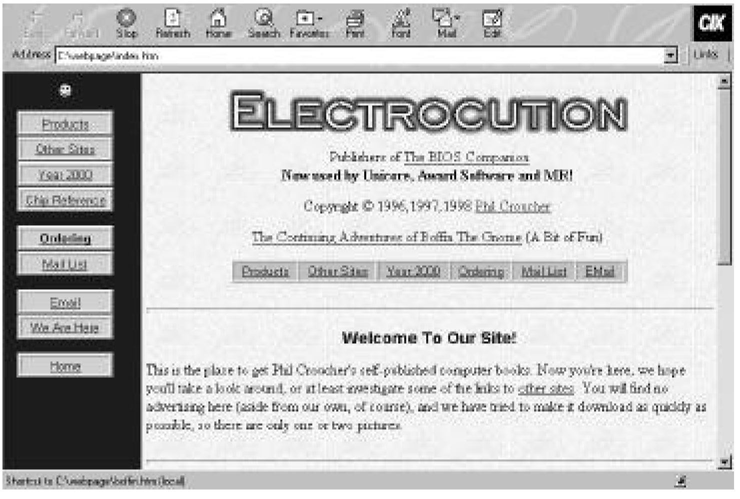
```
TELNET <host>
```

after which you would log on, give your password and get up to whatever they allow you to. VT100 emulation is expected, but you can use what you want, provided it's the same at both ends. **<host>** above is the IP address.

World Wide Web

This is a world wide system of hypertext-based documents created with HTML, or *HyperText Markup Language*, that uses the Internet as a means of transport. The documents are interlinked and cross-referenced. A typical one would be called a *Web Page*, and accessed with a *Web Browser,* that can accept the data stream from a *Web Server* (where the web page is stored), and convert it on the fly into something readable on your screen (it's transported in between as ASCII, and is a good example of Client/Server operation).

There are two main browsers, *Netscape Navigator* and Microsoft's *Internet Explorer*, which was originally based on *Mosaic*, the first one. Usage of either is much the same, and they look somewhat like this:



For email and Newsgroups, you can use *Internet Mail* and *Internet News*, respectively, which can be installed together with Internet Explorer. Netscape can handle mail and news internally. *Outlook Express* comes with Internet Explorer 4.0.

A web address looks like this:

```
http://www.destination.com
```

Our one, for example, is:

```
http://www.electrocution.com
```

The **http:** indicates what type of server the connection will be made to. **http** stands for *HyperText Transport Protocol*, or the method used to transport hypertext documents from place to place. You can only connect to an **http** site with a browser, which will issue **http get** commands on your behalf to get the files you want (you could use **ftp**, but **http** allows more information to be sent about the file that your browser can act on). Mostly, you can ignore the letters **http** when you type the address of a site you want – the browser will assume this automatically.

HTML

This is the language used to create documents for the World Wide Web. The initials stand for *HyperText Markup Language*, which uses tags to describe how the text the tag relates to appears when it's viewed, although you can't specify fonts, etc; this is left to browsers.

You can use background images, which can be **.gif** or **.jpg,** but be aware that they can be turned off at the browser end, to speed things up, which could ruin your layout. The trick is to keep things as basic as possible, to allow for more chance of the page being viewed as you want it on different platforms. In other words, don't have anything that requires a specific browser to view it. This is even more relevant as HTML, although in version 3 and in the public domain, is continually being "updated", or rather, added to, in the same way that the basic set of Hayes commands is affected by modem manufacturers.

As far as tags go, if you've ever used Ventura Publisher, you will know how the system works. If not, it's enough to know that Ventura uses text files with tags preceding each paragraph telling Ventura how to display it, so if you "tagged" another paragraph, that is, applied the same tag to it, that paragraph would acquire the same characteristics as the first. You would prepare tags for headings, indented paragraphs, etc.

With HTML, tags begin with < and end with >, and are used in pairs, the second including the forward slash (/), as shown for a heading (level 2):

```
<H2>Heading</H2>
```

or <I> for *Italics*, <B> for **Bold**. The forward slash ceases the previous command.

HTML Authoring Packages can do all this for you, which means that you lay it all out the way you want, as if you were using a wordprocessor, and the package will convert it into a text file with all the tags required, although this is sometimes not as flexible. Many people find it easier to create the file in a text editor and test it with a browser, which can be easily done with Windows' multitasking ability. Create the file in one window, with a text editor and load it into a browser in another. Make your changes in the original document, save them and watch the results when you press the browser’s Refresh button.

The document itself must start with a tag called <HTML>, so the browser interpreting it knows what it has to deal with (naturally, there is a </HTML> tag at the end of the document). There should he a heading section at the start, which is nothing to do with chapter headings and the like, but for tags like <TITLE>, which is text that appears in the title bar of its window, or which is added to a reader's bookmark list for quick access later on. For this reason, the title should be pithy and descriptive.

The next important tag is <BODY> (and </BODY>). Between the two is the main text of your document, or that which you wish people to read.

So, your basic document could look like:

```
<HTML>
<HEAD>
<TITLE>
      Pithy description
</TITLE>
</HEAD>
      <BODY>
      <H1>Heading</H1>
      <HR>
      Loads of text
      <P>
</BODY>
</HTML>
```

Some service providers only allow you to have one document, so you need a way of jumping from one part of it to another. This document shouldn't be too big, as people have to download it under varying circumstances; 45 K seems to work.

So, to highlight a word and jump somewhere else, you need the line:

```
<A HREF="#TITLE”>Title</A>
```

Don't forget the **#** (easy to do) as this is what tells HTML to jump to a section of the document looking like this:

```
<H1><A NAME="TITLE"></A>Title</H1>
```

which will be the beginning of a section (the Heading 1 tags are described below, but you can have what you want here, of course). The words after the **#** and after NAME *must be the same*, and the case matters.

Jumps to other documents or web locations are done like this:

```
<A HREF="http://www.org.com/doc.html">Organisation</A>
```

Don't forget to cancel out every tag when you've finished with it. <P> means the end of a paragraph (otherwise all your text will flow together), <HR> produces a horizontal rule across the screen, useful for creating sections within a document, and <H1> means Heading, Level 1. You will not be surprised to learn there are 5 more headings, of progressively lesser importance, to choose from. You can indent them for easier reading, as consecutive spaces (more than one) are ignored.

Incidentally, if you want to stop text flowing, but don't want a new paragraph (with a blank line in between the lines), use
 instead of <P>. If you need to include some sort of table without using a proportional font, use <PRE> and </PRE> around the text concerned, for something like Courier.

For a quick crash course, connect with:

```
http://www.??html/crashcourse
```

Frames

Frames allow you to split your screen up to show more than one web page at a time. The idea is that a link in one frame can load a page in another. A <FRAMESET> statement divides the screen into rows or columns:

```
<FRAMESET COLS="120,*" >
```

makes a 120 pixel-wide column on your screen, with another taking up whatever space is left (*). For rows:

```
<FRAMESET ROWS="30%,30%,*" >
```

should be self-explanatory. A <FRAME> statement is included in a <FRAMESET> statement, indented for clarity, and a listing from top to bottom converts to left and right (or top to bottom for rows) on the screen. You can use *nested frameset* statements to create weird layouts, such as rows within a column:

```
<FRAMESET COLS="10,*">
  <FRAMESET ROWS=75,*>
  <FRAME src="text.htm">
  <FRAME src="moretext.htm">
  </FRAMESET>
  <FRAME name="panel"
```

```
src="panelpage.htm">
</FRAMESET>
```

The keyword TARGET is used to load a page referenced by a link into a frame. Just add the word after a normal link:

```
<A HREF="text.htm" TARGET="panel">
```

to use the example on the previous page.

You will need to switch frames off when linking to other sites, because you don't know what the results will be, especially when load a frame based site into yours. Add:

```
TARGET="_top"
```

to the link.

Your Own Page

Many Service Providers allow you a personal home page for free, with up to a certain amount of disk space on their server, and may charge if you're a commercial organisation. You have to get your page on to their system, and you can use **ftp** to do it, bearing in mind that most systems, or browsers, allow only **ftp** from them to you. As I said before, all this can be automated with software, such as **ws_ftp**, but if you need to use a terminal screen, the quick and dirty way is to get to their system prompt and use the **rz** command (**receive zmodem**) to get the file from your machine to their server. Once you issue the command, their server will go into wait mode, waiting for you to send a file with the zmodem protocol (you'll have to check how your software does this).

Once it's there, you may have to change the file's name, possibly to **index.html** or some other default, typical with personal home pages, which relate to your user ID. You will notice straight away that the file extension has four characters, which is why you may have to rename a file once it has arrived.
The Unix command to do this is **mv**, or move:

```
mv DOC.HTM index.html
```

This changes the name of the **doc.htm** file to whatever you specify, in this case **index.html**. Notice the capital letters; your DOS filename will likely have been transmitted this way and Unix is case-sensitive, so don't forget to type it that way. It's easy to forget the names of the graphics files mentioned in your document as well.

A couple of final steps completes the job, involving the **chmod** command, which is Unix for changing file attributes, so that other people are allowed both to enter your directory and access the file containing your home page. This means you will have to go to the directory above yours and make your personal directory accessible to others with **chmod 755** (use the **cd** command to get there), then go back into it and work on the document, which typically will need:

```
chmod 644 filename.ext
```

which gives your file world read permissions.

chmod 711 gives your home directory executable permissions for all.

Some systems may be good enough to do this for you, at least for the directories, but leave you to do the document itself, as you may want to change it at some stage. This is done by uploading the file again, deleting the first version, renaming the new one and redoing the **chmod 644** command.

You must tell people where your web page is; for example, you could ask other authors to include a link to your page in theirs, or tell whoever's in charge of an information search-engine of its existence, maybe:

```
www.yahoo.com/bin/add
www.gold.net/gold/gold2.htm
www.cen.uiuc.edn/~banister/submit-it
net-happenings@is.internic.net
```

Lastly, you could try letting relevant newsgroups know.

Forms

Pages can have "application forms" which can be filled in and sent off to whoever owns the page; you need a script to do the automation.

Scripts

A script is a series of instructions that can be incorporated into a web page, acting just like a macro. It is based around CGI, or *Common Gateway Interface*, the word "common" meaning you don't have to learn more than one way of doing it if you use several programs. However, that is outside the scope of this book.

The script should be put in its own directory on the Web Server, and the directory's location placed in the URL. Some service providers don't allow you to run scripts.

VRML

You could call this 3D HTML, as the basic file type is ASCII, and is read with a browser on the PC concerned. The initials stand for *Virtual Reality Modelling Language*.

Agent Software

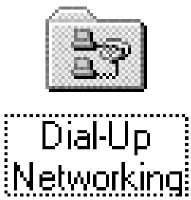
Agents work behind the scenes on the Web finding your data and getting it ready for presentation as you work. They can learn from your normal browsing pattern and tailor their behaviour accordingly. A good example is a spider, which roams around the Net on behalf of a search engine.

Spiders are *robot* programs, that is, automated, that jump from page to page over the web, to gather statistics for updating indexes. If you register your web site with a search engine, they will send a robot out to gather information about it. Over 2 million sites per day can be interrogated, so the indexes will be huge.

Anchored agents live either on a client or a server, running alongside a browser. Mobile agents, as the name implies, move around looking for information; they are self contained and execute whenever they arrive at a new destination.

Installing Dial Up Networking

All Internet software will use a program that allows the TCP/IP protocol to be used over the telephone system, where it ordinarily wouldn't work. For Windows '95, you will need to install *Dial Up Networking*. It may be there already – double click on the *My Computer* icon at the top left of your desktop screen and see if there is an icon like this:

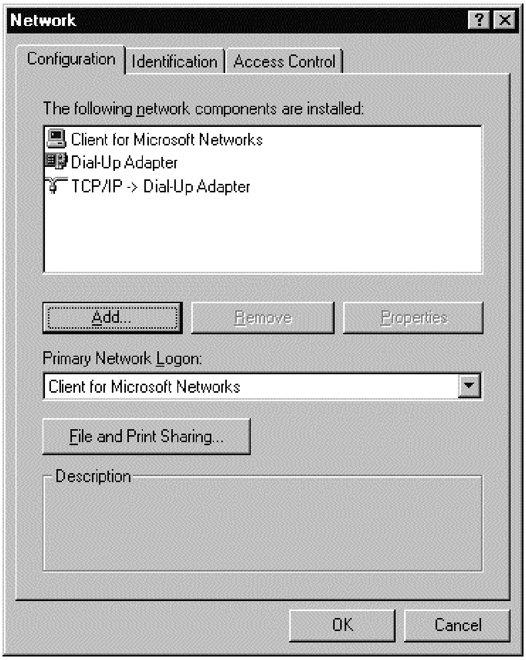


If not, go to *Settings* through the *Start Menu*, select *Control Panel* then double click on *Add/Remove Programs*. Click on the *Windows Setup* tab, click once on *Communications*, then the **Details...** button. Click once on the little box to the left of the words *Dial Up Networking* so you get a tick, then click on **OK**. You will be asked for certain Windows disks or the CD-ROM, and Windows may restart once or twice. While it's doing all that, collect together the following information:

Domain name servers	204.161.142.2 and 204.161.142.3
Default gateway	194.153.2.1
ISP telephone number	0181 276 6234
Subnet mask	255.255.255.0
Username	
Password	
Support phone number	0181 276 6251

The numbers above are examples only. When Windows restarts, you should be back in Control Panel, so open the *Network* icon, select **Add**, double-click *Client*, click on *Microsoft* in the *Manufacturers* list, and double-click *Client for Microsoft Networks* in the list of Network Clients.

If you don't have *Dial-Up Adapter* in the list of installed network components, select **Add** and double-click on *Protocol*. Click on *Microsoft* in the list of Manufacturers, then double-click on TCP/IP. You should end up with a screen looking like this:



Click on *TCP/IP* and select **Properties**. The next screen will have six tabs along the top:

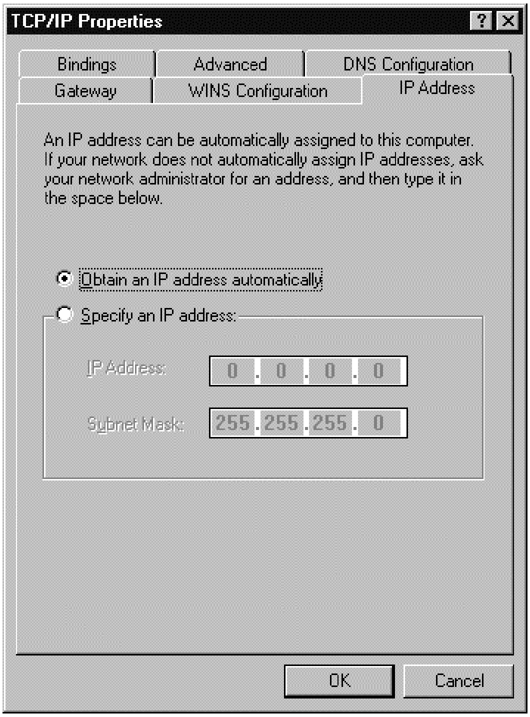
Select the *IP Address* tab, click once on the little circle next to the words *Obtain an IP address automatically*, so it becomes black.

Click on the *WINS Configuration* tab and ensure that *Disable WINS Resolution* is selected.

Click on the *Gateway* tab, enter the Gateway IP address, if you have one, then click **Add..**

Click on the *DNS Configuration* tab and select *Enable DNS*. In the *Host* field put your username (the letters before the @ sign).

In the Domain field enter the letters after the @ sign. In the *DNS Server Search Order* field, enter the DNS addresses (with all the dots in) and click **Add...** In the *Domain Suffix Search Order* box, enter the same as the *Domain* field and select **Add..**



You should not need to touch the *Advanced* or *Bindings* tabs. Click on **OK** to return to the Network dialogue, and click on **OK** to close it.

Restart Windows 95 if asked to do so.

Then go to the *Dial Up Networking* icon in *My Computer* to *Make a New Connection*. You will first of all have to type the name of the service (that is, the name that will appear under the icon), and select a modem from the drop-down list. Click on the **Configure...** button and select the *General* tab. Set the maximum speed of the modem to 115200, or the highest it will support.

Note: This speed can be higher than your modem's base speed, because compression will be used to pack more data down the telephone line. For example, if you have a 28,800 modem, you can set the connect *speed* to 57,600 or more.

Under the *Connection* tab, *Data bits* should be set to **8**, *Parity* to **None**, and *Stop bits* to **1**. Tick all three boxes under *Call Preferences*. Ignore the **Port Settings...** button.

Click on the **Advanced...** button and select *Use error control*, *Compress data*, *Use flow control* and *Hardware (RTS/CTS)*. *Modulation type* should be *Standard*. Click on **OK**.

On the next screen insert your ISP's telephone number and country you are dialling from. Select **Finish** on the next screen. Your new icon will appear in the *Dial Up Networking* folder. Next, right-click on the icon and select **Properties**.

Click the **Server Types** button, and select *PPP*, *Windows 95, Windows NT 3.5 Internet* as the *Type of Dial Up Server,* ensure that only TCP/IP is checked at the bottom of the screen and click the **TCP/IP Settings** button. In the next screen, check *Server Assigned IP Address* and *Specify Name Server Addresses*. In the latter, insert your ISP's *DNS server* details (the numbers with all the dots in), both primary and alternate.

After you click **OK**, your icon should reappear in the *Dial Up Networking* folder. Double click on it, and enter your User ID and password. Check *Save Password* to make the computer remember it. To save a few keystrokes, you can check *Connect to the Internet as needed* under the *Connection* tab through the *Internet* icon in *Control Panel*, so when you open your browser, the connection is made for you.

Now you can use any Internet software you might have, such as a browser.

Useful Web Sites

www.anonymiser.com	Browse without being identified.
www.junkbusters.com	Weeds out spam, proxy server
www.lpwa.com:8000/privacy.html	Roam without revealing identity
www.eflash.com	Purges spam
www.omron.com/oas/index.html	Squashes spam
www.roadblock.net	Checks for junk email
www.contactplus.com	Blocks junk email
www.luckman.com	Browse without cookies
www.rsa.com	Protect email with MIME

Networks +

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Introduction

Modern management needs information as fast as it can get it, and computers make it readily available. However, once a company gets its first one, it's not long before there are queues of people wanting to use it. The next step, of course, is to get one for each person in the queue, and to stop them wasting time by walking round the office to exchange floppy disks (and save money by making them share printers or programs), it's not long before the computers are joined together. This is a common scenario, and many businesses grow to need computer systems capable of accepting and processing information from several users at the same time—a typical example is an accounts system which is fed with data from several operators at different terminals all day.

They're beginning to be useful at home as well; many people find when they buy the latest PC that their previous one is worth so little they may as well keep it. At the very least, it can provide extra storage space and can even be used by another member of the family – with Windows 98 (2nd Edition) both machines can use the Internet at the same time by sharing the connection. Another good reason for having a small network is the lack of room for devices in the average PC. If you've got a lot of equipment to shoehorn into a machine, it can make sense to spread it over 2 PCs and join them together.

A network therefore provides convenience, cost-saving and security, because everything is in one place and can be backed up easily, although you have to make sure that the network's performance is at least equal to that of the machine where the work is being done – people will soon get fed up if they have to wait for data to come over the cable when it would be miles quicker off their local hard drive, so there is a danger that documents could out of sync as people keep their own versions. In the early days, NetWare's delivery was considerably quicker than anything the average workstation could come up with, but it's not the case now.

So, to sum up, a network exists where a number of PCs are connected together to share a resource, which could be a printer, or data on a hard disk. The reasons for doing so could be down to cost, productivity or both. In fact, the combined processing power of the PCs has made networks a viable alternative to minicomputers in many companies. The most distinguishing characteristic of a network is that data can enter or leave at any point and be processed at any workstation—any printer, for instance, should be useable from any wordprocessor by any person at any computer on the network.

If the network is to do with a single location (usually a building, or one or two floors in one), it is known as a *Local Area Network*, or LAN. A *Wide Area Network*, or WAN, on the other hand, can spread over city or international boundaries, and usually has a third party (such as a telephone company) involved in making it work. As some internal systems (like in a university) can cover several miles without anyone else's assistance, distance alone is no indication of whether a network is Local or Wide Area. the best example of a WAN is The Internet.

Somewhere in between is a *Metropolitan Area Network* (MAN), which operates over the area of a city, or within a 50km boundary, with fibreoptics at 100 Mbps. Nodes are connected over 2 km distances, but this appears to have been superseded by the Internet, according to the exam.

A Case In Point

A particular company had a minicomputer (the sort that occupied an air-conditioned room), inside which was all the details of the stock available; 20,000 items and increasing daily. When a manager wanted details of what was sold in a particular period in a particular area (a typical database query, in other words), he would have to create a report on a user-hostile terminal and request a printout, which would be delivered on a trolley in due course (does this sound familiar?).

The software on the minicomputer was sophisticated, but not able to do anything like desk top publishing, so the relevant information was *retyped* into a spreadsheet on a PC so it could be manipulated and printed in a readable form on a laser printer. Depending on the amount of information required, and how much on the printouts was actually relevant, this could take up to two days (and more), which was rather a lot in management time which could have been better spent making business decisions, or whatever managers do.

Then it was decided to connect a PC to the minicomputer directly, and the report was diverted from the printer to the hard disk on the PC over the cable joining the two. Special software was then used to automate the extraction of information that was previously typed in, and the results imported into the spreadsheet. Total time: Less than 5 minutes!

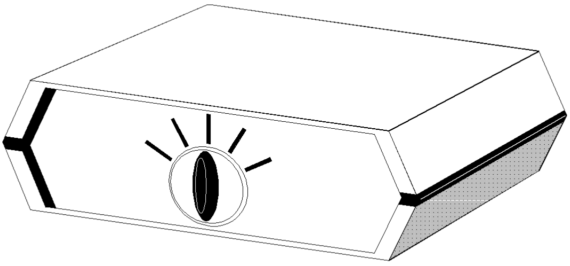
The expense of the equipment for networking was recouped inside three weeks, and this is by no means an isolated example.

The Alternatives

Having decided that Networking may be an answer for you, it may be worth looking at the alternatives before we proceed.

Switching Boxes

If all you need is some kind of connectivity for a simple application (such as sharing a printer), why not just use a simple switching box?



The computers have cables going to the box, as do the printers; the switches (electrical or mechanical) route the data between them. The mechanical type has to be turned to the right position before you print, whereas the electrical sort has some intelligence, in that it scans the lines for data and routes it accordingly. Note that you need a special switch box for Windows (just ask for one that is Windows-capable).

Officially, you need an approved HP one with an HP printer, because cheaper ones arc when switched (that is, they create small sparks).

Multi-user Systems

These typically consist of a central computer controlling *terminal screens*, which are connected to it by serial cable, and which can do no work by themselves. A terminal's job is to send information to the processor via the keyboard, and display information from it on the screen. A portion of the central memory is allocated to each terminal, as is processor time. Only *screen and keyboard information* is sent over the cabling.

There are several types of multiuser system, based on mainframes to PCs, with operating systems to match, such as VAX or Xenix, which are highly specialised and way ahead of the PC with respect to data handling, but with a shortage of readily available applications. Because such a lot of software has already been written for DOS, it's worth mentioning one operating system that can run DOS programs on terminals.

Multiuser DOS

Multiuser DOS is a DOS-compatible, multi-user, multi-tasking operating system designed by Digital Research for use on 386SX, 386 or 486-based PCs, in conjunction with terminals for additional users. *Multi-user* means that several people can use the system at the same time; *multi-tasking* means that they can do so with several applications at once. The product is now owned by Novell and administered by what they call *Master VARs*:

Intelligent Micro Software Ltd
3 Archipelago Business Park
Lyon Way
Frimley
Surrey GU16 5ER (01276) 686569

Concurrent Controls, Inc (CCI)
880 Dubuque Ave
South San Francisco
CA 94080 USA (415) 873 6240

Logan Industries
604 Mango Drive
Melbourne Beach
Florida 32951 USA (407) 984 1627

It is intended for small businesses and departments that already have a lot of DOS software and don't wish to spend more money on anything else, and don't want the cost of a full network. The latest versions can run multiple copies of Windows.

Benefits of Networking

Although, at first sight, a multi-user system has much to recommend it, the real problems arise from software. Disk intensive processes, like accounting or databases, are ideally suited, but there would be trouble with DTP or CAD, for example, because terminals cannot handle sophisticated graphics (they are connected by serial cable, which is unable cope with the information).

The real attraction of a multiuser system is to allow several people to work on large jobs, as with a busy accounting department with too many transactions for one person to handle (assuming you have no graphics requirement). It can also be simpler, and less costly to install and extend than a network. However, networks can do anything a multi-user system can, and are better at processor and screen intensive tasks, such as spreadsheets and graphics, which are run locally (*at the workstation*). Typical advantages of installing a network include:

- **Distributed Processing**. Programs are downloaded from a central point (i.e. the fileserver) and run *locally*. The network system does no processing, but merely provides storage space for data and programs. It's a false economy, therefore, to use underpowered workstations, because that's where people do their work. However, as mentioned before, people will soon complain if they have to get data from a central point over a slower system than their machine.

- **Security**. A workstation doesn't need disk drives, so you can:

  - Stop people stealing your data and/or software.
  - Keep viruses out.

Then again, terminals don't have disk drives, either. In addition, documents don't get out of synchronisation.

- **Backing Up**. Where data is centralised, backing up procedures are more convenient and can be more closely controlled.
- **Shared Resources**. Equipment that would normally be idle for long periods can be utilised more effectively when several people share its use.
- **Communication**. Electronic mail around the office:
  - Sending replies is easy, because the system remembers who sent the original message and sorts it out for you. Files can also be attached to messages—saves paper!
  - Appointments and schedules can be arranged between groups of people, so you can use the system like an alarm clock (resources, such as classrooms or overhead projectors, can be treated as people).

Types of Network

There are as many types of network as there are circumstances. Finding the most cost-effective to suit yours really depends on establishing your priorities—it's worth bearing in mind that the cheapest solution is not always the best. A cheap (as opposed to less expensive) solution often costs more in the long run, and not just in hardware.

John Ruskin must have been a network administrator, because he wrote something along the lines of:

> *"If you overpay for something, all you lose is a little money. If you underpay, however, you lose time and equipment as well, because you've often got to redo the whole job."*

The quote isn't exact, but that's what he meant!

Remember that the network itself isn't important—the information circulated round it is, together with the increase in productivity resulting from its successful manipulation. Company survival may depend on rapid reaction to market changes, and the network is therefore concerned with ensuring that the right information is accessed by the right people at the right time. What that means is that you should get a network to suit your circumstances rather than change the way you work because you got one cheap from down the road; if security from eavesdropping is most important to you, then swallow hard and fork out for fibreoptics!

Topologies

Once upon a time, there were distinct ways of laying networks out; namely *The Star*, *The Ring* and *The Bus*, but the boundaries are becoming less obvious as time goes on. There is another called a *Mesh*, where every computer is connected to the others, but this will only be done with mission-critical computers, such as servers, because it's messy and inconvenient, but highly fault tolerant. In many cases, a topology will be virtualised in the software contained in a switch, if only because remote (and normal) users effectively change it every time they log on, and this is the easiest way to cope. They sort of match their names, in that the star has a central device through which all communications must flow, the bus is just a long cable (known as a *trunk*, or *backbone*) to which all the stations are attached, and the ring consists of a loop of cable or fibre, but these are *physical* attributes, describing how the network is built.

The behaviour of data on it could actually be somewhat different, so the above topologies will be explained within the descriptions of the common types of network described later, each of which is associated with a particular topology, and which may use a mixture. For example, Token Ring uses a continuous circular connection, which, in practice, is actually included in a hub, so you end up with a Star Ring arrangement.

Organisation

Peer to Peer

This is where several computers of similar status share the operation of the network and the provision of services, with no one machine guaranteed to be on all the time. In other words, a machine can act as either a client or a server, as a result of which there is no centralised control, and everyone using the network (or at least owning part of its resources) has a measure of control over it, so security is a problem, even when you can put people into groups which cannot reach outside their sphere of influence.

More than about 10 machines on this type of network is too much, partly because there is no control, and it's easy to lose data (and hard to do backups), but also because the type of machine typically used in such a situation is not designed as a server and will lose performance when dealing with network traffic (a machine sharing a printer will typically need more memory and hard disk space than the others). You also have the problem of expandability.

However, they are cheap and easy to install, and the software is included with Windows.

Server-based

One computer, a server, deals with all the network requests by its clients. In a small network, that computer will likely handle files, printing and modems, but in larger setups, you could end up with a dedicated file server, print or communications server to cope with the workload. As you might expect, a print server will deal only with print requests, and a communications server will be full of modems which can be shared.

The term *client/server*, although commonly used in this situation, really refers to a way of reducing network traffic by changing the place at which program operation takes place. If you run a database on your workstation, not only would the program be loaded from the fileserver, but the data to be searched as well, so all your requests and their answers would be travelling over the cable to your computer, together with temporary files. However, if you moved the database to the server, so the searches take place there, only questions and answers would be transmitted.

Server-based networks are in a better position to grow, since they are very scaleable, particularly with Wide Area Networking. You get centralised control and convenience for people using it, though they take more resources in terms of maintenance and financial outlay.

Zero-Slot Networks

Computers on this type of network are joined through their serial or parallel ports, which is a very cheap way to connect (less than $25 or £25), and no expansion slots are taken up with interface cards (Little Big LAN can use them, though). As performance is not of the best, this is mainly for shared access to a printer with occasional file transfer or systematic backing up, or for any situation where non-permanent networking requirements exist.

Notes

Operating Systems

MS-DOS is not much good as it stands for networks, which is hardly surprising, as it was never designed for the job in the first place. As such, it provides limited support for file sharing, even though versions 3.0 and above have had commands added to them that allow more software to be used on networks, such as **attrib** (which can make files read-only for protection purposes), **lastdrive** (that makes more drive designations available) and **share** (which invokes file and record-locking capabilities).

DOS 3.3 added other networking facilities, such as **append** (similar to **path**, but for data files as well), **fastopen** (which caches filenames for quicker response) and **set handle** (which sets aside space for more open filenames).

Network operating systems emulate these facilities when required, and also allow you to share resources and grant *access rights* to them, as well as printing and communications in the background, if required. Provided the manufacturers stick to the OSI (or any other) model, any software should (theoretically) work with any hardware. The essential point about a *Network Operating System* (NOS) is that it can manage a group of computers, rather than just one, as DOS does.

Products

The following list is not conclusive, and inclusion here does not imply a recommendation, but, in truth, only a few products are used anyway.

Some are heavyweights, used where a LAN may be a cost-effective alternative to installing a minicomputer; in other words, an *enterprise wide* solution. As such, reliability, speed, security and high performance are more important considerations than cost, and will therefore be outside the scope of most readers of this book. It's worth knowing that they exist, though, as many humbler products use features obtained from them.

On the one hand, products can be divided into three groups:

- **Low cost,** with basic facilities, that is, email and resource sharing. They have minimum security and performance, and are peer-to-peer. Cabling is twisted pair, or coax, or even serial/parallel.
- **Medium price**; limited versions of high cost networks, which may need a dedicated server, or at least a powerful machine somewhere. Reasonable security and accounting.
- **High-end**. Do everything, but need equipment to match. May use SFT, disk mirroring, and the like.

On the other, they can be divided into two other groups:

- **Proprietary**, or *server based*, which ignore DOS and do things their own way, as a result of which they provide high performance and security, as everything is controlled centrally. Unfortunately, they can be inflexible for the same reason (it's difficult to share peripherals on individual workstations). The classic is NetWare.
- **DOS-based**, and typically *peer-to-peer*. These run DOS, then the networking software, so you may have to watch memory requirements. They don't make best use of the equipment available (see *NetWare*, below, for why), but faster processors, better DOS and cacheing have largely masked this. Designed for *workgroup computing*, where a group of people wish to communicate with each other all the time, but only occasionally outside. Examples are LanTastic! and Windows For Workgroups.

With both systems, any workstation generally needs two operating systems to connect – one for the machine itself, and one for the network, with a bit of software in between called a *redirector*, which decides which commands are for the local machine and which are for another on the network – all your application sees is more devices in File Mangler (there is also software called a *designator* that manages the drive letters, or, rather, the mapping, and substitutes as necessary). Although the exam might imply that, with Windows 9x, you only need one OS, Windows still technically runs on top of DOS, but it’s true to say that all you need is in one package.

Server Based Networks

Server-based networks have one or more servers, through which all the traffic from attached workstations goes. They can be Server/Client, which generally means one Server, which gets bigger as you add more users, and if you want to change servers, you have to log off the one you are currently attached to, as with NetWare, up to v3.12. *Domain-based* networks, such as NT, allow you to log in to a Domain only once, which may contain multiple servers, which can all be used, without having to log on and off all over the place.

NetWare

NetWare was originally developed around the Motorola 68000 processor. At that time, there was nothing like DOS (or even CP/M) that could be used with it, so Novell wrote something of their own from scratch, in C, so it was easily portable when PCs based on Intel's x86 chips became popular. However, since the idea was for multi-users to be multi-tasking, Novell had to bypass the PCs hardware if they wanted an effective fileserver, because the PC was designed for single user, single tasking applications.

NetWare is an operating system in its own right, which means that you don't need DOS or Unix to run it, even though they might be needed to load it (it will run as a task under OS/2). Version 2 works on 286s, 3 on 386s and above, as does 4. Version 4 is better than the others at multi-server networking and WAN connectivity.

It works with Ethernet, Token Ring and ARCNet, together with protocols such as IPX/SPX, NETBIOS, AFP, TCP/IP and FTP.

As NetWare talks directly to the PC's components, DOS is unable to use the hard disk drives, but Novell uses them more efficiently anyway. Refer to the *Instant NetWare* chapter for more information.

UNIX/Linux

Although not designed as an operating system, its use of TCP/IP makes it useful as a server. With the addition of *Samba*, a Unix/Linux box can join in with a Windows network and even look like and behave an NT server to clients, which will at least save thousands in licence fees.

VINES

A heavyweight, this one, in the same league as NetWare, and based on minicomputer procedures (VINES is short for *VI*rtual *NE*tworking *S*ystem). It really only comes alive on something like a 32-bit server, running on top of AT&T UNIX, although there is a variant for the SCO version. On a 386-based machine, it needs a minimum of 8 Mb RAM. It supports Ethernet, Token Ring and ARCNet, with protocols such as TCP/IP, Appletalk, IPX/SPX, NETBIOS and **ftp** (their own version).

It's always been good for Wide Area Networking, and is mentioned briefly because it's a good example of a powerful system, but really outside the scope of this book. Further details, if required, from Banyan Systems Inc.

LAN Manager

Runs on top of OS/2, Unix or Windows NT, all of which need lots of memory, hard disk space and horsepower to equal NetWare's performance (speed was never this product's strong point, but it is reliable). It's licensed to many OEM's, including DEC, HP, SCO and NCR.

It supports Ethernet, Token Ring and ARCNet, together with NETBEUI (preferred for smaller networks) and TCP/IP.

It uses "Domains", which are conceptually similar to workgroups, except that one machine keeps track of what's going on with shared security databases, which may be replicated for security purposes to *Backup Domain Controllers*. Each domain may contain several servers, and once you log into one domain, you are automatically logged in to each server in it, which saves you talking to each one individually.

NT Server

LAN Manager integrated with NT. Resource hungry. Adds RAID, Remote Access and support for Appletalk, Vines, DEC Pathworks, IBM LAN Server, SNA, WFW, NetWare and TCP/IP. The first version was 3.1, to match the Windows version numbers, then came 3.51, where the split into *Server* and *Workstation* versions came in, and after that NT 4.0, which uses the same front-end as Windows 9x. The latest incarnation is Windows 2000.

Tip: To save money on licences, use 3.51, as it came unlimited.

Many services are provided:

- **Messenger Service**, to monitor the network and provide pop-up messages.
- **Alerter Service**, to send notifications on behalf of the above.
- **Browser Service**, to list all available domain and workgroup servers.
- **Workstation Service** – the redirector.
- **Server service**, to provide access to network resources.

And for NetWare:

- **NWLink**. A clone of IPX/SPX
- **GSNW**, or *Gateway Services for NetWare*, for connections between the domain and a NetWare server. This is used to ensure that you can connect to NetWare through one point, which you can't always do with NetWare. The number of computers accessing the gateway affect performance.
- **CSNW**,or *Client Services for NetWare*. Part of the above, it allows NT clients to use the NetWare server.
- **FPNW**. *File and Print Service for NetWare* enables NetWare clients to use the NT server (purchased separately).
- **DSMN**, or *Directory Service Manager for NetWare*. Another add-on for integrating account information between the two systems.
- **Migration Tool for NetWare** is for converting NetWare account information to NT for people changing systems.

Peer to Peer

This is where several computers of similar status share the operation of the network and the provision of services, with no one machine guaranteed to be on all the time.

Windows For Workgroups

This naturally provides the best integration for Windows, but needs the proper hardware. It doesn't have much security, but it will live quite happily with more security oriented networks, such as NetWare, or LanTastic!. It provides email (for DOS clients as well, with extra software) and fax sharing.

You must designate the resources to be shared first (through *File Manager* for directories and files, and *Print Manager* for printers) on the relevant machines, *then* allocate them on the machines that require to use them (there are full installation instructions later).

Windows for Workgroups stems from LAN Manager, and at least has SMB/NETBEUI and TCP/IP in common as protocols with products such as Digital's *Pathworks*.

ARCNet users won't be able to use Novell networks simultaneously; when required, ARCNet packets are encapsulated in Ethernet ones and unwrapped at the destination, but NetWare cannot handle the unwrapping.

Warp Connect

Developed by IBM for their own OS/2 operating system. Makes a darn good server for Windows networks, with much better security.

Personal NetWare

Entry level system, which came with DR DOS when Novell bought it from Digital Research, and was intended as the first step on the migration path to the full product.

LANTastic!

A DOS-based LAN that is good for mixing older machines (even XTs) with newer ones and the inevitable Windows. Capable of operating very large networks indeed (up to 500 and more). Good security and Email. Can talk to Macs, and a Lantastic! server can be used as a bridge into a NetWare network.

The /AI version is *Adapter Independent*, which means you can use a selection of NICs, as opposed to Artisoft's own.

Appletalk

One convenience of Apple products is that networking ability (in the hardware at least) is built in, including printers. This is a baseband system which, in theory at least, can support up to 32 devices, further discussed under *Types of Network*.

Notes

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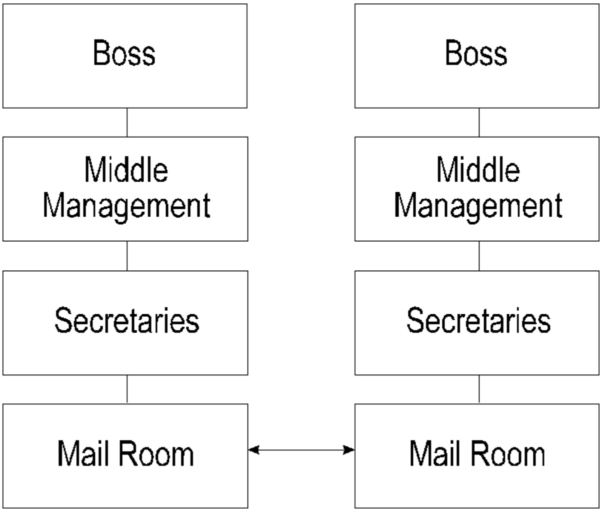
The OSI Model

In the early days, designs were kept behind the various manufacturers' doors so there was little likelihood of cross-connection between them. As a result, they were known as *closed systems*, and one drawback (to you, anyway) was that you were locked into buying one particular brand, regardless of whether it suited your needs or not. Naturally, manufacturers loved the idea, but in 1977 the *International Standards Organisation* (ISO) laid down standards which eventually (in 1983) defined *Open* (as opposed to closed) *Systems Interconnection*, otherwise known as OSI, so manufacturers would make sure that people could connect their systems to others easily.

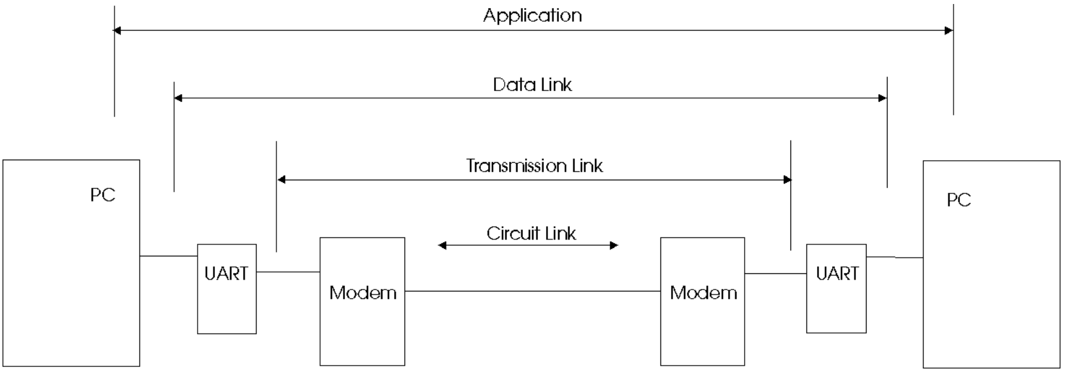


It did this by describing an architecture for data communications systems in very long words. It can be likened to a philosophy of communications, which ensures that interconnection is as easy as possible. It's based on the thinking that communications can be broken down into several layers, a bit like the chart that shows how each part of a company interacts with each other. You know what happens—although The Boss can talk to an equal in another company, tasks are delegated internally to executives, who sub-delegate down the line until you're the one that ends up doing everything, passing the results on to the other company where your opposite number passes them back up their system in the same way (just imagine the steps needed for one Boss to send a letter to the other one – there are many changes in modes of transport all through the process, which need not concern the people sending and receiving the messages, but only those responsible for each stage):

The problems arise when the Bosses are of different nationalities and don't speak the same language, so translators convert from one to the other.

Data communication is similar. At the top, the program in one computer talks to its equal in another (e.g. Boss to Boss). They agree on what they're going to send, how, when and at what speed. The data itself is passed down to the Mail Room (i.e. you) through several levels, having been suitably prepared and converted at each stage, whereupon it's sent along the chosen channel to the next machine and the reverse procedure happens.

Actually, data undergoes a lot of conversion on its way around any system; the signals for the characters on your screen, for example, are made to go down one wire from eight, and are also converted into sound for the telephone cable. Here is an example of a basic setup:



In the diagram above, you can view the processes as layers, with different jobs. The *Circuit Link* just moves modulated data from the *Transmission Link*, thus controlling the modems. The *Data Link* ensures that the data is the same at both ends (UARTs are gadgets that convert from parallel to serial, and are described later. They are actually inside your PC, although they're shown separately here).

Controlling the whole shooting match is the *Application Link*, which ensures that the applications get the data they want without being concerned how it gets there, even if it comes from a completely different system. Each level will have agreed methods of transmitting, levels of voltages, etc, laid down in standard documents that can be easily referred to if you want to make equipment that will fit in.

However, manufacturers are still allowed some discretion as to how they make things—if they had to stick to too rigid a standard, there would be no variety at all, and we all know how bad things can be when they're designed by committee, so there's a need to ensure (at the bottom levels at least) that everything is in a standard form. The translation of the character set (or alphabet) used in one system to that of the other is done through *interfaces*, which occupy the same position as the translators mentioned previously—that is, they convert from one language to another. They are not identifiable pieces of equipment, but *boundaries* to which pieces of equipment can be attached and across which communications take place.

On the other hand, the discussions between the systems (about what they're going to do, at equal levels) is done with equipment of similar standing and with like operating procedures—this is also known as using *protocol*, and further described at the end of this chapter.

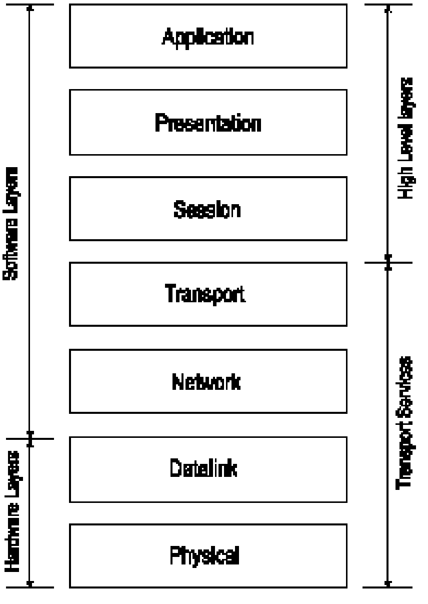
Just to try and make the above clearer—an interface is a connection point between two *dissimilar* pieces of equipment that may use different character sets and possibly different ways of transmitting.

A protocol, on the other hand, is a set of rules (usually in software) that regulate the interactions between machines or processes that are *alike* or have similar functions.

The Model

The *OSI model* is a conceptual map of the communication process, the idea being that if you had a piece of equipment, you could find its location on the model and deduce its relationship to everything else. Also, it allows manufacturers to focus on their product in its particular slot, in the same way that application programs are written to DOS level, saving programmers the trouble of writing too much code. This is particularly helpful when rewriting protocols, as you only have to replace certain modules rather than whole programs. Aside from the fact that the OSI model was created after many of its standards were already widely used, it was originally designed for telephony, with data networking features added much later, hence the sometimes clumsy layout, as a result of which many data networking systems don't use it!

There are seven layers, which get more sophisticated as you go upwards, where the information begins to resemble human language, as opposed to bits at the bottom. Each layer provides services for the one above, and requests them from the one below. There is a defined interface between them which is made as flexible as possible so designers can vary things within the standard; in other words, the standard defines *what* is to be done, designers worry about *how*. The real world isn't so tidy, though, and (just to make things awkward) it is possible that some levels may be mixed in many products, or even missed out in others. Some popular protocols, like TCP/IP, don't fit in at all, but have corresponding layers with similar functions.



As information is passed down the first system, control information, in the shape of headers, is added, so the corresponding layer on the other side can read it and know what to do with it, thus a data package gets bigger and smaller as it moves downwards and upwards, respectively.

In General

The first two are known collectively as the *hardware layers*, as they provide the solid foundation on which everything else is built (equipment layout, transmission speeds, etc).

The next five tend to relate to systems software and procedures, so you could compare them to the first two in the same way that white collar workers are related to blue collar ones in a factory. They are more theoretical than technical, and enable you to think of things in more abstract terms, like referring to devices by name rather than numbers, so software can be written that will run on any communications installation built in accordance with the standards, as long as the name is used.

Because the bottom four levels relate to the manipulation of data, they are also sometimes (as a group) referred to as the *transport services*; as such they would include "middle management", whose job it is to see that the orders of Those On High are carried out. Similarly, the remaining levels are also called the *high-level layers* and concern themselves with the meaning of the data transported—rather like laying down management policy in a company. You will likely only deal with the bottom three with any regularity.

None of the layers defined below are not programs, but support layers where any software can operate in safety – in other words, the layer doesn't do any work.

The Physical Layer

Starting at the bottom, the physical layer concerns itself with the mechanical aspects of converting bits into signals for different media, and *vice versa*, and the type of connections between devices, including the mechanical and electrical aspects (that is, connectors, cabling, voltages and their functions). As it also covers equipment using the telephone system, a good example is V.24, mentioned later, which defines what voltages appear at what times and for how long on what pins of particular connectors. However, it doesn't define where the voltages come from—that's left up to the manufacturers.

It's the most error-prone area, and the unit of exchange is the *bit* (you will find more about physical links later). If you think in terms of a railway, it's the same as the tracks, so in a PC, it would include the cables. No headers are added at this level to packets as they are passed along, and it's the only layer that talks directly to its opposite number in other networks. This is where you would find a repeater.

The Data-link Layer

This layer deals with how data is encoded and decoded around the system, including framing, addressing and checking for errors in messages. It puts the data received from the Physical Layer into frames for onward transmission to the Network Layer, above. The unit of exchange here is the *frame*, which is a group of data bits, with a *flag* at each end to indicate their start and finish. This is where you would find a bridge, since it inspects and acts upon the 6-byte MAC addresses hardwired into each Network Interface Card. The first 3 bytes indicate the manufacturer and the last 3 the card itself. In the days when cards were being copied in the Far East, it was not uncommon for several cards on a network to have the same MAC address and total confusion.

The Data Link layer has been expanded by the IEEE 802 committee (see below) into:

- **Media Access Control** (MAC), which specifies the protocol and shared access for multiple network cards, and thus access to the network at the proper time, such as when no other station is transmitting (Ethernet) or when permission is gained (Token Ring) - check out 802.3, 802.4, 802.5 and 802.12. Frames are assembled here, and packaged in.......

- The **Logical Link Control**, which puts them into the right format for the Network layer above and is responsible for maintaining links between computers. It defines the use of Service Access Points (SAPs), which other computers can use to transfer information to the upper OSI layers. It also involves error correction and flow control. Refer to 802.1 and 802.2.

The Network Layer

This is the third one up, controlling the movement of data from point to point, sometimes including verification of receipt, etc, but this may also be done by level 2. Messages are addressed for delivery here, with logical network names and addresses translated into physical ones, and decisions made on how to route transmissions between computers further away than a single link. This layer is sometimes not used in a simple system when it's obvious where the messages go. The unit of exchange is the *packet*.

Whereas a telephone system expects a permanent connection, packet systems don't, as data transmission (as opposed to voice) can accept a slight delay here and there, due to the lack of need for immediate feedback. Messages are split into parts (packets) that are left to get to their destination as and when they can and reassembled in the right order when they get there. *Packet Switching* is the basis behind most data communications systems and is extensively used on networks, all looked at more thoroughly later on. NetWare's IPX lives here, together with IP, and routers, which make intelligent decisions as to where to send packets.

The Transport Layer

Level 4 does the same job as level 1, the Physical Layer, but between larger entities, such as networks, where the unit of exchange would be the *message* (where you and I exist, were we to be passengers on the system).

It lays down how connections can be made or unmade, giving the higher layers the impression of permanent transmission channels without them worrying about the details of how the data they are sending gets around. It is responsible for transmitting data *unchanged*, which is probably why SPX is located at this level (it's a more reliable version of IPX). In doing this, it will create virtual circuits on a network. TCP is found here as well, as is UDP.

The Session Layer

A connection between applications is known as a *session*, which is kept open as long as data is being transmitted.

The Session Layer concerns itself with organising the flow of data between devices and the management of resources—it gives the most cost-effective use of everything by controlling who may send at any time (sometimes done by issuing tokens, or "tickets to ride" on the system), and is the first layer where applications really begin to use names rather than numbers to keep in touch with everything. In short, transmission sessions are established, managed and terminated here. Sessions may use simplex, half-duplex or full-duplex communication.

The Presentation Layer

Common translation facilities for interpreting information and the methods by which application software can enter the network; in other words, how an application's data is converted for transmission across a network and back again, to be read by the application layer of another system (it may involve compression). As it deals with how things are presented, all the pretty pictures, menus and special effects on screen belong here, as does DOS or Windows on a PC. Here is where you would find a network redirector.

The Application Layer

The highest level, where you, or your programs, interact with everything that the OSI model defines (Boss level). It's where delivery of the communication product is finally made, including the program that gives you control without having to understand the whole process or, in other words, the application on a PC, which is the only place to which this layer provides services. In short, this is where applications gain network access. As with the Physical Layer, no headers are added at this level to packets as they are passed along.

Problems

The model was created after man of the protocols that are supposed to be aligned with it were already in wide use. As a result, a product "conforming to OSI standards" isn't necessarily compatible with anything else on the same level.

NIC Drivers

The driver is the software that sits between the Operating System and the card, and it sits at the MAC layer. Monolithic drivers (i.e. single pieces of software that handle everything) have to cope with all functions of OSI - at one time, the network software had to be generated for each workstation, the classic example being NetWare and the days when every technician had a copy of the **wsgen** disk in the toolkit. The idea behind the two (incompatible) standards defined below is to allow multiple drivers to be used for the same card so you can bind more than one protocol stack to it.

NDIS

Developed by Microsoft and IBM (or is it 3Com? It depends on the book you read, but who cares anyway), this provides one piece of software for each level. Those that handle protocols are called "protocol" drivers, and those that deal with the hardware are called *Media Access Control* (MAC) drivers.

NDIS drivers provide a modular approach to the mix of software, hardware and circumstances found on the average network, and lie between the network card and the protocol stack. For example, they permit multiple protocols on the same machine, typically through one network card, or *vice versa*.

protocol.ini is the initialization file for NDIS drivers.

ODI

The *Open Datalink Interface* is Novell's and Apple's implementation of NDIS. There are three layers to the ODI software in a client, in the order of loading (see the Protocols chapter, next, for more information):

- **LSL**, or the *Link Support Layer*.
- Multiple *Link Interface Driver* (**MLID**)
- *Protocol Stack*, like **ipxodi.exe** (or **tcpip.exe**). **Ipxodi** is split into:
    - **IPX**.
    - **SPX**, or *Sequenced Packet eXchange*.
    - **RDR** (*Remote Diagnostics Responder*)

You can leave out **spx** and **rdr** to save memory, always bearing in mind that some NetWare utilities, such as **rconsole** and **netver** might need them. Thus:

```
IPXODI D loads IPX+SPX only (saves 4K).
IPXODI A loads IPX only (saves 8K).
```

ipxodi should be version 2.0 or greater, to support packet burst ODI, SFT III checksums and the NetWare Management Responder. It can be loaded high.

Just add U to each of the above to unload them (e.g. **lsl u**).

After they have loaded, you need the *redirector software*, which would be **netx** for IPX or **telnet** for TCPIP, so DOS (or whatever) can access remote disks and printers which it cannot ordinarily do. With NetWare 4, the equivalent for **netx** is **vlm**, described in the *Instant NetWare* chapter.

IEEE 802

The *Institute of Electrical and Electronic Engineers* laid down electrical specifications concerning the physical components of a network, and how they transmit information over the cable. They therefore concern to the Physical and Data Link Layers of the ISO model (802 stands for February 1980).

Here are the numbers of the specifications and what they relate to:

802.1	Internetworking
802.2	Logical Link Control (LLC)
802.3	CSMA/CD (i.e. Ethernet)
802.4	Token Bus
802.5	Token Ring
802.6	Metropolitan Area Networks (MANs)
802.7	Broadband Technical Advisory Group
802.8	Fibre Optic Technical Advisory Group
802.9	Integrated Voice and Data
802.10	Network Security
802.11	Wireless Networks
802.12	Demand Priority, 100BaseVG-AnyLAN

Protocols

If you were telephoning somebody you didn't know very well, you might start by checking you've got the right number, then the right person, before saying what you need. You would also know that you're not supposed to talk to them until they've finished talking to you.

In computer terms, you would be establishing a *protocol*, or specific rules to follow when communicating (red tape, if you like). Each protocol consists of a *character set* (or alphabet, as used in a language) and specifies the order and priorities of the way information is exchanged using it; protocols may also have ways of detecting and correcting errors.

In other words, protocols sort out message and error handling, and status checking—even TTY (Teletype) had one. Only devices using the same protocol can communicate directly with each other, and some of those available are fully explained below. The use of protocols comes under all levels of the OSI model, and the processes range from the simplicity of sending an extra bit tacked on the end of each character, to the complexity required for satellite communications, which will incorporate methods of dealing with delays.

In fact, a suite of protocols will be used (typically three) relating to the Network, Transport and Application levels of OSI, and the combination is known as a *protocol stack* – a good example is TCP/IP. There may often be a different protocol for each layer. Protocols for phone lines are somewhat different, and are discussed in the *Communications* chapter.

Network DDP, IP, IPX (or NWLink) and NETBEUI. These route information, handle addressing and check for errors.

Transport ATP, NBP, NETBIOS, SPX, TCP. Ensure that data is sent to the correct destination without errors.

Application AFP, FTP, NCP, SMTP, SNMP. provide support for applications to talk to each other.

Once you have your protocol, you must bind it to your network card, and you can do this more than once. The order in which they are bound determines which protocol is used first.
The most important ones are TCP/IP, IPX/SPX, SNA, DECNet and Appletalk. The exam includes the OSI Model, but it’s not quite correct – the OSI model establishes support layers in which software can operate, and is not software of itself.

Appletalk

The stack consists of:

- **AppleShare**, for Application Layer Services
- **AFP**, or *AppleTalk File Protocol*, for remote file management and file sharing
- **ATP**, or *AppleTalk Translation Protocol*, for connections at the Transport Layer
- **DDP**, or *Delivery Datagram Protocol* - packet transmissions at the Network Layer

DECNet

From Digital Equipment. It is routable and can use TCP/IP and OSI.

HDLC

High Level Data Link Control. Used on IBM’s SDLC.

IPX/SPX

IPX, or Internetwork Packet eXchange, is a protocol devised by Novell (based on the *Xerox Network System*, or XNS) for its networks to handle network packet routing at the Network layer; it directs messages to the network card and out over the "Ether", in most cases the cable joining the computers.

NetWare workstations communicate directly with IPX, but although a "best effort" is made to get data packets to their destination, delivery is not guaranteed (like IP). The hit rate is over 98%, but if you're running something like a financial database, even this isn't good enough (see SPX). Neither is it routable.

Messages are sent as packets which include source and destination addresses, so it is *connectionless*, like IP, in that it doesn't care where the packet is coming from or going to. Its sister protocol, SPX, on the other hand, is *connection oriented*, like TCP, which means that a complete connection is setup and monitored from start to finish, with error checking, both ways. A 48-bit node address is used because IPX was originally based on Ethernet.

Originally, IPX had to be generated specifically for each workstation's network card, with a program called **wsgen** (that replaced **shgen**), but it's now part of the ODI (*Open Datalink Interface*) architecture, which is much more flexible. Rather than being specific to a network card, the programs read a text file, **net.cfg**, when loading, so they know what settings to use.

ODI sets up a virtual (i.e. pretend) network card for each protocol you use, and routes each one's data through the one physical card in your PC (up to 4 protocols per card). You can do it the other way, too, for better throughput.

LSL

The *Link Support Layer* is what switches between the protocols loaded, by virtualising the NIC and providing a standard interface for them all to talk to. Load this low, in base memory, although it will work when loaded high. It covers part of the data link layer and the lower part of the network layer of the OSI model. When MLID or protocol stacks (see below) are loaded, they register information about themselves with **lsl**, and each is assigned a logical number. **lsl** cannot be exchanged between operating systems.

MLID

The *Multiple Link Interface Driver* sits in the MAC sublayer of DataLink. This is the one that drives the network card, such as **ne2000.com**.

SPX

Sequenced Packet eXchange, which guarantees packet delivery (unlike IPX) by ensuring they arrive in the right order, and their receipt is acknowledged. Control packets are sent first to establish a connection (or virtual circuit) and a connection ID issued, which is used in all transmissions. The connection is broken afterwards with a control packet. SPX uses timeouts to decide when they need to be retransmitted. To verify a session is still active, probe packets are sent, the frequency of which can be set in **net.cfg**. Only really for **pserver**, **rprinter** or **rconsole**.

RIP

Routing Information Protocol. Just something that counts the hops needed to reach a destination, then chooses the route with the fewest, regardless of speed.

NLSP

NetWare Link Services Protocol. This sits at the Network layer and is a routing protocol that takes into account link speed and network traffic as well as the hop count, so is more efficient than RIP.

NCP

NetWare Core Protocol. Spans the top four layers of OSI and handles file and print services.

SAP

Service Access Protocol. Used on servers at the Application layer to broadcast services available.

LU 6.2

Developed by IBM for the mainframe market. As a result, everyone uses TCP/IP.

NETBEUI

Or *NETBIOS Extended User Interface*. NETBIOS on steroids, I suppose, and standard for Windows for Workgroups, etc, but is not routeable, because it doesn't contain network layer address information. It is a transport protocol meant to support NETBIOS, introduced by IBM as a mechanism for passing **netbios** packets over Token Ring and Ethernet. Best to have available rather than the default in large systems, although it is the fastest available for NT.

NETBIOS

Designed by Sytek, and licensed by IBM as its own product, **netbios** is a standard interface for networking PCs on stand-alone networks, with the same function as the System BIOS inside the PC, but for networking. It allows PCs to communicate without needing a file server – in other words, applications can talk directly to the network through it (Microsoft later added features to DOS that allowed disk I/O to be redirected to **netbios**, and hence to the network). The file-sharing protocol eventually became known as SMB and later CIFS.

Many network operating systems have their own way of doing the same job, but can emulate NETBIOS if a program expects to use it. Just don't expect to use any old thing with the same name that comes bundled with the software you want to use. It used to be the default, but is now old hat. It evolved into NETBEUI (see above).

NFS

Network File System. developed by Sun for sharing files and drives. Similar to a combination of **telnet** and **ftp**, also at the Application layer.

NWLink

Microsoft's version of IPX/SPX, which is routeable, and supports NETBIOS names.

SMB

Server Message Block. A Microsoft protocol at the Presentation layer, used between the server and redirector.

SNA

Systems Network Architecture, used with IBM mainframes and AS/400s, containing APPC (*Advanced Peer-to-Peer Communications*) and APPN (*Advanced Peer-to-Peer Networking*). the former supports the Transport and Network layers, while the latter handles the Network and Transport layers.

TCP/IP

Transmission Control Protocol (TCP) and *Internet Protocol* (IP – see below) were used over the original Internet and its predecessors, and still are, but can also be used over Ethernet. It is routeable and can be fully duplexed. Although only those two are mentioned in the name, TCP/IP is a suite of layered protocols and others are included:

- **snmp**. *Simple Network Management Protocol*. Used for managing network devices.
- **smtp**. *Simple Mail Transfer Protocol*. Handles basic Email, mailing lists, return receipts and forwarding at the Application layer.
- **ftp**. *File Transfer Protocol*. This is more sophisticated, consisting of FTP Server and FTP Client software, and is able to send files under user command, at the Application layer. Remember to specify binary or ASCII.
- **telnet**. Provides remote logon capabilities (e.g. terminal emulation) at the Application layer, so a TCP/IP equipped PC can act as a terminal over a network to a Unix machine.

In fact, the five primary protocols (exam question, this) are TCP, UDP, IP, ICMP and ARP. Additional protocols are POP3, SMTP, FTP, SNMP and HTTP.

TCP is needed at each end of a connection, therefore running at the Transport layer, using checksums to see that packets are delivered error-free, together with flow control. It breaks down packets into smaller pieces (datagrams) and places them in sequence in an IP envelope, which then takes over. A datagram is simply a packet with just enough information to get to its destination independently of any others, since the original idea was to ensure that data could reach its destination if parts of the network became unavailable.

The origin and destination points of the transmitting computers are called *ports*, which are allocated by convention to various functions, such as:

FTP	21
HTTP	80
POP3	110
SMTP	25
TELNET	21 & 205

The addresses, or port numbers, are unique, 16-bit numerical and range between 0-32,767. The protocol you use automatically chooses the correct port. Note that, although the terms *port* and *socket* are used interchangeably, technically, a port number identifies the application associated with the data, while a socket is a combination of a port number and IP address.

TCP/IP is the most widely available and used set of protocols in its field, despite being only loosely compatible with OSI. Alternative software incorporating it includes *PC-NFS*, from SunSelect, and *PC/TCP* from FTP software, good for connectivity to Unix. Other manufacturers, such as Microsoft, add their own functionality. Changes to the specification are suggested and promulgated through RFCs (*Requests For Comment*), which are referenced by a specific number, such as RFC 1880, *Internet Official Protocol Standards*, which is where you will find a complete index of current RFCs concerning Internet Standards. The numbers are issued sequentially and are never reused.

TCP gives each machine a specific address, which takes the form of four groups of three numbers separated by dots (*nnn.nnn.nnn.nnn*, for example). The first parts refer to the network, and the remainder to the specific machine, which gives TCP/IP its routability (see *Internet Layer*, below).

NFS, by the way, is the *Network Filing System*, which allows remote systems to act as file servers to dissimilar equipment, originally developed by Sun Microsystems as a way of making a file system on a remote host look as if it's part of the local file system, so it should look transparent. TCP/IP is normally loaded first (under Unix, anyway).

Talking of OSI, TCP/IP has four layers to contend with:

Application

Contains user programs, including **telnet**, **ftp**, etc, described above. It corresponds to the Application, Session and Presentation layers of the OSI model. For Microsoft's version of TCP/IP, two different APIs operate here, Windows Sockets and NETBIOS, through the *Transport Driver Interface* (TDI), which allows programmers to create components for the without having direct knowledge of the underlying concepts concerning the Transport Layer underneath. It is specific to Microsoft's implementation of TCP/IP.

Windows Sockets

Commonly called *WinSock*, this is a networking API that makes communication easier between different TCP/IP applications and protocol stacks. It is based on the original sockets API created for BSD Unix.

NETBIOS Interface

This is used by Windows for its naming service. The *Universal Naming Convention* refers to a share with a double backslash to signify the server and a single for the directory, as in:

```
\\server\directory
```

NETBIOS names are sorted out through either broadcast queries to the local network or with a *NETBIOS Name Server* (NBNS). WINS (*Windows Internet Name Service*) is Microsoft's version, and is used by most large networks for name resolution.

NETBIOS Datagram Services send and receive information through broadcasts and connectionless datagrams. *NETBIOS Session Services*, on the other hand, use a reliable two-way connection called a Session.

Transport

Corresponds to the same layer of OSI, and checks data integrity during transmission, including establishing and maintaining end-to-end communication between two hosts, using a virtual circuit.

This layer contains the TCP and UDP protocols. TCP is reliable, but UDP isn't, which is probably why it's called *Unreliable Datagram Protocol*. However, it is cheaper to implement. Each protocol has a number, which is transmitted with the data package. The IP layer examines this and delivers it to the one required.

Each application or service that runs over TCP/IP is also given a 16-bit *port number* so the process receiving the data (e.g. **telnet**) can be identified. Port numbers below 126 are for services that can be found anywhere. Those between 256-1024 are Unix-specific, such as **rlogin**. Port numbers are not unique, but the combination of port number and protocol is. Some services run all the time, being started up automatically with TCP/IP. However, most are started as and when needed.

The combination of IP address and port number is called a *socket*, but sometimes the term is used instead of *port*. Default, or well-known ports (that is, the first 1023) are assigned to server-side protocols by the *Internet Assigned Number Authority* (IANA), while those on the client side are assigned dynamically by the application initiating communication.

A *three-way handshake* is used to establish communications. First, TCP on the client sends a packet specifying the port number it wishes to use, and its *Initial Sequence Number* (ISN). The Server responds with a packet containing its own ISN and an acknowledgement of the client's, plus 1. The client then acknowledges the Server's ISN, plus 1 Each TCP packet contains a source and destination TCP port number, a sequence number for messages that get broken up and a checksum for error checking. There is also an acknowledgement number that tells the sending machine which parts of its message have arrived, and a Sliding Windows metric for flow control. Sliding Window describes the variable sizes of the sending and receiving TCP buffers and the mechanism that controls how full they get. This window size can be increased or decreased to alter performance.

Internet Layer

Corresponds to the Network Layer of the OSI model, and where IP lives. It provides a 32-bit addressing scheme so each machine can be uniquely identified, and is where connections are made between two Internet addresses, which includes routing packets. However, present IP addressing and procedures are becoming inadequate. 128-bit addresses are to be used rather than 32-bit, and improved security is coming, amongst others, in the shape of IPv6 (the present standard is Ipv4).

There are two types of node on a TCP/IP network, those that send or receive data, and those that direct it based on its address – host or router nodes, respectively. Each machine needs a unique address for identification, and this is composed of 4 8-bit numbers separated by dots, with a range of 0-255 each. The resulting 32-bit number separates into two parts; a *network* and *host* number, with a *subnet mask* being used to find out which is which. When you join the Internet, for example, you become a subnet of your ISP, that is, a smaller portion of a larger network. Because there only a certain number of addresses available to the various classes of network address you can have (see below), particularly in the last octet, where you can only have 256, they have to be split up even further.

A subnet mask is a 32-bit number applied to a network address, actually added to it, indicating which bits must match.

DNS

There is a way of translating these numbers into names that make sense to humans. A *Domain Name Server* is a machine that does this for you or, rather, a database on a machine that keeps track of IP addresses and their associated names. DNS actually stands for *Domain Name Service*. When you issue an address, your web browser queries one of the Domain Name Servers in your TCP/IP settings, which refers to its database. If its not there, the domain hierarchy is searched for other Domain Servers, which are queried in turn (each Domain must have 2 Domain Name Servers).

Unfortunately, DNS cannot communicate directly with DHCP, which is another part of the equation that assigns the addresses in the first place. DHCP stands for *Dynamic Host Configuration Protocol*, which is an application that assigns IP addresses on the fly, or when a device actually connects to the network. Once that device has finished with the connection the address can be used again, which helps when IP addresses are in short supply, and also saves you, as administrator, remembering who has what address and constant reconfiguration when you move machines to different networks, as you would with a portable, or change your ISP. The joining device has some software called a *DHCP client* which issues the request for an address and the DHCP server is supposed to respond with an address it can use. The server can issue a *static address*, which is permanent, or a temporary one, called a *lease address*. However, if your network doesn't change very much, or doesn't need much admin, you won't need it.

A DHCP client computer needs an address of 0.0.0.0 or its network connection set to obtain an IP address automatically. All messages are transported in UDP datagrams, and the client initiates the process by sending messages to port 67 on the DHCP server, which sends them back to port 68 on the client.

So, a network needs a range of permanent IP addresses, split into network and host portions, the latter identifying each machine. The numbers between 1-254 are used (numbers with all ones and zeros are reserved). There are five types of address, with only Class A, B or C in common use or supported by NT at least, and the first byte of each address determines the class.

You cannot use numbers beginning with 127, because that is reserved for loopback functions.

IP addresses are actually assigned by InterNIC, but you can use anything you like for your own network, provided it doesn't have a connection to the Internet, or you don't use anything that's already reserved, such as:

- Addresses beginning with 127 and 224-255, which are used for testing (127 is actually used for loopbacks).
- Class A, B and C addresses (see below)

Class A networks

```
net.host.host.host
```

The first byte's range (e.g. net) is 1-127, so there aren't many of these; they would have to be big (and senior) networks to justify the number. Specific nodes are identified with the last three bytes. 0 designates the network itself, so there are only 126 Class A networks.

Class B networks

```
net.net.host.host
```

Network addresses here range from 128-191, used for large organisations, since the numbers are still restricted. The last two bytes are used to identify specific nodes.

Class C networks

```
net.net.net.host
```

As you can imagine, covers small networks, with few hosts. The range is 192-223, with the last byte used to identify nodes. Class C networks are split into subnets with a *subnet mask*, so machines on one cable can be seen separately if they use different masks. A subnet is equal to a range of numbers in binary which have all top bits the same.

Class D networks

Selected hosts can be addressed.

Class E networks

Reserved.

Subnetting

This is used to break an IP address into *meaningful* and *manageable* groups, as when splitting networks into smaller entities – you might want to reduce traffic or provide a little security. Two PCs with the same subnet mask are on the same network. Effectively, therefore, a subnet splits an IP address into three groups rather than two, where the centre two octets identify the subnet. Subnets are connected together with routers, which use the subnet to decide which is which, using binary addition. The octets of the *subnet mask* it uses to do this are either all 1 or all 0s, so:

```
11111111.11111111.11111111.00000000
```

is the equivalent of 255.255.255.0. The 1s must be to the left and the zeros the right. The number of octets with zeros in determines tells you how many hosts (PCs) you can have inside the subnetwork:

Class	Default	Networks	Hosts
A	255.0.0.0	126	16777216
B	255.255.0.0	16484	65534
C	255.255.255.0	2097152	254

The default masks indicate that the net ID is to be found in the first, first and second, and first, second and third octets, repectively.

If you add the IP address to the subnet mask, the result is the subnet address, used by the router in its decision-making. Since 1+1 in binary equals 1, and 1+1 and 0+0 = 0, any places in the original address with a 1 translate straight through, and octets in the subnet mask with all zeros convert the equivalent in the IP address to zeros as well:

```
00110001.00110011.00111100.11000010
11111111.11111111.11111111.00000000

00110001.00110011.00111100.00000000
```

To create a subnet mask, which can be given to all pCs that are supposed to be on the same network, find out how many network IDs you need, add a bit for later expansion, then find the number of Host IDs per subnet. The goal is to find a subnet mask that covers both bases. Assuming a Class B address, to find out how many bits of the third octet you need to use, decide how many subnets you want, convert that number to binary (use the Windows calculator), and add the bits. 14, for example, would translate to 1110, which is 4 bits used up of the third octet, giving you a subnet mask of 255.255.255.248.

The network IDs resulting from this come from the number of bits used in the third octet, for example, 001 would give you 32, so your PC's network address now looks like:

```
204.112.32
```

assuming you started with 204.112. The host ID can start with the last digit of the fourth octet and use anything not previously used in the third, actually up to 1 less than the subnet ID of the next subnet. You can't use 000 or 255, though, which are reserved for broadcasts.

Sharing Connections with ICS

If you can get a permanent IP address for the Internet, you can set up a server for use with any ISP, meaning that other people can find you without having to search for your address every time. The trouble with having such a portable address is that you have to keep routers informed of your position as they rely on this information being kept in large tables of addresses to which they refer in the course of doing their job. Addresses are therefore grouped or divided to make administration easier. This means that routers need lots of memory and processing power to cope just with routine chores – people having portable addresses would make this worse, so you won't get this facility under normal circumstances.

A dynamic address is issued by the ISP when you log on. They get these numbers from a higher authority to be used as they see fit. There are three main organisations that oversee this, who work in conjunction with the *Internet Assigned Numbers Authority* in the USA. Dynamic numbers allow fewer lines to be used and hence less expense.

This is where DHCP comes in. It is based on **bootp**, an earlier protocol with less features. Not only does it allow ISPs to share numbers, but it allows LANs to share Internet connections, as is done with Windows '98's (and 2000's) ICS, which acts as a DHCP server to computers on a network using numbers in the range of 192.168.x.x, which is reserved for private networks (actually it's part of IE 5 – you can see if you have it available through the *Windows Setup* tab in *Add/Remove Programs* in Control Panel. Look under Internet tools). It also obtains a single number from the ISP and shares it with the rest of the network, using routing software to do so, acting as an underpowered Proxy Server. The sharing computer is given an IP address of 192.168.0.1, and the rest range between 2 and 153.

A computer acts as a DHCP client if its IP address is set to 0.0.0.0 or if Windows' DUN is set up to look for a server-assigned IP address.

Before you use ICS, you naturally must have all machines on the network able to see the machine the modem is attached to, so they are essentially sharing a modem. They must also have TCP/IP installed, though not necessarily set up, as you can do this with a disk later. Assuming ICS has been installed (see above), run the *Internet Connection Sharing Wizard* (ICSW) from IE5's *Tools* menu. Click the *Connections* tab, then the *Sharing* button in the LAN section, the *Enable Internet Sharing Option*, then *OK*.

You will be asked the type of connection to be shared, *Dial-Up* or *High Speed*. Choose the latter for cable modems.

After you've answered questions about the settings, you will have the chance to create a disk that will configure the rest of the machines on the network.

Naturally, after all that, you will have to reboot everything.

Network Layer

This is responsible for encapsulating data into frames and the mapping of IP addresses to physical addresses. Its nature depends on the hardware (whether Ethernet, SLIP, etc). It is the equivalent of the Data Link and Physical layers of the OSI model.

Physical

Not strictly defined by TCP/IP, since existing methods (such as RS232) are used. It provides the network interface for transmission of data. The most common system here is Ethernet; each interface card in each PC has a unique 48-bit Ethernet address coded into it, which can't be. The address is in two halves, consisting of the manufacturer's code and the card address.

As data is passed down the TCP/IP layers, extra data (or headers) are added to the data, that identifies the protocols and addresses.

ARP

The only unique method of identifying a machine is through its 48-bit address, so you must find a way of extracting this from an Internet address, which is 32-bit. *Address Resolution Protocol* does this, by keeping a table of matching MAC and IP addresses. A broadcast packet is sent, which asks each machine for its Internet address; one machine will respond and return its local Ethernet address.

RARP

Reverse Address Resolution Protocol. Does the same thing as ARP, but in reverse.

IP

This works with TCP (see above), but at the Network layer, and lives in all pieces of equipment, acting as a relay, moving data between them; it takes care of packet addressing so a routing computer knows where to send to. It doesn't care where the messages are coming from or going to, so is very resilient to network changes on the run. All systems on the Internet must have unique IP addresses (with all the dots in), and there is an organisation called InterNIC that is responsible for issuing them. They can be contacted on **http://rs.internic.net**. Most of us, however, get them from *Internet Providers*, who have already negotiated with InterNIC for blocks of addresses.

IP can be inefficient under certain circumstances, hence the invention of SLIP, now superseded by PPP, which has error correction and ways of controlling connections. It can also encapsulate datagrams, which allows better transportation across different equipment. PPP is internally built on HDLC.

UDP

Unreliable Datagram Protocol. A datagram is a packet with minimum overhead, hence the name. It works at the Application layer.

XNS

Xerox Network System, created by Xerox for Ethernet networks, and is the basis for IPX. Old and slow.

X.25

X.25 has been the most widely used system for packet switching since 1976, but is slowly becoming obsolete due to improvements in technology; the restrictions it was designed to overcome (noise on analogue lines) are getting fewer, and it's relatively slow anyway. Having said that, networks based on it are easy to set up and service. It requires data to be split up into small packets labelled with origination and destination addresses, and sequencing information (so you know the order). The data itself can be of any form, from Baudot to Binary, but is usually stuff like credit card information these days. It works at Physical and network layers.

An X.25 network is often represented by a cloud, because of the mysterious ways a packet could be routed to its destination (all you really need to know is that a packet goes in, and comes out somewhere). In other words, a *virtual circuit* (VC) is established; stations know of a connection between them, but not the details of it. Switched VCS are set up as and when needed, and Permanent VCS are established in advance. Most users of X.25 require equipment to conform to a standard called GOSIP, or *Government OSI Profile* (those initials again).

The physical connections conform to X.21, and are often replaced with RS232. A lot of error checking is performed, so there is some overhead. The error checking is there because X.25 was originally devised for terminal use, and they cannot do it themselves. X.25 can be used privately, around the company or over leased lines, but it's more commonly used with the PSS.......

The Packet Switch Stream

This is a data network which closely resembles a telephone system, but is meant for computers and other equipment that speak digitally. It's the same principle as the Internet, which uses TCP/IP, but is still a *Packet Switched Network* that provides full duplex communications between connected terminals using standardised data packets. The PSS, however, is based directly on X.25 and related recommendations.

You can link into the PSS at a local "node" (one of which can be found in each major city), so a call across the Atlantic need cost no more than a local one, but you still have to be a subscriber. To get on to it (apart from handing over your cash), you need equipment capable of sending and receiving packets. You can either create packets yourself with a *packet terminal*, a specialised computer that gets on to the system through a dedicated Dataline, or dial the system directly with your own computer and let them do it. If you do dial the system, it will be to a *packet assembler/dissassembler* (PAD), which is essentially a protocol converter which takes a stream of data and sandwiches it between packet information that is discarded when the message arrives at its destination. PADs, therefore, accept your incoming data (automatically selecting speed, parity, etc) and send it along the PSS according to whichever X-protocol it uses.. At the other end, they change everything round again, still doing automatic error detection.

You will need a *Network User Identity* (NUI) and, for the other end, a *Network User Address* (NUA), which is similar to an IP address, to which you send your data, which will probably require a password. The NUA format is different from PSN to PSN - on Datapac, for example, you must include 0's, but on Sprintnet, they are not necessary. Also, BT's Tymnet uses 6 digits rather than 8. The standard format is:

```
PDDDDXXXXXXXXSS,MMMMMMMMMM
```

Where:

> **P** is the pre-DNIC digit, commonly a 0, but is 1 on Datapac. It must be included for PSNs other than your own, so it's not needed within your own network.
>
> **D** is the DNIC, also known as the DCC (*Data Country Code*), 4 digits that make sure that each NUA is unique, so it's only used for calling internationally. It can correspond directly with telephone area codes
>
> **X** is the NUA.
>
> **S** is the LCN (*Logical Channel Number)*, for subaddressing, which is used to connect to a system in the same NUA. Subaddresses are used occasionally for security.
>
> **M** is the Mnemonic

NUIs can get stolen and used to call NUAs around the world, so the real owner gets the bill.

Each country's *Packet Switched Data Network* (PSDN) is identified with a DNIC, or *Data Network Identification Code*. Both the NUI and NUA consist of 12 digits, of which the first 3 refer to the country, the 4th to the service within that country (that is, the four together make the DNIC) and the rest to the terminal itself. The DNIC must precede everything else.

A set of wide area protocols used in packet-switching networks, created originally to connect remote terminals to mainframes. Used mainly in Europe.

Routable Protocols

You will be expected to know some of these:

- AppleTalk
- DECNet
- SPX
- PPP
- SLIP
- PPTP

- SMB
- SNA
- TCP/IP
- UDP
- X.25
- XNS

Network Management Systems

Network Management Systems (NMS) are software based, and are typically run from a workstation, where interrogations can be made of devices like bridges, hubs, routers, workstations or servers, regardless of manufacturer, which must be running *agent software*, that replies to questioning, including:

- **SNMP** *Simple Network Management Protocol* (actually, it's the protocol that's simple, which actually means that it doesn't impose stress). It's part of TCP/IP and uses *Protocol Data Units* as messages between local and remote clients. It was designed in the mid-1980s as a quick fix till something better came along.

  There are 5 types of PDU; 2 for reading terminal data, 2 for setting terminals and 1 for monitoring network events (the *trap*). SNMP itself has 3 elements; *MIB*, *Managers* and *Agents*. An agent runs on each node and is often included with terminal software, but share ware ones are available. The Manager on the host, or machine the network is managed from, polls agents for information.

  Be sure to use version 2, as it addresses some security problems; version 1 had virtually none, so anyone could get hold of management information. SNMP depends on devices providing information to *Management Information Base* (MIB) standard, also to version 2, which allows better data retrieval.

- **CMIP**. *Common Management Information Protocol*, which comes from ISO, was supposed to replace SNMP, with an unlimited development budget from governments and large corporations, but failed to catch on, principally because it takes up 10 times the system resources. It's basically similar to SNMP, but has 11 PDUs and needs less work from an administrator to monitor the network.

- **NETVIEW**, from IBM.

- **PolyCenter**, from DEC.

Notes

Network Components

Hardware

Server(s)

A server is a PC that provides services to other computers on a network; a *file server* shares files on its hard disk, an application server shares programs as well, a *print server* shares its printers and a *communications server* will share modems (as will a *proxy server*, which is essentially the same thing but used for connections to the Internet, and which allows several PCs to share one IP address). In small networks, say up to about 4 clients, one PC with a single CPU and up to 64 Mb RAM is quite capable of doing the lot, and it follows that the more work a server has to do, the more powerful it needs to be, without losing sight of the fact that, in a network, your work is done *at the Client* (see below), and the server provides the facilities, so it has to handle input and output, rather than run programs, except in certain specialised situations not relevant here.

Windows' networking is *peer to peer*, where all computers are supposed to be equal and share in the admin, so there is officially no identifiable server, but, in practice, one is more equal than the others, and often called the Server as a form of shorthand, even though it can still do wordprocessing and the rest.

Because they are the central point of the network, severs should be secure from interference, and are often locked away in secure rooms with keyboards and monitors (and floppy drives) hidden. They are more expensive, because they need staff, who need training, and suitable equipment, because, even with one server, you need some sort of backup to take over when it stops working (it will).

In a server, concentrate on hard disk, Memory, I/O bus, Network Interface Card and CPU, in that order. Otherwise, the same performance parameters apply as for any PC. In a server, the memory is used for cacheing.

UNC Pathnames

The *Universal Naming Convention* is a standard way to access network resources, as opposed to just using drive letters. It takes the form of:

```
\\servername\sharename
```

NETBIOS only allows 15 characters in names, with a 16th used by the system.

Client(s)

The computer(s) that use the resources of the server, or, in other words, where you do your work, sometimes known as *workstations*, but this term is often confused with high-powered graphics computers. It's a mistake to have these underpowered; many people put their money into the Server instead, forgetting that its main role is just to shuffle data round the network.

Repeaters

Signals can only go so far down a cable before they weaken, so there is a maximum length for a network cable before you need to start thinking about boosting them (185m for Ethernet). On a digital network, the repeater keeps the signal strength up and allows you to increase the span of a network by giving you more segments. A segment is a part of a network where nothing is private, so repeaters block no signals, but broadcast and amplify them (as do hubs, below). The equivalent for an analogue network is the amplifier.

Everything a repeater hears on one segment is repeated on another, with the singular disadvantage that traffic is doubled on either side of it. Networks being joined together with repeaters must use the same media access scheme, protocol, etc (e.g. Token Ring to Token Ring), but may use different media types, such as coax to UTP. As they have no addressing or translation facility, they are no good for easing congestion. They are found on the Physical layer.

Too many repeaters will slow down synchronisation, and will produce similar effects to having cabling that is too long—in fact, the maximum cable lengths are more to do with timing than attenuation, although this is important.

Class 1 repeaters are limited to 1 per segment, and you must connect multiple ones together through an Ethernet switch. You can have 2 per segment with Class 2. There is a repeater in every Token Ring Card.

A collection of segments, by the way, is called a *sub-net*, *network*, *area* or *neighbourhood*, depending on who writes the software.

Hubs

A hub sits in the middle of a system and connects the PCs together, providing a central point which can be controlled from the front panel, or a workstation, with suitable management software; it could even be an expansion card in a PC. Not all networks need one, but a hub is required if you use either ARCNet (see later) or Ethernet with UTP cabling (see even later), and you might see one disguised as an MAU in a Token Ring network. You can also use hubs as repeaters, which is what they evolved from in the first place, as any frame that enters a hub gets sent to every other port, with the exception of multi-segment hubs, mentioned below.

There are several types of hub, *switching* and *stacking* to name but two, and you will also come across *active* and *passive* hubs, that have a power supply built in, or not, as the case may be, to regenerate signals as they pass through. A *managed* hub will have its own CPU, together with the ability to split itself internally into several sub-units, which can be used collectively to increase bandwidth; this gives you more functionality out of one item of equipment, as you can only have so many hubs in a segment (The 5-4-3 rule, which means 5 segments in a series, 4 repeaters and 3 segments with nodes in them). *In-band* hub management enables you to control the hub from any PC on the network, but if the network fails you lose the connection. *Out-of-band* management means joining the PC directly to the hub.

Port Switching hubs can split up your network without needing multiple hubs, but they are not switches (see below). They include multiple segments inside them, say, 4 or 8. Some can monitor traffic and switch nodes between segments automatically with traffic demand, known as *load balancing*. A useful feature in a hub is the ability to switch the transmit/receive pins on the end socket, so you can either use it for a PC or a daisychain a link to another hub. One advantage is, if a cable breaks, you only lose that connection.

Ethernet can only have a certain number of hubs within a segment; *Stackable hubs* can combine internal connections to simulate a larger device, so you don't use up the hub limit within a segment.

Cheap hubs are half-duplex only. Also, many hubs cannot cope with a machine running full-duplex with other devices running at half, which will likely disappear off the network (that’s why you get a lot of collision lights).

Bridges

These block the flow of unnecessary information by splitting up segments, increasing performance by making better use of bandwidth, since you can't normally increase a network's capacity (that is, make the cables wider), but have to make the best use of what you've got (see *Switched Ethernet*), so bridges reduce congestion, not traffic, by inspecting the MAC address of a packet and allowing it to pass, or not, to the right areas. In other words, it acts like a sentry. The decision is based on the 48-bit address burned into every network interface card, which means that ARCNet cards can’t be bridged as they don't have one. Neither can anything to do with WANs, so bridges are restricted to LANs, connecting at Layer 2, DataLink. Bridges can improve performance when they perform error checking, as they reduce the chances of retransmissions.

Bridges are also used for troubleshooting purposes, where work can be done in isolation without affecting other machines. Another reason for splitting things up is security.

As bridges don't understand packets, they are protocol independent, in the same way that telephones are language-independent, but you must ensure they use the same *addressing scheme* (such as 802.3 for Ethernet or 802.5 for Token-Ring). Otherwise, it doesn't matter what protocols or software are used—it is entirely possible to run Novell's IPX, 3Com's XNS, DECNet and TCP/IP across a bridge all at the same time. All the bridge does is look at the NIC address and allow packets to pass.

An *internal bridge* lives inside a file server as a second interface card. An *external bridge* could be a workstation. To make one, take an old PC (floppy-only will do), put 2 network interface cards in it and run bridging software, having connected each card in the PC to a LAN.

When they connect two LANs directly, internal and external bridges are known as *local*. Where something like a telephone or satellite link is used between them, they become *remote*.

Aside from being remote or local, bridges can come in enhanced versions; some LANs have more than one bridging connection between them, which can give a circular feel to the system. This might happen because multiple paths might exist on the network, created as the network became more complex, or deliberately as a backup mechanism. In such circumstances, a non-intelligent bridge can circulate information around endlessly, which stops other stations sending because the cables are full of a *broadcast storm*. *Spanning tree bridges* can detect and break such circles by turning off certain links, which can be restored later if any of the other links become inoperative. In other words, packets are prevented from being duplicated when they take multiple routes round a system. They are multiport, and isolate traffic into smaller data streams. If they can build up a list of all NIC addresses in the segments they are attached to, and add them automatically if they are new, they are known as *learning bridges* as well. Such a bridge will also inspect the packet’s destination address and forward it, on all ports if the destination is not in its database. It will also be able to filter packets.

A *load balancing bridge* will also allow two or more ports of a bridge to send data to the same destination, sharing the data between the ports and combining their capacity.

A *source routing bridge* can make limited routing decisions based on data placed in a packet by its originator. Such bridges monitor each other and assume primary or secondary roles. A client will send a message through primary bridges only, but a server will return a message through every possible route, with a maximum of 7 hops. The client selects the best route to the server based on the returned messages, so the source eventually picks its own route, hence source routing. This method came from Token Ring.

Bridges are now being superseded by switches, which do a similar job, with less features, but perform better. Use a bridge when the protocol, such as NETBEUI, can’t be routed.

Switches

Switches are hubs that create dedicated circuits internally on the fly, so connections are only made between computers that actually need to talk to each other, like a telephone system, which switches voice transmissions. This provides more security, but not necessarily performance, although that is the intention.

You can have a *store-and-forward* switch, which will analyze each packet in a buffer before letting it pass. A *cut-through* switch just routes a packet to its destination with no error checking, or reads the addresses and forwards it before the rest has arrived. A *fragment free* switch reads the first 64 bytes to check the packet's length, which sorts out the *runts*, or small packets that arise from collisions, that are less than the minimum 64 bytes in size.

Unfortunately, broadcast frames, that are transmitted just to keep the network alive, have to be transmitted to every port, which doesn’t happen with switching, so this offers no better performance than basic hubs.

Routing switches provide a solution to the situation where a frame has to pass from one virtual LAN to another, where both would exist inside a switch and you also need a router to do the transfer, which just reduces speed and adds cost, defeating the object somewhat.

Routers

A computer on a network should know about all the others connected to it, but if your network is split up, say between cities, this won't be the case, so you need a device that does know where the rest are and can route messages accordingly. A router is about as powerful as a 486, and is meant to relay packets between the many networks it is connected to or knows about; the effect can be to hide parts of a network from other parts, but the main object is to help lots of smaller networks look like a big one. It works like a bridge, but at a higher level (and cost). Because NETBEUI headers do not contain information at the Network Layer, where routers operate, this protocol is not routeable.

Routers transfer packets between networks of dissimilar topology at Layer 3, and are protocol dependent; where bridges don't normally modify a packet, routers can extract the data from one type (e.g. Token Ring), insert it into another (X.25) and ensure it's placed into something else at the destination.

There are two aspects to routing; finding the optimal path for the data, and actually sending it. The latter operation comes under *Switching*, and is dealt with in another chapter. To help with the former, *routing tables* are kept full of routing information, such as "to reach network 1, send to Node A" in computerspeak. All of this, of course, has to be programmed in, and moving a router is not a popular task, because it will all have to be done again. In fact, there are two types of router in this respect, *static* or *dynamic*. the static type has to be programmed manually, while a dynamic router can update itself from information on its own segments and other routers.

If a router figures out that it cannot forward a packet, it is typically dropped. Otherwise, the final destination's physical address is changed to that of the next hop (e.g. Node A, above) and the packet sent on. This is repeated if the next destination is not the expected final one (of course, the final destination is always in the packet somewhere).

Like hubs or bridges, the size can range from a PC with two cards and software, to a specialised unit costing more than a small house. A Novell server with one network card can be a router, because NetWare uses an internal network, consisting of the other slots inside the PC. You can then put a PC on a card in one of those slots and have a very fast connection.

NetWare and NT have routing software, as does TCP/IP and the Vines IP, but any PC with two NICs running TCP/IP (or Vines' IP) can be a router straight away, albeit less sophisticated. Routers are normally based on Unix (well, Cisco ones are, at any rate) and therefore use similar commands. Typically, they don't have keyboards and screens, so must be managed through a terminal attached to an admin port. Commands are entered line by line, so routers are not taken offline frequently.

A router has to decide whether to forward a packet to another router or to its destination, in which case it has to find out the 48-bit address of the card, for which it uses ARP, or *Address Resolution Protocol*. With IPX, the address goes with the packet. TCP doesn't worry about the address until the last leg, that is, from the last router to the destination.

Firewall

A firewall is a PC that acts as a barrier between two networks or, more simply, the inside and the outside world, blocking off ports from internal and external addresses – this can be done in a basic fashion by a router. Like a bridge, it examines packets going either way and lets them pass or not, as the case may be. Unlike a bridge, the filtering techniques are a bit more sophisticated:

- Packet filtering is the least expensive, with the least effect on performance, is the least secure and the most difficult to set up.
- An application gateway filters out data meant for specific applications.

One thing to watch is that binary files, including viruses, are sent over the Internet as text, and are decoded after they arrive at the destination. Make sure you do your virus checking after incoming messages have been decoded, otherwise you won't detect anything nasty.

Brouters

Brouters (or remote bridges) exist midway between bridges and routers. They can route one or more protocols and bridge all others. In other words, when it receives a data packet, it checks to see if it routeable or not and acts accordingly (if it is not, it refers to the MAC address in the packet). They are slower than bridges, but smarter, and are found on both OSI's Network and DataLink layers.

Gateways

Gateways typically connect networks to different equipment using Layers 4-7, such as mainframes or minicomputers that don't even share the same routing protocol (e.g. NetWare to TCP/IP) or maybe have different architectures, so you would find them at the Application Layer. Typically, they could be used from a LAN to an X.400 or other external service (e.g. PC-mainframe links—see below). They can translate protocols, in other words, where a bridge would package a frame inside another belonging to the destination network – any translation is done at the receiving end.

Whereas a router spans several layers of the OSI model, and lives one stage higher than a bridge, the gateway spans all layers, and can make decisions at the top layer, although they are not as flexible as equipment lower down. For exam purposes, though, they exist above the Transport layer.

However, they are secure, in that only certain types of traffic can get through. A *firewall* (see below) is a device midway between a gateway and a router which stops public access to a network or, rather, only stores information that the public should have access to. On the other hand, a firewall allows you to audit who tries to get out.

As with a bridge, the gateway needs at least two interface boards in a workstation; one for the LAN and another for the host system connection, which may be through a modem and telephone link (if remote) or a coaxial cable, if direct. The gateway will emulate the software required at both ends, acting as an interpreter.

Software used with a gateway will need to provide some sort of terminal emulation, so the workstation will behave as a terminal of the host.

Network Interface Cards

A NIC is needed in each machine on a network, whether server or client. Sometimes, you need more than one, depending on your software – for example, you need three to run *Gateway Services for NetWare* on an NT Server, and the signal from the workstation has to pass through all three. SNA Server for IBM mainframes and AS/400s can require up to four.

In brief, an expansion card that converts data into packets suitable for transmission over cables (a glorified serial card, in other words). It's quite common to have more than one in a server to cope with heavy loads, or to split a network up for security reasons, and you should have them matched properly to the bus type; that is if you have a 32-bit bus, use a 32-bit network card. Avoid 8-bit ones as a matter of course.

As with anything, some of these do the job better than others, have become quite popular and therefore industry standards in their own right. Novell's NE 2000 comes to mind as one example, and there are many clones of it, but some other cards are so good at their job that they can even cope with longer distance cabling than standard, on top of giving better performance. 3Com cards are also particularly excellent.

Many adapter cards come with connections for both types of cable commonly encountered, UTP and coax; they are known as *combos*. For UTP, make sure you get one for the right speed—Ethernet (10BaseT) runs at 10 Mbps, whereas Fast Ethernet (100BaseT) uses 100 MHz, and the two don't mix.

There are three speed factors concerning network cards:

- That between the card and cable. As like cards are similar, the only thing you can usefully do to improve matters is to get a better card.
- Processing data. This depends on the network software.
- Between the card and the motherboard, which depends on the bus type and the operating system(s).

Later Macintoshes, Power PCs and some IBM-compatibles have network cards built in to the motherboards. In fact, Macs have always been able to connect through AppleTalk, a relatively slow system, but which works fine and *doesn't work with Ethernet*. Printers are connected to Macs over an AppleTalk interface, so they are actually devices on a network.

For portables, use either a connector on the parallel port, or a PC-card, some of which come with a modem facility, due to the lack of slots, and although many can emulate the NE 2000, very few are compatible down to chip level, a point to watch if you are programming.

As with other expansion cards, NICs have to use IRQs, base memory, DMA or I/O addresses to communicate with the computer. Refer to *The BIOS Companion* for more details on this. With combo cards, don't forget to set the jumpers for the type of connection you want to use.

Transceivers

A combination of a Transmitter and a Receiver, used in Thick Ethernet to connect the PC to the cable, typically with a *Vampire Trap*, so called because sharp teeth are used to clamp on the coax, which is a lot quicker and easier than soldering connectors and stuff. The transceiver is built in to Thin Ethernet cards.

Cabling

Signals can be carried over anything, even microwaves, which radiate their energies freely into space unless a *waveguide* is used, which is a hollow metal conductor that guides radio waves in a particular direction. However, not only does the waveguide concentrate energy, it also reduces unwanted interference, so other systems use *bounded media*, which perform all of the functions of a waveguide, the most common of which would be either coaxial or twisted pairs of cable, or fibreoptics.

Installation of cable can be (relatively) cheap, but can be up to 80% of your running costs once people start to move around, as they will. It makes sense to put the best cable you can in to everywhere you can think of, which will make your installation more expensive, but will cause less trouble later, especially if the cable is to be buried in the structure of the building.

If you don't call in the experts, be aware that cables intended for crawl spaces between floors and ceilings (plenum cabling) have to have special fire resistant properties, and the casing material must not give off hazardous fumes when burnt.

The local fire inspector *will* close you down, regardless of the cost to your business, if you use the wrong cabling!

Also, make sure that corners are turned gradually, and you are about 4 feet away from elevator shafts or power cables. From fluorescent lights, dimmer switches and anything with a sort of coil, the distance should be around 1.5 feet.

There is a maximum length specified for segments, which has more to do with synchronisation than making sure the signal doesn't weaken. For example, the length of an Ethernet packet is calculated to make sure that transmission doesn't stop before errors are detected, and the proper length of the cabling reflects this.

AWG, short for *American Wire Gauge*, describes wire thickness, which increases as the number decreases.

Lastly, try and install it after the telephone company, because you can use their conduits!

Twisted Pairs

UTP (*Unshielded Twisted Pair*) cabling is essentially two telephone wires twisted around each other inside an outer coating, with a telephone-type connector at each end. Twisting one wire with the other cancels out certain types of interference, particularly crosstalk. The more twists per inch, the less interference you get.

It is easily bent around corners, and the bandwidth allows a reasonable rate of data transfer, but there are sound reasons as to why it has speed limitations.

For a start, every electric current has an associated magnetic field, which will rise and fall in sympathy with the current flow. If current tries to move too fast down a wire, the electromagnetic radiations from it will interfere with sensitive equipment nearby and induce a current in the next wire, which will be mistaken for pulses and therefore genuine data (known as *crosstalk*).

Twisted pairs can also act as receiving aerials, unless shielding is used to counteract it. STP, or *Shielded Twisted Pair* is more expensive, and less flexible, and in a small office won't really be necessary unless you're in a particularly hostile situation (electrically, that is), or you want to avoid being tapped, but it does handle up to 500 Mbps. It requires proper grounding, and it's not a safe assumption that buildings grounded, as anyone who has had trouble with terminals will tell you—assuming it was properly connected in the first place, an older building may have moved, or had repairs done and had the Earth connection broken.

Twisted Pair has the advantages (over coax) of lower cost and less disruption if a cable break occurs, due to the hub it needs to operate with. However, its maximum segment length is 100m.

There are several types of cable. The higher categories contain more wire pairs and have more twists per inch:

Category 1	Unshielded, for voice communications, and below 4 Mbps. Do not use on networks.
Category 2	4 twisted pairs, also unshielded, rated at 4 Mbits/sec. Now rarely used, but not for networks anyway.
Category 3	4 twisted pairs, 3 twists per inch; the minimum for Ethernet at 10 Mbits/sec, or Token Ring at 4.

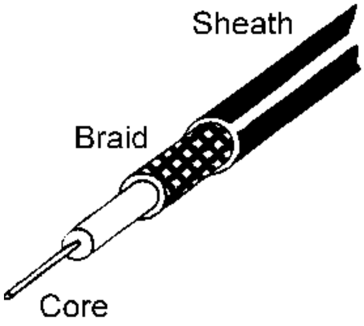
Category 4	4 twists per inch, supporting up to 16 Mbits/sec, for Token Ring.
Category 5	5 twists per inch, can handle up to 100 Mbits/sec. There's no real advantage to using anything else.

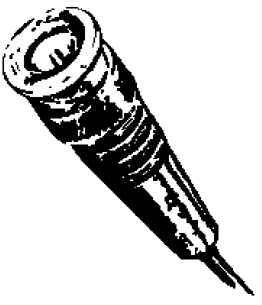
Connectors used are RJ-11 for 2 pair, RJ-12 for 3 pair, and RJ-45 for 4 pair. The two former have the same plugs, and are commonly used with ArcNet networks, 3270/5250 connections and modems, so be careful!

UTP cabling allows full duplex – makes sure your hub is, too.

Coax

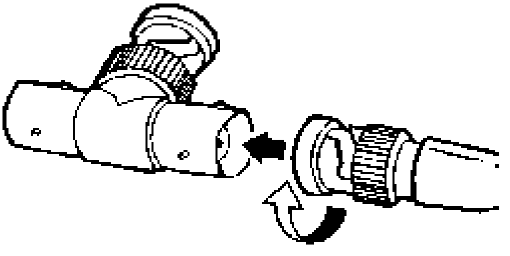
Coaxial cable works on the same principle as twisted pair, except that the second wire is converted into braid and placed around the central one to act as a *screen*, which is more effective at keeping out interference. Coax needs to be handled carefully as, when it's crushed, it loses some of its screening ability. You will recognise it as that used to connect your TV to its aerial, but computer coax is of better quality. It has a BNC (*British Naval Connector*) connector at the end.



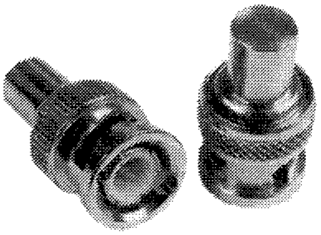


It is routed from PC to PC and connected to T-pieces, which in turn are connected to the network adapters; there is a terminator at each end of the cable, which contains a resistor that stops signals echoing round the cable and confusing things.

T-pieces go on the back of a network adapter, on the BNC (*British Naval Connector*) connector and are used for attaching coax cable, which also uses BNC connectors, so they are not needed for UTP. It is important to ensure that the connectors are securely twisted on, every single one of them



Terminators go on the open end of the final T-pieces at each end of the cable.



They will have a resistance (50 ohms for Ethernet) and are meant to soak up stray signals so they don't bounce back down the cable and get counted twice. Again, ensure they are securely connected.

You don't need a hub with coax, except for ARCNet. Here are the types of cable (RG numbers are issued by the US Military):

Type	Name
RG 8 or 11	Thicknet (50 ohm)
RG 58	Thinnet (50 ohm)
RG 58/U	Thinnet, solid copper centre
RG 58A/U	Thinnet, wire strand centre
RG 58C/U	Thinnet, military grade
RG 59	Broadband, cable TV (75 ohm)
RG 59/U	Broadband, cable TV (50 ohm)
RG 62	ARCNet (93 ohms)

The maximum length (for Ethernet) should be 185m per segment, with 30 nodes (PCs) on it. The minimum radius for bending should be 5-10 times the diameter of the cable. Thick coax was the original specification, but is now only used for trunk cabling, if at all. Thin coax is also called *Thinnet*, or *Cheapernet*.

Fibreoptics

Light rays bend, or refract, when they pass from one medium to another, caused by the slowing down of the rays at one edge of the beam at the crossover point, which is why anything under water appears to be displaced when viewed from outside. Because of refraction, light can reflect internally along a glass fibre and bounce along the inside (like stones skimming on the surface of the sea), giving the signals a longer effective range.

Every optic fibre (which is about the size of a human hair) consists of three strands, each inside the other. The centre one (the core) is a special low loss grade of material that has a constant *refractive index*; that is, its ability to bounce light along its inside doesn't reduce along its length. The next one (the cladding) and the outer one (the sheath) each have progressively lower refractive indexes (or is it indices?) which stop the light straying from the centre. The core should be made of glass for best results, but plastic-based fibre networks are used in modern cars.

As transmissions are unaffected by electrical interference and don't weaken so quickly, fibreoptics are good for long distances, especially as the transmission speeds are those of light itself—systems have been demonstrated that can carry over 4000 voice circuits per fibre, transmitting up to 2 Gbps (Gigabits per second) over stage lengths of at least 100 km without repeaters.

Repeaters are needed, not because of *attenuation* (or weakening), but because the signal tends to get less concentrated, and spreads out. In fact, any loss of signal strength in fibres is due to:

- **Scattering** because of imperfections in the material, which can never be eliminated completely.
- **Absorption losses**, which occur when the angle of entry of the light into the fibre is larger than needed for proper refraction, whereupon the power it contains is used for digging itself into the coating rather than skimming along the insides.
- **Connection and bending losses**, which occur when the cable is not aligned properly; the ends of the fibres must be parallel to within 1 degree or less, or the light rays will not be started properly. The core must also be as concentric with the cladding as possible.

If you include fibres with opposing characteristics, that is, put in some cables backwards, these can be somewhat reduced, although you probably need to do this anyway, because the signals only travel one way. Some advantages of using fibre include:

- **Less maintenance**, because it isn't as fussy over its environment, so it doesn't need to be so watertight.
- **Noise immunity**, where external electromagnetic and radio fields don't interfere with the optical signals in the cable, and *vice versa*.
- **Security**. Optical signals can't be tapped by electromagnetic means.
- **Bandwidth** is high for its cost; the full availability is 25,000 GHz; one fibre could theoretically carry all the phone calls in USA at peak time, all at the same time.
- **High speed** over long distances.
- **Light weight**.
- **Grounding problems** are reduced.

Multimode fibre is used in networks, as it is thicker and sturdier than *single mode*, although its maximum transmission speed is around 500 Mbps. Single mode is so thin, you have to use acid to eat away the insulation before you connect it, rather than use wire cutters.

There is a plot to broadcast data as light signals over fibreoptic cables everywhere (similar to radio) and have your computer tuned to the particular frequency, or colour, of the data you require; this is really what the *information superhighway* is.

Disadvantages

Every time light is split, the frequency is halved, so you need light amplifiers at all junctions. Electrical facilities are still therefore required to amplify and switch the signals, using photodiodes to convert them from light to electrical ones, switching, rearranging and generally interfering with them until they are reconverted with an LED or laser.

The main point is that once data travelling at high speed hits an electronic switching device, you get a bottleneck. Switching light waves without converting them to electricity is called *photonic switching*, and is likely to be ready sometime next century.

Data only travels one way, so you need two cables for each segment that transmits and receives data.

Wireless

This can be done with laser beams, radio, microwaves or infrared. There are security implications, and line-of-sight may be required, so these methods should only be used in special circumstances, such as between buildings or when convenience is required, say, for people running round supermarkets who are nowhere near a desk (and for which you don't have to use a PC). However, they do mean that you don't have cables all over the place, and you can join two buildings electronically without using a cable that is a prime candidate to get fried the first thunderstorm you get.

Many systems are proprietary, but there is a standard, IEEE 802.11, which makes it easier for one manufacturer's equipment to work with another's which, unfortunately, is relatively expensive.

Infra Red

This is limited to about 100 feet, because of possible interference from light sources, but they are relatively immune to eavesdropping because they are not sensitive to RF interference and the beams are quite tightly focussed. There are four types:

Reflective

The signal is beamed towards a central unit which routes it accordingly.

Line-of-sight

You must have a direct line between transmitter and receiver.

Scatter

Designed to bounce of walls, etc, so it is slower, and limited to about 100 feet.

Broadband Optical Telepoint

Very good transmission rates.

Radio

You need an FCC licence, and the system is subject to eavesdropping.

Narrow Band

Similar to broadcasting from a radio station – both ends are tuned to the same frequency, but subject to the usual restrictions.

Bluetooth

An inexpensive solution, which uses radio (the 2.4 GHz band), so, for all intents and purposes, line-of-sight isn't required. Because of the restrictions on radio transmissions, a *spread spectrum* method is used called frequency hopping, which changes frequency up to a thousand times a second, somewhat randomly. This also means that it has some immunity to interference, and corruptions that do occur are fixed by Forward Error Correction.

Its expected range is about 10m, and the data rate 1 MB/sec, a tenth of Ethernet.

WAP

Wireless Application Protocol is packet radio rehashed.

Microwave

Satellite Microwave is used to transmit globally, while Terrestrial Microwave handles shorter distances.

Summary

Media	Bandwidth (Mbps)	Nodes/Segment	Max nodes	Max length (m)
UTP	4-100	1	1024	100
STP	16-155	Varies	260	100
Thick Coax	10	100	300	500
Thin Coax	10	30	90	185
Fibre	2000	1	1024	100000
IR	1-10	NA	Varies	32

Types of Network

The term *Media Access* describes how each device gets its information to and from the network, since the machines must have some way of sharing the bandwidth without getting in each other's way. Ethernet is the one most likely to be used in most offices, but Token Ring is still important. The others are mentioned in case you inherit a system.

The three primary access methods are *CSMA/CD* (or CA), *Token Passing* and *Demand Priority*.

- **CSMA/CD** (or *Carrier Sense Multiple Access with Collision Detection*, for short) is a passive system that allows stations on the network to send messages whenever they want, with no precedence or order. *Carrier Sense* means they listen out first to see if other machines are transmitting, then back off for a short while if they are before trying again (we're talking milliseconds here). *Collision Detection* means that messages will be retransmitted if they don't get to their destination because they've hit another one. There is a version that attempts to get around this, used on Macintoshes, using *Collision Avoidance*, where computers signal their intent to transmit first, which increases the overheads a little. Although all stations may receive every transmission sent, only the correct one will respond.

- In **Token Passing**, messages go round continually in one direction round a loop until claimed by the workstation they are intended for, so collisions between messages don't occur, as they might with *Ethernet*. TR is not a passive system. As designed by IBM and Texas Instruments, the first station passes a token (or a "permission to send" message) to the *Nearest Active Downstream Neighbour* (NADN), which can either send data or pass the permission on, in which case it becomes the *Nearest Active Upstream Neighbour* (NADN). If it wants to send something, it adds header and trailer information as well as the data to the free token. The data itself is in a frame, the header contains addressing information and the trailer concerns error checking. The receiving station adds a receipt to the token then sends it back to the originator, which confirms the confirmation and sends out a new free token.

- **Demand Priority** is used in 100VG-AnyLAN networks (see the 802.12 standard, and *Ethernet*, below). Only one node is allowed to transmit at any time, with the hub keeping track of requests, so the system is more efficient than CSMA, as there are no broadcasts. Also, as there are more cables, computers can transmit and receive at the same time. In case two machines want to transmit at the same time, the hub can allocate priorities. If *normal* requests aren't dealt with inside a certain time, typically 200-300ms, they are automatically upgraded to *high*. The system needs a bridge to communicate with 100BaseT.

Frames & Packets

The words *packet* and *frame* are interchangeable throughout the industry, although technically a packet goes inside a frame structure. In NetWare, for example, the data goes into an NCP packet, which goes inside an IPX packet, which goes into the frame. We shall be using *packets* to describe the chunks in which data is broken into for transmission over a network. But first, a short, but relevant, digression......

Switching

Switching gets around the need to connect every station to each other (imagine the wires!), and allows better use of the bandwidth available by ensuring that only those stations that need to talk are actually connected at any time, so excess traffic is not circulating round the system and clogging it all up. A path is found (by routers) between all the potential connections that may exist, which will not be the same the next time the call is set up.

Circuit Switching

A circuit switched communications system (like the telephone) consists of a number of exchanges interconnected by *trunks* (major direct connections), each capable of switching to alternate circuits if a call can't get through on a particular route. The circuits are used for the duration of the call (that is, the connection is permanent as long as it's needed), then are broken up into their component parts for reuse in other switched circuits. The connection to your exchange (i.e. from your telephone), on the other hand, is permanent. The disadvantage is that if the recipient is busy you have to call back later. Another is that the next time you set up the call, you might not get such high quality lines.

Message Switching

Where data is concerned, immediate feedback (and the need for continuous interconnection) is not so important, so permanent circuits are not only unnecessary, but wasteful. As a fast response is not required, the system only needs to deliver to a specified address, so the emphasis turns to reliable delivery, at the cost of some delays, which actually are in the nature of milliseconds. As well as the data being sent, the total message will consist of address and identification information concerning the sending and receiving stations. This means that, whereas a circuit switching system needs to wait for a path to be set up before data can be sent, a message switching system can send at once and wait for the links to made later.

For this reason, some message switching terminals have memory for temporary message storage. If the trunk is busy, the message can hang around until the channel is free. This is often known as a *Store-and-Forward* system. Storing messages provides a way of avoiding peaks during high system loading, so an engaged tone doesn't matter so much—all messages will eventually get through, provided they contain all the necessary routing information.

Packet Switching

Packet switching, although similar to message switching, is different, in that a message is split up into packets (say 512 bytes long) which don't even have to go in convoy; each segment has extra information which includes its address and sequence in the original message so it doesn't get lost, rather like Paddington Bear, so you don't get near the end of a message and have to retransmit the whole thing if you get a glitch; packets are easier to resend.

The idea of controlling data transmission without a dedicated channel between sender and receiver (in other words, sending multiple signals down one carrier and redistributing at the other end) was first thought of by Paul Baron, developed by Donald Davies at the National Physical Laboratory in UK and also used in the ARPA Net, the beginning of the Internet, in the US in 1964.

A packet is a series of bits between a leading flag and a trailing flag; the data between them can be of any size. The flags look like:

```
0111110
```

and to make sure no other bit pattern resembles it, a zero bit is always added after any series of 5 ones and removed at the destination.

Packets consist of:

- **Headers**, which contain alert signals, which announce the packet's transmission, the source and destination addresses and clocking information.

- **Data**, which can be anywhere between 512 bytes and 4K in size.

- The **Trailer** usually contains error checking information, such as CRC, but the contents can vary according to the system.

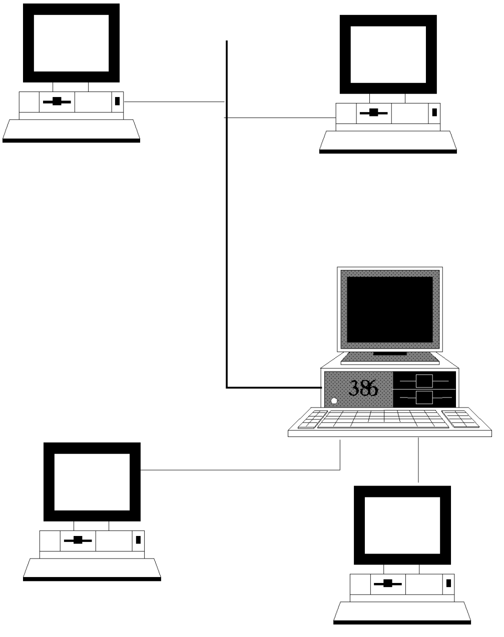
They are transmitted individually over the system, being given the best routing by the control nodes, according to traffic jams, and reassembled at the receiving terminal. There's no real intelligence involved; the packets are merely routed nearer and nearer to their destination until they hit (of course, this happens so quickly that you don't notice).

On a long-distance link, sy over the Internet, packets from one conversation are interleaved with packets from others, which means they must be relatively small to allow for maximum flexibility; if you're trying to fit parcels in a small space, it's easier to fill the space economically with several small ones than a few large ones. This makes the use of one line more efficient as spare capacity can be used when it's idle. However, what usually happens is that normal permanent connections are used and the segments fit in between the gaps left in normal speech transmission, allowing them to hitchhike a lift at greatly reduced rates over long distances.

The most appropriate route of the packet is determined by controlling computers or nodes. Sometimes packets may be stored in them temporarily, which is not usually noticeable as the delays are seldom more than a fraction of a second. You will not be surprised to hear that there are standards laid down for packet switched networks as well, one of which is CCITT (or ITU-T) recommendation X.25 (X means digital transmissions over public data networks).

Ethernet

Ethernet is the most common way of allowing computers to talk to each other, and is the one most associated with the bus topology (10Base2 or 5), although it can use a star layout with UTP cabling (10- or 100BaseT), which requires a hub. The signals are broadcast over the cable, which is hardly surprising as the system was developed from Packet Radio by Digital, Intel and Xerox; Intel made the chips, and DEC did the marketing—it was known as DIX Ethernet, after the manufacturers' initials, hence the connector of the same name. The IEEE 802.3 standard was based on this, where 802 means February 1980 (in case you ever wondered).



It’s called Ethernet because it's not meant to be tied to any particular medium; *Ether* was supposed to be a hazy word. It's typically used in a *bus configuration*, where each computer is attached to a thin coax cable, terminated at each end with a small resistor (50 ohms) that absorbs unwanted signals so they don't get counted twice. This version, called CNET (or cheapernet), was developed by 3Com Corporation in 1981.

With Ethernet, messages are split up into packets and sent round the system in short bursts separated by comparatively long idle periods, each with its address tacked on the front, and being reassembled at the receiving terminal.

Some errors (the wrong address, for example) mean that the message is totally ignored. In practice, there is a short delay before any error is detected so there must be a *minimum packet size,* otherwise transmission could finish before mistakes are found.

In other words, minimum packet size and *maximum path length* mean that even if two machines at each end begin transmission at the same time, a collision will be sensed before transmission is finished. A workstation transmitting must listen long enough to assume the packet arrived safely; a 512-bit frame is specified in the standard, so it will travel 2,500m before the workstation finishes processing it, after which a collision may arise; in other words, while transmitting, the workstation knows it has control of the line. Timing and synchronisation issues, rather than signal strength (though this is important) are why cables have to be of specific lengths, even with Ethernet. The cable works like a telephone party line, in that only one station can transmit at any time; all stations can transmit freely, but if a collision occurs between packets, the culprits back off for a short time and then retry.

The most commonly used system for this is *Carrier Sense Multiple Access* (CSMA), which comes with either Collision Avoidance (CA) or Collision Detection (CD) procedures—the former is used by Apple.

Looked at in more detail, the line is sensed for activity by the originating sender and is "acquired" if nothing is happening. Line voltage drops significantly if two stations transmit at the same time, and the first station to notice this sends a high voltage jamming signal around the net to signify a collision. The stations trying to transmit then back off for a random time interval, which is doubled if it happens again. After 16 attempts an error condition is reported.

Frames

The *frame structure* (or how the packet is constructed) is defined by IEEE standard 802.3,which is not officially Ethernet (it should be 802.2). 802.3 was being used by the industry, having been developed from DIX, while 802.2 was being hashed out, and was adopted as part of the new standard, but the remainder was considered excess baggage and not used (what they had was working, wasn't it?). Now everyone behaves themselves and uses 802.2—NetWare 3.12 and above now defaults to it.

The client's interface card must be told to use the same frame structure as the Server; with NetWare, this is done with a line in the **net.cfg** file (later).

Cable Specifications

The first number indicates the transmission speed, 10 or 100 Mbits/second. *Base* indicates Baseband technology, or the use of the whole bandwidth as a single channel. The last figure should mean the maximum length of the cable, but T means *Twisted Pair*, and F means **Fibre**.

	Media	Segment Length	Nodes/segment
10base5	Thick coax	500m	100
10base2	Thin coax	185m	30
10baseT	UTP	100m	1 per link
10baseF	Fibre	2Km	1 per link
100baseT	UTP, Fibre	100, 400m	1 per link

10Base5

Thick Ethernet (10Base5) uses a thicker coax, yellow in colour. At the client PC, the network card is split into two, with a *transceiver* at the other end of a *drop cable*, which is terminated with a 15-pin AUI connector (looks like a game port). The transceiver's connection is screwed through the yellow cable, or simply clamped with a *Vampire Trap*. The drop cable has 5 pairs of wires, for transmit, receive, control in, control out and power. It's not commonly found now, but mentioned for completeness, in case you come across it as a backbone somewhere.

You can have up to 100 nodes per segment, at least 2.5m apart, and up to 5 segments, of which only 3 can be populated.

10Base2

Thin Ethernet, using RG 58 (10Base2) coaxial cabling rated at 50 Ohms. When they created it, 3Com moved the transceiver to the card. You use a T-piece at the interface card and attach a cable to each side of it, making one long trunk, at both ends of which would be a 50 ohm terminator. You can have a maximum of 30 nodes per segment, and a maximum of five segments, of which only three may be populated. They should be at least .5m apart.

10baseT

A standard for Ethernet transmissions laid down in 1990, defining a baseband 10 Mbps signalling speed over twisted pair cabling through hubs, giving it a star topology. The phrase **10BaseT** decodes to *10 Megabits, Baseband, Twisted*.

The maximum segment length is 100m, with a maximum of 1024 nodes at least 2.5m apart.

10baseT hubs can send a signal (known as the *Link Beat Signal*) to check the integrity of the cables and devices attached. You just check the LED on the hub to see if all is well.

UTP/STP (*Unshielded/Shielded Twisted Pair*) cable has the advantages of lower cost, less disruption if a workstation goes down (due to the hub) and longer cable runs. Many interface cards come with connections for UTP and coax, known as *combos*.

10BaseT uses 2 pairs of wires; pins 1 and 2 for the first pair, and 3 and 6 for the second. Here are the pinouts:

Pin	Function	Colour	Other Pin
1	Transmit+	White/orange	3
2	Transmit-	Orange/White	6
3	Receive+	White/Green	1
4		Blue/White	4
5		White/Blue	5
6	Receive-	Green/White	2
7		White/Brown	7
8		Brown/White	8

For a crossover cable, connect the orange wires on one side to the green on the other, with brown and blue straight through (see also table above). It's better to make a crossover box, with the above wiring internally, then you can use straight cables at each end. You can add a hub later, then keep the box in your toolkit.

Link Integrity concerns the condition of the cable between the network adapter and the hub, which will automatically disconnect its port if the cable is broken. Auto-partitioning occurs when a hub port experiences more than 31 collisions in a row, when it will also turn off the port concerned.

100BaseT/ Fast Ethernet

"Fast Ethernet" is a generic term for a variety of systems running at 100 Mbps. These are:

- 100BaseVG-**AnyLAN**. VG stands for *Voice Grade*, and this doesn't work in quite the same way as 100BaseT, which is more to do with Ethernet. It uses cheaper cabling, but costs more because it uses 4 pairs. In fact, it works with category 3, 4 and 5 cabling, allowing 5 hubs per segment. Uses Demand Priority, previously described, and defined by IEEE 802.12. Its longest cable length is 250m, and requires its own hub and expansion cards.

- **100BaseT** uses standard Ethernet procedures, and needs some form of switching. It allows 4 hubs per segment, and has three variations:

  - **100BaseTX**, which uses two pairs of high quality UTP/STP; one for transmission and one for reception, hence full duplex with room for expansion, but don't forget full-duplex switches. Cat 5 UTP (RJ 45) or IBM Type 1 STP (DB 9), with patch panels and jumper blocks to match.

  - **100BaseT4**, which uses two out of four pairs of cabling, but the other two are bidirectional, in that they can either transmit or receive, so you can split the 100mbps data signal between three pairs of wiring, allowing you to use lower quality cable, as the frequency is lowered. Because it uses all four wires, you don't get full duplex. Cat 3, 4 or 5 UTP (RJ 45) or IBM Type 1 STP (DB 9). Cheaper than 100BaseTX.

  - **100BaseFX** is fibreoptic, designed as a backbone, such as for connecting Fast Ethernet repeaters, as it allows longer distances (over a mile of cable). Only two cables are used, one for transmission and one for reception. Standard cabling is multimode fibre with a 62.5 micron core and 125 micron cladding.

The extra speed of the above systems is achieved by dividing the time each packet is transmitted by 10, giving you ten times the packet speed, although this does reduce the segment length somewhat, because the adapter listening time is reduced, based on a minimum frame size of 64 bytes; actually by a factor of 10, so 200m is the max *network* length. This is not a great problem, as most machines in most offices are quite close together, certainly within 100m of a hub. For Gigabit

Ethernet, the minimum frame size should increase to 640 bytes to avoid a distance limit of 20 metres, but 512 bytes has proved to be adequate.

10BaseF

The maximum segment length is 2000m.

Switched Ethernet

This uses switching boxes or hubs that create dedicated circuits internally on the fly, so it only makes connections between nodes that actually need to talk to each other, in theory making better use of available bandwidth, and similar to a telephone system, which switches voice transmissions. I say in theory, because broadcast frames, that are transmitted just to keep the network alive, have to be transmitted to every port, which doesn't happen with switching. Performance will only be boosted in certain circumstances:

- Where bandwidth utilisation is more than 35-50%.
- Your network is getting sluggish.
- There are no bottlenecks.

It is not cost-effective where your network has only one server and there is minimal traffic anyway; you would be better off increasing the Server's connectivity with more interface cards.

More about switches in *Internetworking*.

ISO Ethernet

This is essentially 2 networks running over one set of 10BaseT cabling. The second one, the ISO part, adds another 6 Mbps of bandwidth and sits on top of the normal Ethernet channel, being split into 64 Kbps segments which can be used by themselves or merged.

In short

Ethernet, in particular the thin variety, is easier and cheaper to install than Token Ring, and is most cost-effective for up to around 200 users running common applications. Expect delays, though, if you've got 5 or 6 people loading Windows at the same time.

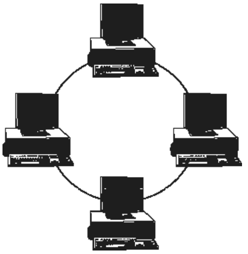
Although the connection can be removed from the interface card without affecting the rest of the system, the cable itself must not be broken, otherwise the network will not operate, as it will be unable to broadcast signals.

Because there's no guarantee that either errors will be detected or a signal will get through within a particular time, this sort of system is better geared to an office rather than a factory, where real-time is less important.

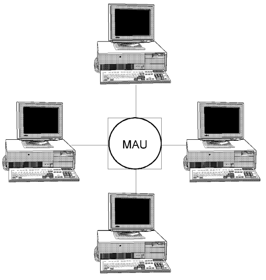
The 5-4-3 rule applies to the numbers of segments, repeaters and nodes.

Token Ring

In concept, a ring network looks like what you see on the right.



However, each station must connect to a *Multistation Access Unit*, which is like a hub, and the setup becomes more like:



Which is really a *Star Ring* layout. The cable ring is still there, as circuitry within the MAU, where a relay is opened or closed as a connecting plug is inserted or extracted, or a Network Interface Card is activated (MAUs click from time to time as relays are activated; this is quite normal - you might also see them described as MSAUs or SMAUs). When a computer is connected, the internal ring automatically converts to an external one.

Enhanced MAUs can provide diagnostics for interrogation by network management software. The token is generated by one card in a PC which is called the *Active Monitor*, (the first to be switched on) and which also maintains a master clock, aside from having to clean up soft errors and restart the system after a hard error (hard errors tend to stop the network, and soft errors tend to damage the token).

The Active Monitor sends a data packet every seven seconds to its *Nearest Active Downstream Neighbour* (NADN), which returns via its NAUN (Upstream). According to 802.5, this is clockwise – IBM says it goes the other way. If a packet is not received every 7 seconds, another is sent which announces its address, that of its NAUN and its beacon type (i.e. Active or Standby). The packet goes to the furthest point that it can, where the problem is, and the other computers can use the information in it to reconfigure the ring to avoid the break.

The Token Ring card is split into two, for transmitting and receiving. If there is a problem with the receiver (a CRC system is used to check messages for damage), the transmitter starts *beaconing*, or sending a signal that can be heard around the network. It will also do so if nothing is heard from the upstream NIC, in which case both should take themselves off the network and sort themselves out. After eight beacons, the card assumes the problem is with itself and shuts down for a self-check (essentially talking to itself), after which it can rejoin, if it's OK.

You can use software to detect beacons and diagnose problems, called *LAN Network Manager*, supplied by IBM.

Once access has been granted to a computer, by having the token, data frames can be sent for a time, depending on how many nodes there are and the length of the cable. A busy token is also

sent, which carries on from the destination back to the sender so it can check the proper coding. There can be 2-4 tokens at any time, depending on the size of the network.
There are two types of frame on a Token Ring network; one is what you might call "normal", in that it carries data around, and the other is a "management" frame, called a MAC-layer frame, used by the clients to communicate with each other and check their state of health. The latter are generated by the cards themselves and are independent of the network operating system. The normal data frame is larger than found on Ethernet.

Token Ring frames have their bytes arranged thus:

Start delimiter	1
Frame Control	1
Destn Address	6
Source Address	6
Frame Data	Variable (max 4/17K)
Frame check	4
End delimiter	1
Frame status	1

A MAC-Layer frame carries ring management information in the frame data field. They are identified by 00 as being the first two bytes in the Frame Control Field (others have 01). The remaining bits are MAC Control ID bits and refer to the type of ring management.

Every 6 or 7 seconds, the Active Monitor (that is, the NIC that has been powered on the longest) sends an *Active Monitor Present* frame, to its NADN and other machines. The response is a *Standby Monitor Presence* frame, which means they are able to take over if the Active Monitor doesn't broadcast on time (they negotiate with each other for the privilege). If a computer does not receive a packet from its NAUN every 6 or 7 seconds, it creates a packet that announces its address and its beacon type, that is, *Active* or *Standby*. The packet travels to the furthest point, which is where the error is, and the computers on the ring can take the appropriate steps. This error detection is a process called *beaconing*.

Cabling

The original idea was to use STP; the data rate then was 4 Mbps, later increased to 16, and 4 over UTP, hence the 16/4 rating you often see.

Type 3 UTP is used, in set lengths, as timing is important. *Adapter cables* are 8 feet long, and connect workstations to MAUs. *Patch cables* (type 6) on the other hand, can be 8, 30, 75 or 150 feet long, and are used for extending adapter cables or connecting MAUs (from the *Ring Out* socket on one to the *Ring In* socket on the other). The maximum distance between MAUs is 152m.

Inside the cable, there will be a minimum of two wires terminating in either a 9-pin D-sub connector (at the PC) or a proprietary IBM connector (at the MAU).

You can use UTP, but note that, while a 4 Mbps system can accommodate up to 260 nodes using 100m between each of them to the MAU, a 16 Mbps system would struggle to cope with 70 nodes with only 45m (the figures are actually dependent on a calculation involving distances, station count and type of cable, and each is variable as the others change). However, with only a few workstations on a 16 mbps system you could push this to 300 feet from a MAU. Poor signal quality is possible, though. Computers must be at least 2.5m apart. The distance between MAUs is 100m with type 1 cabling, down to 45m with Type 2, and you can have up to 33 MAUs. With fibreoptics, you can stretch up to 4 Km.

Coax, if used, for Token Ring is RG59.

Here is a summary of IBM cabling types:

Type	Wire	Notes
1	2 STP solid core 22 AWG wires, up to 101m	Between terminals and distribution boxes
2	2 STP & 4 UTP pairs, up to 100m	Adds voice capability to type 1
3	4 UTP, at 2 twists per inch, 22 or 24 AWG, up to 45 m	Lower cost alternative to 1 & 2
4	Not defined	
5	2 62.5/125 micron multimode fibres	Fibreoptic
6	2 STP, 26 AWG	Data patch cables
7	Not defined	
8	2 STP 26 AWG	As for 6, but with a shield for use under carpets
9	2 STP, 26 AWG	Plenum Grade

Connectors

MIC (*Media Interface Connectors*) are used for type 1 and 2 cable, also known as *hermaphroditic* as they have no male or female ends, and you can flip them over to connect them to each other. use RJ 45s with type 3 (4-pair) or RJ 11 for 2-pair.

In Short

Token Ring is costly to install (especially for 16 mbps), but is often better at coping with heavy workloads than Ethernet, due to its "regulated" way of working (you could say it's more polite). Consider using it if you want a large network (plus of 2-300 users) capable of handling data in large amounts.

A good use of Token Ring is where strict timing is important (as where milling machines and suchlike have to make adjustments in times down to one-thousandth of a second or so), or when you want connectivity with IBM 3270-type mainframe computers, which are built round it.

AppleTalk

This has a dynamic network addressing scheme. When starting, the AppleTalk card broadcasts a random number as its card address. If it is not claimed, that number is used as its own. Otherwise it tries other numbers until there is no conflict. The number is then stored for use every time it goes online.

The cabling system is known as *LocalTalk*, which works like a combination of ARCNet and Ethernet, using collision *avoidance* at 230 Kbps over shielded twisted pair cables, with a mini-DIN connector on each device. There is a maximum bus length of 300m, though, because packet sizes need to be kept down - you can daisy chain up to 254 devices, but 32 is more practical. CSMA/CA is similar to CSMA/CD, as used in Ethernet, except that a warning packet is broadcast before each transmission, which reduces collisions because other computers don't transmit when they detect a warning packet. However, it also increases network traffic.

You can enable Appletalk in NT, thus allowing Macs to talk to an NT server (install *NT Services for Macintosh* first). However, you must use an NTFS partition. *Appleshare* uses a Mac as a file server for combinations of up to 32 Macs and PCs.

To use Appletalk equipment on something like Ethernet, you will need some sort of converter (e.g. Kinetics' *FastPath*) or a bridge, as the original cannot be scaled up properly. However, Appletalk zones (subnetworks) can cross routers, where Windows workgroups can't.

Ethertalk and *TokenTalk* are ways of running the system over the respective cabling methods.

Appleshare relates to the file server, which also shares ptrinters.

FDDI

100 Mbps, based on timed Token Passing, using a ring or star-wired topology over fibreoptic or copper media. It's used mainly as a high speed backbone. It can cope with up to 500 stations in one ring up to 100 km in length, although in practice a primary and secondary ring are used for fault tolerance.

You can have *single* or *dual attach* cards, both of which are expensive and have lots of RAM. The former are used at the desktop and have two cables attaching through a *FDDI Connector*, which is around the same size as a 25-pin RS232 one.

Dual attach is used for dual ring connections, for fault tolerance; the second ring can be switched to if there is a problem. Two cables are used for transmitting, and two for receiving.

ARCNet

Short for *Attached Resources Computing*, this was one of the first commercially available LANs which uses *token passing* over coaxial cable (a "token" is an "electronic courier" to which stations that want to send can attach data). It was created in 1977 by Datapoint, and broadly equates to IEEE 802.4. However, unlike *Token Ring* (see later), where a station can only transmit to the next station in line when it has the token, ARCNet stations can broadcast to all the others (approximately in the order of workstation ID numbers) at about the same time, using a star or bus topology with a hub, either active or passive. It was marketed by Novell as RX-Net.

ARCNet is therefore a switched network that needs a hub. Switching ensures that only stations that need to talk to each other are actually connected at any time. It runs at 2.5 megabits/second and has small frame sizes (508 bytes), because it was found that 90% of messages were small anyway.

When PCs join an ARCNet LAN, the cards inside them have to reconfigure to take account of the new numbers, etc. When *Recon*, as it's known, is going on (no, nothing to do with the Marines), you can see the green lights flashing on cards and hubs. If the lights are steady, everything is fine. When establishing ID numbers, keep them close to each other – that is, don't have 7 and 8 at opposite sides of the room, as this will reduce performance when the token travels too far back and forth.

Whereas Token Ring and Ethernet interface cards have a unique address number burned into them. ARCNet station IDs are set with switches on the card, and must be between 1 and 255 (0 is reserved). The PC with the lowest number is "the controller", which ought to be the most powerful one to cope with the extra traffic.

Cabling

Coaxial (RG-62 or 59), but some companies have been able to adapt it for UTP (fibre is also available). RG-62 requires a 93 ohm terminator, and RG-59 a 75 ohm (the latter is used for video, as well, and the BNC connectors *have a different pin size)*. RG-62 was commonly used with IBM 3270 terminals at the time ARCNet was invented, so was easily available.

Limitations

The maximum number of workstations is 255.

The maximum span of the network is 20,000 feet, with 2,000 feet (610m) between a workstation and an active hub (reducing to 100 feet with a passive hub, and 305 with a bus topology). It is not bridgeable, as ARCNet cards don't have unique 48-bit IDs.

In Short

ARCNet's transmission speed is slow (2 Mbits per second, with 20 for ARCNet Plus), but it's quite dependable. In fact, its efficiency and relative cheapness still gives it the occasional edge over more modern and faster systems, but it's certainly not the first product that comes to mind when you want a new installation.

You will likely only see it if you inherit it. In fact, because they're in relatively short supply, the interface cards can be expensive when new. Their secondhand value is mostly nil, but Murphy's Law dictates that when you want a card desperately there are no cheap ones available. This also applies to Token Ring.

Wireless LANs

These can be radio or infra-red based. They are useful for staying connected while you move about (within range, of course). You don't need to lay cables everywhere, either, so you can set up a network in a couple of hours (great for demos). They are slower and costlier than conventional networks, but make up for it in convenience.

It uses a remote relative of FSK, which originally used two different transmission frequencies, switching between them as data changes. *Spread Spectrum Technology* (SST) spreads a signal over a broad range of frequencies. FHSS uses hundreds, and the frequencies are only known to the transmitter and receiver. Typically a hundred will be used within a 1 MHz bandwidth. Once a frequency has been agreed, data is sent with FSK.

DSSS (*Direct Sequence SST)* uses one frequency, and the data is chipped into smaller units. It's less prone to *multi-path distortion*, where waves arrive at the destination out of phase with each other; this could be caused by objects in the way or people moving about. It can be quicker, as there's no retuning after a frequency change.

Don't expect much security, even though IEEE 802.11 specifies an encryption protocol. If stations get too far from others, some nodes won't be detected, even if they are already transmitting. RTS and CTS packets have to be used, which unfortunately reduces performance due to the overhead. Alternatively, one station can assume control and allocate priorities.

ATM

Asynchronous Transfer Mode is intended to make better use of bandwidth. It does this by working more like a telephone system, where "permanent connections" are made only between nodes that need to transmit. In other words, a circuit is created by switching when required, and broken up into its constituent parts once the conversation has finished. It moves data over *virtual circuits*, and should be used with fibreoptics.

ATM has a fixed packet size of 53 bytes; 5 are for the *header* used for routing, and the rest for the payload, which is ignored by the network. The packets are organised, so are more efficient. This allows ATM to handle video transmissions in particular, which need consistency and response time, rather than data throughput, although that is important. Setting up connections across ATM is called *signalling*. It has two types of *virtual circuits, Permanent* and *Switched*, as with X.25.

Each node has its own link into a central "exchange", which makes and breaks the appropriate connections. You can set up several *Switched Virtual Circuits* (SVCs) from a single node, and they can last for a single cell, a multi-cell packet or a complete network session.

ATM has the potential for seamless integration of various systems, including networks, with at least 150 Mbps bandwidth available. In theory, you could knit the whole of the country into one giant network, with similar response times wherever you are. Many applications, however, don't understand it properly, so don't expect too much performance quite yet!

Performance And Security

Setting up a network for best performance is the same in principle as doing it for a PC; make each component work to its best capacity, then eliminate the bottlenecks between them. The "components" in this case are the PCs and devices on the network.

So, how good a network is depends on the amount of traffic carried, and the capabilities of the equipment on it, together with the software running it (actually the main problem). For example, the original Token Ring chip set is notoriously bad at data transfer, and is well known for bottlenecking. In fact, until the design of the PC's data bus was improved from ISA, it was very often the case that data took longer to get in and around the PC from the cable, than to go completely across the longest networks!

Where NICs in general are concerned, don't use 8-bit ones in file servers, where the most traffic is going to concentrate—you should try not to use them at all, but if you have to, they are best restricted to Client PCs.

Throughput and response time are mutually exclusive, in that you can have one or the other, but not both. Where a response-based system will work bit-by bit, a throughput-based one will send blocks of data at once, which can't be interrupted (similar to *HDD Block Mode* in the Advanced Chipset settings). The number of bytes read from and written to a server gives you a useful measure of how busy it is. If, on a Windows NT network, the server doesn’t accept data, it’s because the memory is low, as a certain amount is needed as a buffer. Related to this is the number of commands being queued for execution.

Speed

Many products never meet with the commercial success they might expect because they're not perceived as being "fast" enough with respect to transmission speed. It may seem important to salesmen, but speed is not actually that important. However fast your car may be able to go, you will still find yourself doing an average speed of 40-50 mph when travelling across country. So it is with networks, and a quoted throughput of 10 megabits per second is more likely to be 6 in practical terms (in fact, a "fast" system using CSMA may, in many cases, be significantly slower than one using "slow" ARCNet, due to the relative efficiencies with which data is transmitted).

As far as benchmark testing goes, remember that it doesn't take account of spooling print jobs when the tests are run (for printing, reduce the number of trips across the LAN and PC buses).

The slowness, or otherwise, of a network, is often due to false expectations. The trick is consistency; if it always takes 5 seconds for an operation, you will get very few complaints, but if it varies between 1-5, people will ask you why it can't be done in 1 second all the time! This is often to do with printing, which is always given a relatively low priority anyway. Mainframe people used to make sure that everything was slow for this reason, but you can't tinker that deeply with a network.

Traffic

The components of a network are always exchanging messages, if only to keep a link alive. Even when users are idle, there is a minimum level of traffic. For Ethernet, whose minimum packet size is 64 bytes, 500 workstations would generate 17K bits/sec, which is more than a V.32.bis modem! On top of that, temporary files increase the load, which could simply be solved by increasing the amount of RAM in the clients. Different versions of the same protocols can cause excessive collisions when they can't get through and have to rebroadcast, or if you regularly have fights between software generating large files.

When you get excessive collisions, and the cards back off and retry after a random time interval, you could get them locking up, which they tend to do after about 8 collisions. The only way round this is to switch the machine off and start again. One of the main causes of collisions are cables that are too long.

Client/Server

This is a way of reducing traffic by changing the place at which program operation takes place. If you run a database on your workstation, not only would you probably load the program from the fileserver, but also the data required for searching, so all your requests and their answers would be travelling over the cable, together with temporary files. However, if you moved the database to the server, so the searches take place there, only questions and answers would be transmitted.

A system of software called *middleware* allows you to mix and match systems (thus allowing you to keep old systems alive), and introduces the keyword *complexity*. The client/server arrangement allows smaller systems to emulate mainframe systems by spreading the load around the processors available, where SQL is typically the language used for communication. HTML works on a Client/Server arrangement.

Bandwidth Management

Otherwise, traffic capacity depends on bandwidth. Improve it by:

- **Adding more cable**, within the length limits allowed. For example, one way to improve on Token Ring is to have another cable going the other way round the circuit, so a packet can take the shortest route to its destination by selecting the appropriate line.

- **Splitting the network up** into segments at the server, and have an interface card for each segment (based on the thinking that the fewer users there are on a segment, the greater the effective bandwidth. As each segment improves, so does the network average). Then use the fileserver itself as a router to link the two (NetWare has excellent internal router software). A side benefit of this arrangement is an improvement in reliability, as one segment being down doesn't affect the other, but it also ensures that only traffic that needs to be in a particular place is actually there. Usually, you can have up to 4 NICs in a server. If you do, match the work to the cable.

- **Providing a dedicated link**. In practice, use switching to filter out unnecessary traffic and provide dedicated connections on the fly.

Bandwidth can be divided into a number of channels, and where this affects LANs is whether they are *baseband* or *broadband*.

Baseband

Baseband is a bandwidth with 0 Hz as the lowest frequency, having only one channel, thereby concentrating all its energy into one aspect, namely speed (this covers most LANs). Data is also transmitted directly, that is, in its raw state, not modulated in any way. Because all units use the same type of energy, only one signal at a time can travel along the cable.

Although potentially fast, the effective speed of baseband systems is slower than the official rating. With only one channel available, you can't retransmit on another one if there's a bottleneck, but have to wait till there's a gap.

Broadband

A broadband LAN can carry multiple channels on a single cable, so many communications can be active at the same time; more than 100 channels each, in fact, so this system compared to baseband is like a motorway compared to a country lane.

Because the overall bandwidth is subdivided into different ranges of frequencies (cable TV is one example), these networks require special tuning and strict procedures to work properly, which implies trained support staff.

Measuring Performance

You need to start somewhere, so the first problem is to find out how well your network is doing at the moment, for which you will need some sort of measuring tool. At its crudest, this could be something as simple as a stopwatch measuring the time taken to copy a large file around, every time you make a change. It's tedious, but cheap. As one reasoning for a network is file transfer, though, it's not far off the mark. Windows NT has *Performance Monitor*, that measures a number of parameters.

Protocol Analysers

At the other extreme is a *protocol analyser*, which is essentially a PC with special equipment and software that can capture packets and analyse them, so you can look on them as telephone-tapping devices for networks. Don't expect it to look like a PC (unless you build your own), but do expect to pay a lot of money for it, although there is one based on the HP 200LX palmtop. NT 4 has *Network Monitor*, which performs many of the functions required.

A protocol analyser joins the network in the normal way, and captures *all* packets; a client PC only gets those addressed to it. Facilities include:

- **Triggering**, for capturing packets on occurrence of certain events.

- **Filtering**, for displaying only packets you want to see.

You can also do the following:

- Check the **broadcast level**. Maintenance-type signals need to be as low as possible to make way for real traffic. This should be 8-10% at most, with peaks as people log in and out, affected by leakage from other networks, if attached; to detect them, filter out broadcast packets, and relate them to addresses (tedious!). Then get the bridges to filter them out.

- Check for **duplicate addresses**.

- Check **where packets spend their time**. If things are slow, and a packet ends up mostly in the file server, look there first. Track a complete conversation between client and server, and note the packet's location(s). Remember the figures are not absolute, as they would change with the equipment used; just use them for comparisons. An increase in memory may well solve the problem.

- Check **optimum packet sizes** or, more correctly, the block size of data in the packets, so you're not trying to push them through a point on the network that can't cope. Conversely, make sure you get the maximum data through where the system can handle it. A protocol's optimum packet or block size may not be the same as the hardware's. NetWare defaults to about 100, but can use over 1500.

- Check **overall bandwidth utilisation**. Normal average for Token Ring should 40%, with a peak of 65. Ethernet average would be 30, peak 55.

- Check **each node's use of that bandwidth**, and which are hogs.

- Check **response times**, or how quickly a server responds to a client PC's request. The accepted average for LANs is less than 100ms, or double that for a WAN.

- Check for **overlaps**, occurring when data from a file is duplicated inside the packets that transport it. For example, the first packet might consist of the first 100 records of a large file, and the second records 50-150, so there would be an overlap of 50 records. Check for inefficient applications.

- Check **protocol levels**—you may be getting leakage from other networks.

- Check for **bad packets**. If you get a lot, maybe caused by too many collisions, consider a store-and-forward switch.

- Check for **retransmissions**, which could be caused by different versions of protocols, faulty NICs or cables that are too long. Try and see what files are being continually opened; for example, **autoexec.bat** may indicate a bad **path** command.

The ideal is a low broadcast level, with no retransmissions, and low average and peak bandwidth utilisation so you don't get overloads.

The trouble is that a protocol analyzer can record *and play back* signals into a cable, so can be a security risk in the wrong hands:

- **Corrupting and Killing** is a method of getting a network to repeat itself. If the data is corrupted and killed, the network has to rebroadcast, and a lot can be deduced about your network from this.

- **Taping and Replaying** just records data necessary to get into a network, which is replayed as required, without even knowing what it means. This is one reason why encryption has to vary so much.

Hard Disks

One potential bottleneck in a network's performance is the hard disk on the server. It may be a good move to use two smaller ones (or as many as possible) to split the load of requests for access. This will also give an improvement in system reliability and the security of having backups available. Talking of which........

Fault Tolerance and Data Security

What happens when the network doesn't run? Nobody works, of course, but, more importantly, the information in it is inaccessible when you may need to fulfil contracts or legal requirements.
How much of a disaster this will be depends on your circumstances, but most companies will have a *disaster recovery plan* which is geared to getting the network up and running again in as short a time as possible, even to the point of having a spare building available, although this is often shared with other companies. Again, how much you spend on this is up to you, but the quicker the recovery you need, the more it will cost.

However, the best way out of trouble is not to get into it in the first place. Many network operating systems now incorporate system fault tolerance features originally incorporated in NetWare. Fault Tolerance is a procedure used in many industries as a means of coping with equipment failure, which is accepted as a possibility, but not allowed to stop a system from running; an aircraft is a good example, which will have dual (or triple) systems built in so a flight can progress safely if one of them goes wrong. A good example in the computer world is the RAID system, described below.

General SFT features include:

- **Disk mirroring**. Two hard disks are used, with one being an exact copy of the other (hopefully not the bad sectors!) and constantly updated. Although both could fail, it's statistically rare. You need a multiple channel card for best results, or better yet, two cards, as several drives on a single-channel card behave like a mini-network, that is, when one drive is speaking, the others can't, so the updating is slower.

- **Disk duplexing**. Duplicates the whole drive chain, including controllers, drives, interfaces and power supplies.
- **Transactional Tracking System**. Ensures that *all* changes being made to a file are carried out, or none. A copy of the original data is kept until the complete update has taken place; if not, the original data is replaced and the process aborted.
- **Hot fix**. Data on damaged areas of the hard disk is automatically rewritten to a safe area set aside for the purpose. This is mainly a NetWare feature, but other software will make copies of the equivalent of the FAT and have them scattered about the place.

RAID

This stands for *Redundant Array of Independent Disks*, or *Inexpensive*, depending on the magazines you read. It's a method of spreading data over a number of disks so it can be reconstructed after a disk failure, but performance can be better as well (this was, in fact, the original idea). It uses techniques called *striping* and *mirroring* to do this; striping distributes data across many disks at the same time, whereas mirroring uses duplicate disk drives, each of which contain all the data. Increasing the stripe size reduces disk latency and increases performance. For purely sequential access (video servers), this should be as large as possible, even up to the track size of the disks being used. Like an aeroplane with one engine out, you would get slightly less performance while one is out of commission, but life would otherwise continue normally until the faulty disk is replaced and brought up to date again.

The operating system will see the RAID system as one drive, so it can be useful if you just want to add more capacity without fiddling with drive letters or volume names (see Level 0). There are 7 official levels available; the three most popular (for PCs, anyway) are 0, 1, 3 and 5. Other manufacturers, such as Mylex, have their own systems on top.

Level 0 Basic striping with multiple spindles (drives). Gives best performance with no capacity overhead, but with no redundancy and therefore no fault tolerance, so restoration must be done from tapes if a disk fails, as data is not duplicated. Good for non-critical servers, or where sustained throughput is important, as performance is better with several drives rather than one; data can be read from more than one location. Needs a minimum of 3 drives. Your CPU must be working faster than the disk(s) can keep up.

Level 1 Just uses Mirroring and Disk Duplexing, so will only work with 2 drives and is most cost-effective for 4 Gb or less, but becomes expensive when you have to add one drive for every primary drive. Data is written twice simultaneously and can be read from alternate disks, depending on which one has the nearest head to the data, performance is good for reads but poor for writes. There is also low disk utilisation, as you can only use half the total available - 2 1 Gb drives are actually 1 Gb. Use for small read-intensive applications, or use level 5.

Level 0+1 Data striping on over 4 mirrored drives, a combination of the above 2.

Level 2 For mainframes—data is written a bit at a time to each disk in turn, with error codes for reconstruction written to a check disk –you must have a minimum of three linked to one controller. One ECC disk for every 4-6 drives makes it expensive for PCs, as ECC uses more space than parity codeand only provides a marginal improvement in utilisation. SCSI has error correction anyway. Little used.

Level 3 Transfers all data in parallel (that is, striping) to several data disks and one extra for parity checking (which leaves you with no redundancy if it dies, so look at level 5 if this is important). Good for large blocks of data, such as graphics or image files, and is commonly used with the Macintosh or fast workstations. Provides the same standards as level 2, but is cheaper.

Level 4 As for 3, but data is put on a block at a time. Little used.

Level 5 Uses at least 3 drives, which operate independently, with data and error recovery information (parity) interleaved across all of them, although parity information is not on the same disk as the data it refers to. if a single disk fails, it can be restored from the parity information , but if two go you need your backup tapes. Read performance is good, as parity is not used. Best suited to small-block transfers, as used in NetWare file servers or databases. It is more efficient than 2, 3 and 4, though not as secure as 1.

3,4 and 5 all use parity. The last is called *Dynamic RAID 3/5*. Although some operating systems (NT and NetWare) can do RAID-like protection in software, equivalent to Levels 0 and 1, anyway, there is no substitute for a proper controller in the PC, or a separate box outside. As RAID drives are hot-swappable, *hot spares* are useful, and the data will be rebuilt transparently.

If you do this with IDE drives, it’s worth noting that using UDMA reduces the CPU loading from around 90% to 5%. A RAID 0 system will be about twice as fast as a single disk, and a RAID 5 will actually be slower, due to the fault tolerance overheads. Disk striping without parity only needs two disks; with parity, you need at least three.

UPS

Uninterruptible Power Supplies sit between the mains and whatever equipment they feed, allowing electricity of whatever pedigree in, and a smooth supply out. Part of their job, therefore, is to supply continuous, clean electricity. The sort of things they clean up are *surges, spikes, noise,* or *sags,* otherwise known as *dirty power,* which technically is any power that fluctuates by more than 10%. Surges come in various voltages, the small ones of a few volts being by far the most frequent, but they last for less than a full cycle. Spikes, or *transients*, may be caused by lightning and can temporarily load the system with up to 5000 volts, albeit briefly (for one cycle). A sag is a momentary drop, typically caused by an extra load, such as an air conditioner. Brownouts, common during summer in North America, are longer drops in voltage, officially dipping below 10%. I’ll leave it to you to guess what a blackout is!

Surge Suppressors

Luckily, a PC's switching power supply is able to cope with these, and a so-called surge suppressor only needs to minimise their size. The simplest "shunt" type, placed across the AC power lines, has a minimum threshold of 300-400 volts, so your equipment must be able to cope with this directly. As they also take time to react, larger surges of smaller duration may still get through. A series protection is better, between the AC line and the equipment. they have a high degree of resistance at frequencies greater than 60 Hz, so can pass normal AC. The cost is directly proportional to how much current they supply and for how long, which can be anything from 5 minutes to an hour or a day. They are more important for networked installations, because the data is not so often saved to disk; network operating systems keep data in memory for speed and flush to disk at less frequent intervals than do single-user systems.

Where fault tolerance is involved, each server should be protected, but workstationsmight need it as well, depending on how important you think the work done there is.

Capacities

UPS capacity is measured in terms of power (volt-amperes) or energy (watt-hours). The former tells you how much equipment it can cope with and the latter for how long. Multiply the consumption of watts by 1.4 to get the equivalent for generation.

Generally, a UPS works by allowing the mains to charge a battery inside, converting from AC to DC, then powering the computer through an *inverter*, which converts the DC back to AC. As the input is separate from the output, batteries act as buffers to swallow nasties. There are two power paths, and a transfer switch is used to change between the two (the time taken is called *transfer time*). These double conversion units can be operated in *on-line* mode, or *standby*, the latter kicking in when the power actually drops, inside about 2 milliseconds, so the primary source is filtered AC. In this mode, the batteries don't get as hot and last longer. Also, you don't need such a large battery charger. When on-line, the AC is there as a standby.

However, life isn't that simple, as many on-line units are in fact standby. Official classes of UPS include:

- **On-line without bypass**—*has no backup power source*, and the inverter is a single point of failure.
- **Standby on-line hybrid**—as above, with a standby DC/DC converter. The current is rectified, that is, from AC to DC, then inverted back to AC continuously, so are also called *double-conversion*. The battery and converter are on a bypass circuit, in standby mode.
- **Standby-ferro**. Primary (AC) power goes through a transfer switch and a ferro-transformer that has three power connections. If AC power goes, the transfer switch opens and the inverter, which is always on standby, takes over. Unfortunately, the transformer is inefficient, and can generate a lot of heat and its own transients, even though it can filter AC. This is not an on-line unit.
- **Line-interactive**. When AC power is normal, the inverter is operated in reverse to charge the battery. Good for sites with very poor power supplies. Simpler design, and able to *boost* or *buck* the voltage to your requirements, , that is, drop the supply if there is a surge and increase for a sag. There is no isolation, though hot-swappable batteries are useful.

Computers draw power at a rate of 120 pulses per second (100 in Europe). The rectifiers (switches) inside the PC's power supply actually ensure that the PC is disconnected for 70% of the time! Capacitors store energy between pulses to provide a continuous flow inside the computer, but they can only hold a charge for about 50 milliseconds before needing a recharge. As this is done much more often than is required, a PC can actually operate without power for about 65 milliseconds. And in case you were wondering, a capacitor able to run a PC for 10 minutes would be the size of a video cassette!

Whether you need a UPS or not depends on how important your network is. One of the problems of running complex programs (particularly databases) is the inability to get back into them if they're not closed down properly, the same situation as if the power suddenly goes. This is usually because the equivalent of the File Allocation Table is not saved to disk (as it would be on a proper exit) and the software can't find anything again.

Some networks can send signals to a UPS over a serial cable, kick it into life and close down automatically in the proper manner. 5 minutes should be enough for this. If you need more than about an hour, consider a generator instead.

Design

Start with a pencil and some paper. The two main areas of concern are the customer and the network goals. Here are some suggested headings for your list:

- Server-based, or Peer-to-Peer? Cost, convenience, security and expandability
- How many nodes?
- Topology – distance limitations
- Media type (UTP, coax, etc, lengths and placement in the building – hostile environment?
- Cards in PCs – hardware compatibility
- NOS and Protocols
- Level of security & disaster recovery
- Type of business
- Skill of people using it
- Budget
- Commitment of people wanting it

Gotchas

- You need a lamp on the UPS, since the main lights will go as well.

- Just pulling the plug of the UPS is not a good enough test, since the other electrical devices in the building are not pulling at the current available, as they would in a real power outage, and typically the response time is actually longer, maybe 20-50%.

- Watch out for earth potential between buildings; cable has been known to melt under certain circumstances. If you must do it, Thick Ethernet, which has a max cable length of 500m, is probably best, with an auto-isolating transceiver at each end. Tie the cable to something more substantial, like rope. Try wireless?

- Check the equipment is as capable as your cabling is.
- Make sure the cable isn't counterfeit, it's not too long, and it's been installed properly (e.g. minimum bends, twist ratios, etc).
- Use military grade T-pieces (i.e. not ones that are glued together!).

Software

There are two types of software to consider; that which runs the network, and the application programs that do the work you require.

Application Programs

Provided only one person is using it, anything normally used on a PC will run on a network, because the network operating system should provide an environment that allows it to. All you need to do is tell the program where to find the files it needs, which is not necessarily on the computer it is run on.

The problems arise when the same *data files* need to be shared, and making sure that while somebody is using part of a file, the remainder is still accessible by others, or that alterations are not lost. DOS does not normally allow this, so most programs expect to have the computer to themselves, and behave accordingly, particularly with printing.

Network-aware software, on the other hand, is specially designed to behave itself in the following ways:

- ❑ You can load several copies at once without it getting confused over who's got colour screens, or not.
- ❑ It can recognise more disk drives from where it can get data.
- ❑ It allows more than one person to share data files (through *file* or *record locking*), and lets them keep their own directories.

- It will understand that printers need to be released immediately after a print job; as it doesn't expect anyone else to be there, single user software will tend to keep hold of the printer until it is terminated.

As long as only one person is allowed to write to a particular file at a given time (although several may read it), that is, it supports *file locking*, it should be usable over a network. If you don't plan to share files, you can run anything, provided there's no copy protection that hates networks. You will need to tell the program where to find its related files, so that if it's invoked from an unexpected path, it doesn't get lost.

Preventing Damage To Files

Simultaneous reading of files is not a problem (you would need this for the **.exe**, **.com** or **.ovl** files belonging to your program, for instance) but reading and writing together can cause any kind of trouble up to and including a system crash. The most common problems arise when several people wish to use a data file at the same time or, more specifically, write to it simultaneously.

Although a DOS **share** command allows a filename to be shared with a specified number of locks between application programs, this must be done every time the facility is required. Also, it doesn't keep track of who locked what. It does, however, allow an application to lock a range of bytes in a file for exclusive use.

File Locking

It's worth noting first of all that file locking can cause problems of its own, in particular the *deadly embrace*, which occurs when users lock files that others need to finish their tasks. You could wait for ever for a file to become unlocked, particularly if there's a queue, like a house buying chain.

Some products restrict access to only one user at a time; others allow multiple access to files, but no alterations until the original user has finished. A lot depends on how a program uses a file; some will load it into memory, work on it and then close it. Others load a file, close it for safety and reopen it later to save the changes.

There are three versions of file locking commonly encountered:

- **None**. Used where just viewing takes place (and the file is marked as *Read Only*).

- **Shared**. Used where information may be extracted from a file (say for printing). Even though you're technically just viewing, it ensures the printout reflects the file's contents *at the time of printing*; shared locking prevents others from changing things in mid-print.

- **Exclusive**. To change the file, you will need an *exclusive lock*, which prevents anyone else from doing anything that needs a lock—to use the previous example, printing while changes are being carried out. Similarly, you need to prevent writing to that file as well.

Locks can be *implicit*, that is, where the program assumes them based on your activity, or *explicit*, those that you consciously select.

Notifying Changes

Changes must be communicated to other users, and updated files must be circulated. Since even placing a lock on a file is an update, ways must be found of spreading the information around without clogging up the system.
The change could be made and the changes immediately sent to everybody, but this causes two problems:

- Other nodes that are due to receive the changes must be in a position to receive them, i.e. not doing anything else, which could be quite difficult on a busy network.

- Circulating changes increases the amount of traffic.

The file could be marked in a similar way to DOS, that is, in the file itself, or you could have a separate file to which any potential user must refer prior to going for the file required. This is called a *lockfile*, of which you could have three, one for file information (status, etc), one for area information (which parts are locked) and one for update information (the changes actually made). Lockfiles not only keep track of who does what and to where, but, more importantly, who else knows about it, or who has received the updates.

Licensing

As we said before, software used on a network is generally the same as normal, but additional licences will be needed to cater for the extra users. You can either buy a separate copy of a program for every person using it on the network, or use a *licence extension*, where a single copy of a product is licensed to a larger number.

Notes

Internetworking

Companies often want to join networks in different cities and make them look like one. "Internetworking" is the connection of two or more Local Area Networks, with the aim of turning them into one transparent entity, that is, a *Wide Area Network*, which will mean involving telephones – the connections could be *analogue* (normal telehone), *digital* (T1, ISDN or similar) or *switched* (X.25, Frame Relay).

Even inside a building, a simple connection to another LAN can vastly increase the effective range of the original; for example, where a Token-Ring network is limited to 96 nodes, just join it to another to get 192. This could be done in a building with different LANs on different floors.

Alternatively, you may be wanting to upgrade your present equipment and are unwilling to actually part with it; joining the old and new together would ease the transition. You could also access the company network with a portable computer (see below), or from home, as you would when teleworking. Connections over long distances are becoming popular, due to office rents being lower out of town. In this situation, your computer could be either:

- **A workstation in its own right**, in which case program code and data are sent over the telephone line. More powerful equipment is needed for this, if not an ISDN line, as performance will be significantly slower.

- **A terminal off a workstation on the network**, in which case, only screen and keyboard data are transmitted either way, so you can get away with more modest equipment.

Portables

The simplest connection is either a serial or parallel cable joined directly to another computer, commonly used for data transfer, but portables can be used directly as workstations.

As very few have expansion slots, this generally means using an Ethernet adapter that attaches to the parallel port, a PC-card, or software that allows the portable to attach to a workstation's parallel port and connect through there (*Lap2Lan* springs to mind).

Otherwise, you could use a *docking station* which is permanently attached to the network, into which you plug your portable. The nearest equivalent to that is a *port replicator*. It could be, of course, that your portable has connectivity built in, but this is comparitively rare.

Wide Area Connections

As we know, a WAN involves a third party, in the shape of the telephone company. The problem is that no telephone link can equal the bandwidth of a network—just over a tenth even at the 1.54 Mbps of a T1 line, so you will get bottlenecking, and notice even more the basic traffic a network needs just to keep alive. Normal telephone communications use compression to help in this situation, and so can WANs. With PPP at each end, you can use CCP, or *Compression Control Protocol*.

There are two types of compression:

- **Packet based**, which uses a "dictionary" to replace regular patterns with a token in the dictionary, which is exchanged for equivalent data at the other end. The bigger the dictionary, the better the compression.

- **History based**, which places new data in a dictionary at each end, and replaces it with a token when duplicate data passes through the system. This would certainly clear up broadcast packets.

As well as the above, packets can be filtered before they get on the link.

Advanced WAN environments include Frame Relay, ISDN and SONET (see below).

RAS

RAS stands for *Remote Access Server*. It's one way of expanding a network using the telephone lines (Windows 9x calls it *Dial Up Networking*, or DUN) connected to a machine on the network. It provides auditing, callback security, Security Host and PPTP filtering, but is only really useful below a bandwidth of 128 kbps

SLIP

Single Line Interface Protocol. An old standard, used with TCP/IP. It requires a static IP address for each node, is text-only, cannot encrypt logon information and is only supported by RAS clients.

PPP

Point-to-Point Protocol. An upgrade to SLIP, which supports TCP/IP, IPX, NETBEUI, AppleTalk and DECNet, encrypted passwords while providing data compression, error control and security.

PPTP

Point-to-Point Tunneling Protocol. As for PPP, but also secure transmission over TCP/IP, private links over the Internet (connections are encrypted), Virtual Private Networks, RAS and Security.

Telephone Lines

Unless the computers that need to talk are sitting next to each other, there needs to be some way of connecting them over long distances which, for practical purposes, means the telephone system, commonly called the PSTN in the computer industry, or *Public Switched Telephone Network*. Other people call it POTS, or *Plain Old Telephone System*. Refer to the Peripherals chapter for more information.

Frame Relay

A packet-switched service between Switched 56 and T1 giving 56-512 Kbps. It uses a virtual link, or *Permanent Virtual Circuit* (PVC), connects at up to 2048 Mb/s, faster than X.25 at 64 Kbps, of which it is a development (together with ISDN), because it doesn't do so much error checking, and has less overheads to cope with. That's left to software at each end of the link, saving you from doing the same job twice, as a high quality line is assumed. In fact, the address is read, and the packet passed, before it has fully arrived. The PVC is the equivalent of a dedicated line, and, because time isn’t used calculating routes, is faster.

A *Frame Assembler/Disassembler* (FAD) is needed for Frame relay; it does a similar job to a PAD on X.25.

X.400

X.25 is used for small packets of information, but there is no way of ensuring compatibility between formats at either end, which is where X.400 comes in, providing a message and address structure that helps to ensure that the data is actually understood by the receiving station, whatever it's being run by.

Basically, X.400 provides an "envelope" for the individual letters sent by X.25—what starts as a complete letter arrives as such and is sent to the right place, instead of being scattered. It's mostly used in corporate Wide Area Networks, as many people who implement it do so differently (well, there's a surprise). This is not desirable for Internet use, hence the development of MIME, which can transmit binary files as text.

PC-Mainframe Links

There are two ways a PC can integrate with larger computers, similar to a portable using the telephone:

- **Terminal Emulation**, or making the PC behave like one of the mainframe's usual terminals (say, a VT-100 for a DEC). Although only screen and keyboard information is sent, file transfer could be available as well, typically using Kermit or XModem.

- **Full synchronous links**, with the PC and host processing in sympathy over a network, such as Token Ring or Ethernet.

Any DEC Vax using VMS can act as a server for a PC network. Others with Unix would use TCP/IP, and NT would also be available.

Note that most mainframes only support 7-bit ASCII, so can only cope with printable characters (ASCII 32-127).

Connecting a Network to the Internet

Multiple access may require something faster and more convenient than the normal telephone line. Although performance itself won't be a lot different with ISDN, the connection process will be a lot slicker.

Your network needs an IP address for each PC on it, or use a proxy server, which will allow other PCs to connect through one address allocated to it, and has the side effect of hiding the other machines from sight. NAT (*Network Address Translation*) does the same, but not all software works with it.

You also need a router to connect with the telephone line at one end and the network at the other. It will expect to use TCP/IP. If you can get one that includes a DHCP server, you won't have to issue IP addresses for your workstations; they will be issued dynamically. This can be a PC with suitable software and not necessarily dedicated.

Managing A Network

Once a company becomes dependent on computers, proper management of them becomes extremely important. Aside from protecting the information they contain, there needs to be some sort of discipline to ensure the system is not overstrained and that those using it have a right to be there.

The Role of the Supervisor

The coordination and smooth running of a network of computers is the task of the *Supervisor*, or *Network Manager*. The job includes *data security* in the form of proper backup procedures, as well as the more mundane tasks of allowing people on to the system, making it easy for them to use, and so on. In smaller companies, this may include adding machines and other hardware to the network, but there may well be a technical department to do this for you. If there isn't, your job will essentially be split between setting up the system in the first place, and maintaining it thereafter. Actually, the idea is to maximise efficiency and productivity, using computers for automation as much as possible (see *Network Management Systems* in the *Troubleshooting* chapter). ISO specify 5 areas that need to be addressed, *Fault Management, Configuration, Security, Performance* and *Accounting.*

This chapter will assume you have a system already and deal mostly with maintenance, because this is how most supervisors come into the job. The network is usually inherited from somebody else, and you need to quickly get a grip on what they've been up to.

Supervising

On the network, you will have *Supervisor status*, which means that, amongst other things, you will:

- ❏ Decide what areas of the system people can get to.
- ❏ Determine whether they need passwords to get there.
- ❏ Restrict access to other areas.
- ❏ Load and update software.
- ❏ Maintain backups.
- ❏ Install new equipment and peripherals (maybe).
- ❏ Train users.
- ❏ Monitor network performance (check equipment and weed files).
- ❏ Keep yourself informed about new developments.
- ❏ Think about what could go wrong and take preventive measures.

All the above actually makes network supervision a full-time job. However, many companies will expect you to combine it with your normal duties (and without training!). Sometimes, you can delegate your authority and allow *Workgroup Managers* to do some of the above on your behalf. You will also need to appoint a deputy with equivalent security clearance to yourself, just in case you fall under a bus or something.

Users

Users are the people served by the network or, in other words, those who use it as a tool in the course of their work. Generally, they should not be allowed outside the strict confines of a menu or batch file system that controls where they can go and what they can do there. With proper automation, the network should be invisible to anyone using it—users will only be interested in the services offered and not the technical details. All programs should work normally, with the only difference being that more facilities are available, particularly disk drives and printers, which won't be physically attached to their computers, but somewhere along the cable connecting them.

You can make life much easier for yourself by grouping people together and treating them as one unit (e.g. a *Group*) for administrative purposes. Any changes affect all group members, so you cut down your typing.

Facilities

The facilities available to you as Supervisor include:

- ❏ Enabling and disabling user accounts.
- ❏ Specifying account expiration dates.

- Requiring user passwords, and specifying their lengths.
- Forcing periodic password changes.
- Forbidding the use of previously used passwords.
- Restricting logging on times, particularly useful in a university environment, where different classes are allowed access to the computer facilities on a shift basis. The normal use, however, would be to restrict logons during a backup session, because open files won't be backed up. You could specify, for instance, that nobody logs on between 2200 and midnight whilst backing up takes place.
- Restricting logging on at particular workstations.
- Restricting concurrent connections (e.g. not logging on more than once at the same time).
- Restricting disk space used (not with NT).

You don't have to use all of the above; they're just there in case you need them; what you get up to really depends on the size of your organisation and your local circumstances. As well as the above, the network ensures that each person has the right to continue being there by checking:

- Whether that person can log on during this time period.
- Whether the account has expired or has been disabled.
- Whether the account is out of funds (if applicable).

Security

Security can be difficult—on the one hand, you need a network that is open enough to share what it was set up for in the first place, and closed enough to guard against damage, loss and unauthorised access on the other.

If installed, *accounting systems* keep track of who's using what and where. Some companies charge internally between departments for network facilities, and you can produce figures for this purpose, but it's also handy for keeping track of network performance and intruders, since all logins and logouts are kept track of. Each person's account keeps records of resources consumed. You can charge for server time (the time logged in, or *connect time*), server disk space, or server requests (such as reading or writing files).

Otherwise, security revolves around *login procedures* and *rights of access*.

Rights of Access

You can allow or disallow access to files (or directories), and control what people can do with them by granting *privileges*; that is, you can allow people to operate in certain areas and work with files there up to certain levels.

Directory Level

Directory rights apply to the directory and any files and subdirectories in it. Typically, a person can:

Level	Action
Read	Read all files in a particular directory, or a single file.
Create	Create directories.
Write	Write to files
Erase	Delete directories or files.
Modify	Change attributes, or rename directories or files.

The ability to open a file is often assumed, but this may also be specifically granted. You give or take away the above rights through the *user account*, accessible through the setup or admin program.

File Level

File attributes provide further protection by overriding directory level security. For example, even if somebody is allowed to delete files in a directory, a *Read-Only* file is still safe.

Effective Rights

Those that can actually be exercised, despite what is theoretically granted.

Viruses

If users have permission to modify files, so has any virus brought in by them; Supervisor privileges (e.g. the ability to do *anything*) will also be transferred.

Printing

This was one of the original reasons for installing a network, when printers were expensive, since one person was not likely to use it all the time and it was more cost-effective to let others utilise any idle time (assuming, of course, that they have similar demands. A secretary frequently putting out lots of small memos will get very annoyed if the printer is hogged by somebody churning out 100-page documents). The suitability of the printer for the application concerned also needs to be thought about (you can't often use a daisy wheel with Windows), as well as keeping it supplied on a regular basis with ribbons or paper. The paper issue can get more complicated when you have to mix both headed and plain, or continuous and cut sheet.

Printing from a single PC can be bad enough—on a network it can be a positive headache, once *print queues* are formed. These arise from *spooling*, a process that allows printers to pause for breath occasionally during their work (computers can churn out data faster than the printers can cope with). The practical difficulty of this as far as you are concerned is that you cannot see the results immediately—in all probability you will either have to go to the print room or wait for somebody to bring it to you.

The word SPOOL allegedly comes from *Simultaneous Peripheral Operation On-Line*, an operation that is supposed to give the impression of doing two things at once. The computer's output is fed to disk instead of the printer and placed in an orderly queue, where the jobs are processed in order of priorities previously set by you.

In this way, programs that process files as they print (rather than just sending them and forgetting them) are fooled into thinking that the job has been completed and are ready for something else.

Even a small office will generate long queues, so each print job is normally separated by a sheet with the user's name on it. This is called either a *banner* or a *separator page*, and you should go through a process called *despooling* if you don't want to print something you've already sent on its way, otherwise you'll confuse the printer (such as opening up the print queue and deleting it, with **pconsole** with NetWare, or Print Manager with Windows).

You will need to understand how each application you propose to use carries out its printing tasks, and whether the printer needs special setup codes. A common problem is that some programs do not send an end-of-file character at the end of printing, which means the inconvenience of having to leave the program before the print job is accepted.

One solution here is to specify a 5-10 second *timeout* (usually as an option with **capture**), telling it to insert the required character if nothing is forthcoming from the computer (watch out for programs that take some time to assemble graphic images, however).

As many programs expect to send their output directly to LPT1 (or whatever), there needs to be some method of redirecting it to a queue. The relevant command for NetWare is **capture**, mostly issued from a login script (preceded with #) so it is active all the time.

Multi-user versions of many packages know about all these problems, including whether to send a banner page or not, and may be able to bypass queues (Windows for Workgroups can find NetWare queues with no problems). They also allow users to have private dictionaries and formatting defaults.

Talking of Windows for Workgroups, you still might need the **j=** setting that comes with **capture**, even though the software itself is theoretically not needed, if you get garbled print jobs. This forces a NetWare print job to be used, rather than the Windows driver, which might be causing the problem. Needless to say, you need to set up the print job first!

On a typical network, a wide variety of users will send a wide variety of print jobs, all of which needs to be coped with properly, to produce high quality output with the minimum of delay. The larger the network, and the larger the variety of work, the higher in specification the printer needs to be, in terms of:

- ❏ Reliability.
- ❏ Ease of use, configuration or attachment to the network; eliminate the need for a print server, so you don't get a bottleneck at the parallel port. External Network Printer Adapters typically use bidirectional parallel ports and can reduce the bottleneck quite markedly.
- ❏ Resolution; the highest dpi doesn't always give the best quality.
- ❏ Speed and performance (13-25 ppm or more).
- ❏ Capacity and flexibility (several paper bins for different sizes), as people want to print documents with letterheaded and plain paper).
- ❏ Language support.

- ❏ Emulation switching, automatic *and* reliable.
- ❏ Font handling. Laserjet IIs can only hold 32 soft fonts.
- ❏ Running costs.

Just remember that 200 users printing 10 pages a day means at least 40,000 pages per month, which is well above what a "normal" laser printer can cope with. Aside from the possibilities of it breaking down, you've got to keep filling it up with paper and changing cartridges.

Don't just rely on the engine; you will probably need lots of memory to handle complex graphics and to provide page protection, together with a fast processor. Some have hard disks to keep fonts on.

5 users per printer seems to be a good ratio, but some companies have 1 to 1, and some more. Printing as a task on a network is generally given a low priority, which can adjusted as the workload increases, so printing speed can be somewhat variable. Users, unfortunately, will see this as a problem, and if you can't get speed, at least be consistently slow.

A print server can help, as will a printer with a dedicated network connection, as some of the load will be taken off the fileserver. In addition, it will allow you to have more printers on a NetWare network, which traditionally routes everything through the server.

A print server doesn't need to be anything more than an old PC running **pserver** (with NetWare) or similar. With Windows for Workgroups, make sure it has a little extra memory, otherwise it will lock up when multiple jobs hit it.

Please make sure people can get to it easily! Aside from complaints from users if they have to travel too far, somebody's got to look after the thing.

Notes

Windows

You can use Windows 3.x or 9x on a server on a small network, where all you need is data storage and a convenient backup system. This requires less admin, but they both suffer from memory leakage and you shouldn't run applications under it (i.e. the server should be dedicated), especially DOS-based ones. NT Workstation is a little better, but doesn't allow remote administration and you require the same user accounts on each server if you have more than one.

Where do you want Windows installed?

Installing Windows on to a server is not necessarily where you want to end up. Let's have a look at the pros and cons of where to put it, although this discussion is not so relevant if you have newer machines. You might, though, have older ones, and the data from a NetWare server arrives faster than it would from a local hard disk (this used to be a common situation not so very long ago). That is, unless you get burgled regularly, in which case you've probably got the latest equipment already.

Workstation only

Doesn't interfere with the network, so doesn't use server disk space. On the other hand, you need loadsa space on the local hard drive, but large hard disks are standard now.

Server only

Generates maximum network traffic and uses max server HD space. Updating means you don't have to trawl round all the machines in the building, possibly important with '95. It's worth installing on to a server, even if Windows will be used locally, as it's easier to install from another hard disk (like using a CD-ROM). Windows allows you to copy the files first to a server, then do a proper install from there to the workstation (logon first, of course!). You end up with a directory full of Windows files that can be shared and the personal files for each user either in the user's directory on the server, or on their workstation. Having setup one user, you can copy their files to set up others very quickly. Or, you can use an automated setup routine, with the **setup.shh** file (below), to install a complete copy from the server to the user's directory or hard disk.

Windows '95

Windows '95 uses a *push* (server-based) or a *pull* (client based) installation. In the latter, the PC initiates a script that runs the install routine. The files are then pulled down to the PC. The former is an automatic process. Both methods use the **netsetup** program, in **\admin\nettool\netsetup** on the CD. This runs from a client and puts everything onto a server (you can only install '95 on to a server from another '95 system).

You can create a custom client setup script with it, which will answer all the questions a user will normally get asked. The resulting installation file is called **msbatch.inf**, which can be changed manually, like **setup.shh** for Windows 3.x (see below). To get a pull installation going, type:

```
netsetup msbatch.inf
```

from the client, then go away and have a couple of coffees. It's not that clever, though, and can be tedious if you've got a lot of machines to install. Windows '95 has 32-bit client software for most networks, that is, NT, NetWare, Vines and Sunsoft. Other manufacturers may well supply their own. You need the client software under *Microsoft* for NetWare networks; that under the Novell heading is *16-bit*. Also, '95 does not use **netx** or **vlm**, but **nwredir**, which may not be compatible with your software.

SETUP Command Switches (3.1x)

Those specific to networking include:

Setup /A *Administrative Setup*. Copies and expands files to server, which gets 14 Mb fuller over about 20 minutes. You can do the same to another server from the first server. Don't use **copy**.

Setup /N *Network Setup*. Sets up Windows on to your workstation or a user directory from the server; i.e. a shared copy with a small number of user files, such as **grp**, **ini**, **pif** and **win.com**; the remainder stay on the server.

Setup /H Allows a "hands off" installation, with the **setup.shh** file. Use the command:

```
SETUP /H:SETUP.SHH /N
```

You could have **.shh** files reflecting different configurations, for example with SVGA screen drivers, so you could call it **svga.shh**. You can add **/n** if you want a shared copy.

Setup /F From *outside* Windows for Workgroups (3.11), allows you to force network card detection.

Network card detection

Comes with Windows for Workgroups and doesn't always work! Once you've got the right card, you can tell whether your setup works when you start Windows; it will tell you whether it's found the card or not. You don't need to reinstall Windows to change any settings, but go through **protocol.ini**.

Browse server

All machines share a list of shared resources, such as names of machines, shared directories and printers. This *Master Browse List* can be located on one machine in a negative sense, by excluding the rest of them from the job. As this will slow down the performance of the machine concerned, make sure its not yours! The main symptom of this is momentary hanging while you're doing something, when the network information is updated. See the **[network]** section of **system.ini**.

Setting up a Windows Network

It is assumed that your PCs already have Windows installed, and that you are using PCs with network cards installed, as opposed to a direct cable or dialup connection (below), but if not (say you build a new machine), installing Windows first for *No Network*, then adding the networking stuff later is the least troublesome method, even though it may seem the long way round. It is *not* a shortcut to try and do everything at the same time, especially on Friday, about an hour before everyone goes home for the weekend!

In fact, it's always a good principle to install Windows for no frills first, then add complexities later, which avoids situations where autodetection fails and you have to reinstall, and you haven't got the original disks. This is particularly relevant where your Windows is preinstalled, and you forget, or can't be bothered, to make a backup copy. At least you get the files expanded and copied, and have something you can work with.

Gather the equipment:

- **Enough cable**, but not more than 185m for the first segment, or a tenth of that for 100BaseT, made up professionally and *tested*. Cables are like drains—you need to have them done properly, but you don't see the benefits until you get problems (or rather don't get them), which is when you wish you'd spent the money. Even cabling off the shelf can be suspect, and you can spend hours tracking down a fault which arises purely and simply from cabling. It simply isn't worth taking shortcuts.

  If you have to do it yourself, try not to use screw-on coax connectors, and check the continuity with a multimeter; just one stray earth strand can stop the whole show. Any competent electrician can do the job—you don't need a network engineer, certified or otherwise.

  For UTP, buy a proper crimper.

- **Hub**, if using UTP.

- **Adapter card** for each PC, suited to the bus with instructions and/or software to set up the IRQ and I/O address settings.

- A **T-piece** for each interface card, if using coax cabling. These are usually supplied in the box with the card, but if have to buy them separately, make sure the joints are welded, that is, have proper *electrical bonding*. Cheap ones are simply glued together, and create the same effect as a bad cable, causing just as much hassle when it comes to tracing problems. Relative to the cost of the whole system, T-pieces are insignificant, so pay the money.

- Two **50-ohm terminators**, one for each end of the (coax) cable.

Hardware

Set up the network cards, with switches or jumpers for older cards, but with software otherwise. Plug and Play cards should be able to look after themselves as far as resources go, but if you have to manually select them, IRQ 5 and I/O address 340 should avoid most devices already in your machine, with IRQ 10 as a good alternative (IRQ 3 and I/O address 300 are the usual defaults, but don't forget to disable COM 2). Also, with legacy cards, you should reserve the IRQ for that card through your BIOS setup. When you input those settings into Windows, you are only telling it where to find the card, *not* changing its settings.

Insert the cards in the normal way, and connect up the cabling. For UTP, simply plug one end of the cable into the card, and the other into the hub, then make sure the hub has power.

For coax, attach a T-piece to the adapter card, and a cable to each open end, so you end up with one very long cable punctuated by PCs, not forgetting the terminators, of course. Ensure all connectors are fully twisted on. If the cabling isn't available quite yet, place a terminator on each end of a T-piece and put it on the adapter card by itself, which will fool Windows into thinking it's attached to a network while you're playing around. It's not always needed, but sometimes Windows hangs if not set up this way.

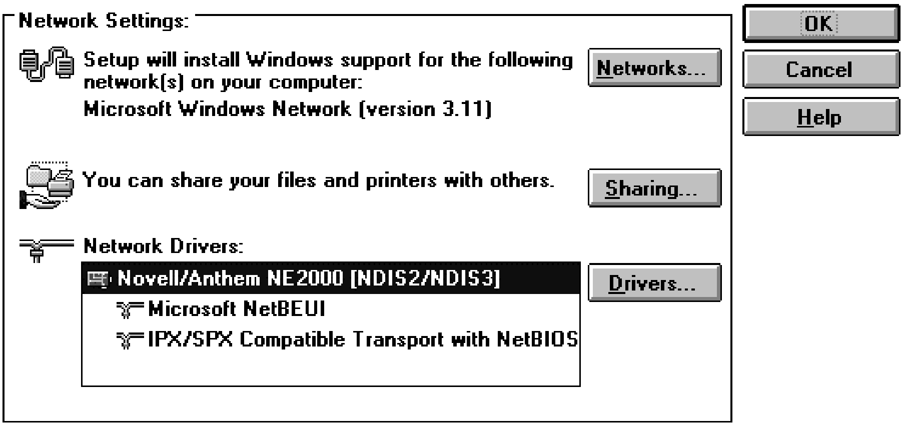
Network Adapter

In theory, Windows '95 will automatically find this next time you boot up, but you can also install through *Control Panel*, then *Add New Hardware*. In this case, since you presumably know what you're installing, don't let Windows autodetect all your hardware, it may take ages. Select *Network Card*, then the manufacturer and type. If yours is not in the list, you should have an accompanying disk, in which case use the *Have Disk*.... option and proceed as instructed. This is an area where '95 is often too clever for its own good, and may not let you put your proper IRQ and I/O address settings in. Just give in and let it carry on, and change them later through the *Properties* option in the *Device Manager*, under *System* icon in Control Panel after a couple of compulsory reboots.

You won't get autodetection with NT 4, but the procedure is similar, also through *Control Panel*, but with the *Network* icon. You can add the card you require by clicking on the *Adapters* tab, then the *Add* button. Windows for Workgroups 3.11 is set up in this way through the

Network group, and the *Network Setup* icon. All the items you need to adjust are in the resulting dialogue box:

Behind the **Networks** button, click on the *Install Microsoft Windows Network* radio button. Similarly, behind the **Sharing** button, enable the file and printer sharing, as required. For the network card, click on **Add Adapter**, then select yours from a list. If your card uses it, you will be asked for Interrupt setting (the **Detect** button only attempts to find the make of the card). The NETBEUI protocol will be selected automatically. Then click on successive **OK** buttons.



When you reboot your machine, Windows should come straight up with no error messages. If you do get one, probably saying that the network card is not working properly, the most likely cause is a resource conflict (e.g. wrong IRQ). Don't forget that PCI cards can share IRQs.

Protocol

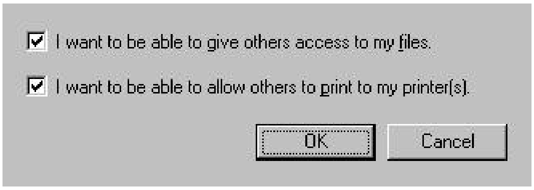
So now Windows knows about the card—how does it use it to send data over the cable? The answer is with a *protocol* which must be bound to the card. For straight Windows networking, the choice is simple, NETBEUI, which is just an extended version of the original NETBIOS created by IBM.

Luckily, it's usually selected automatically, but otherwise, with '95 and NT 4.0, done through the *Network* icon in *Control Panel*. In Windows for Workgroups, use the *Network Setup* icon.

Services

As we said before, each machine on a peer to peer network shares some of the administration tasks, and with '95 and NT you will need to specifically load some of the functions you expect the machine to provide. Again, through the *Network* icon in *Control Panel*, click on the *Services* tab in NT, or the *Configuration* tab in '95, and ensure that the Server and Workstation services are loaded in NT and *Client for Microsoft Networks* is loaded for '95. For the latter, also make sure that the *Primary Network Logon* box shows the same thing.

You should also have been asked whether you want *File and Printer Sharing* during installation, but check that this has been activated, or you could spend many fruitless hours later looking for a problem in the wrong place. Simply click on the box and make sure both squares are ticked:



NT seems to assume you want File and Printer Sharing anyway.

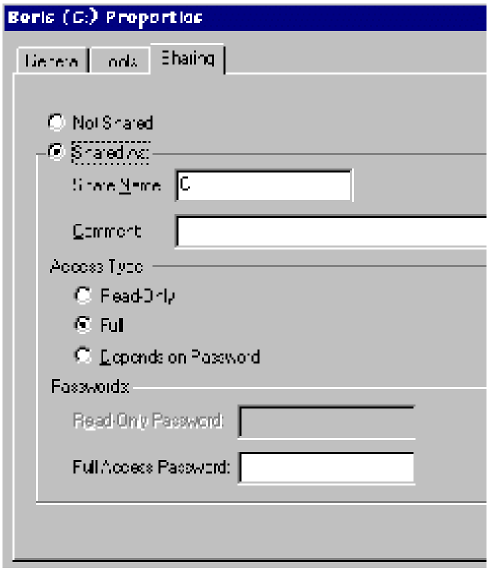
Workgroup

When you installed networking, you would have been asked for a name for the computer, for identification purposes. All the computers attached to the same hub or cable will be regarded as one workgroup, and the default name for this is WORKGROUP, oddly enough, but a common reason why machines aren't seen on a Windows network is that they may have ended up with a different or misspelt workgroup name, so check now, through the *Network* icon in *Control Panel*, that the workgroup identification is exactly the same for every machine.

Testing 1-2-3

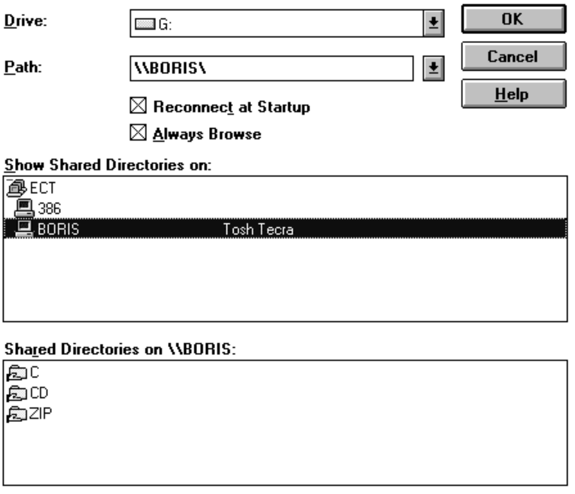
We should already know that the hardware's OK, because Windows hopefully is not complaining as you start it up. As to whether the machines are talking to each other, this can be checked simply by trying to connect a network drive from one machine to another. If all is well, the machines in the workgroup should be seen from File Manager or Explorer, but first, the machines (or drives) you want to be seen by others must be made visible, also done through File Manager or Explorer. In Windows for Workgroups, go through the *Disk, Share As...* menu.

Otherwise, right-click on the drive and select *Properties* through Explorer.



Under the *Sharing* tab, the suggested share name will be the drive letter, but you might want to change this, maybe to CD, or Zip, Jaz or whatever, and of course you don't have to share the whole drive, you can make only one directory shareable if you want, which must be given a drive letter. The suggested name in NT 4.0 will be C$ (for C), for example, and it's important to note that this is administrative, so you will have to push the *New Share* button and create one for C by itself, otherwise you'll be there all day again, trying to find out why you can't see it. Make all shares Full, with no password, just to get the system running—you can change all that later.

Now you have to go to any other machine and see if you can find the drives you artificially created. Open up File Manager in Windows for Workgroups, and select *Connect Network Drive* under the *Disk* menu. You should see the workgroup name and the machines found on it about halfway up the window, and the shared directories on the selected PC below:



As you click on the drive you want to get to, you will see the path name being completed at the top, together with the proposed drive letter.

Tip: if the network is working, but you can't see the drive later, check the **lastdrive=** setting in **config.sys**.

With '95 and NT, just go to the bottom of the left hand window in Explorer, where you should see a folder called *Network Neighborhood*, with a plus sign to its left. Click on the plus sign, and you should see the machines visible on the network; clicking on any one should bring up a list of shared drives in the right hand window. If you can't see anything, try the *Refresh* option under the *View* menu to force Windows to look again.

Printers

These are shared and subsequently found in the same way as drives are, only through *Print Manager* (WfW) or under the *Settings, Printers* section of the Start menu for '95 and NT. For the latter, you will be asked whether you want to install a local or a network printer, so just proceed according to the instructions. In Windows for Workgroups, use **Connect Network Printer** under the **Printer** menu. You will get a similar display to the one in File Manager for connecting network drives.

One important thing to note is that you need the drivers for that printer on the local machine, even though your using the printer from another, because there is no way of using the remote printer's drivers, so have the disks for your printer to hand.

DOS Machines

DOS machines can join in the fun—you need the following files:

```
NET.EXE
NET.MSG
PROTMAN.EXE
PROTMAN.SYS
PROTOCOL.INI
```

Don't forget your network card driver. Run **net use** to activate and join the network.

Problematic Settings

These **system.ini** settings (in 3.x anyway) are worth watching for networks:

[386enh]

AllVMsExclusive=	Forces VMs to run full screen, avoids mem conflicts.
EMMExclude=	Ranges of memory to block out.
FileSysChange=	Alerts Windows when a DOS app creates, renames or changes a file. Can affect performance, and cause File Manager not to refresh screen displays.
InDOSPolling=	On if TSR uses Int21. Apps won't run if DOS is busy.
InDOSPSP=	Helps control TSRs that use Int21
Int28Critical=	Prevents TSR conflicts. Off if network uses Int28.
NetAsyncFallback=	Whether Windows will attempt to save a failing NETBIOS request by increasing a temporary buffer.
NetAsynchTimeout=	NETBIOS timeouts of VMs to allow the LAN to complete its processing.

NetDMASize=	Buffer size for NETBIOS software transfer.
NetHeapSize=	Controls size of data transfer buffers .
NoWaitNetIO=	Allows faster multitasking.
PSPIncrement=	Additional VM memory.
ReflectDOSInt2A=	Use on if your software uses Int 2A.
TimerCriticalSection=	Whether only one VM will receive timer interrupts. Avoids a deadlock with LAN IRQ initialisation code. May slow down the network. Set greater than 10000.
TokenRingSearch=	Check off if not using Token Ring.

[standard]

Int28Filter=	Detects idle time. Try a lower number.
NetHeapSize=	Size of conventional memory buffer.

[boot]

Network.drv=	Name of network driver.
CachedFileHandles=	Number of most recently used **.exe** and **.dlls** open, and kept in memory. Helps with problematic Windows software when running from the server. Default 12, reduce down to 2.

[NonWindowsApp]

NetAsyncSwitching	Allows DOS app to receive comms while in background in Standard Mode by preventing Windows from switching away from an application that has an asynchronous link across a network using NETBIOS.

[Network]

InRestoreNetConnect	Re-establishes net connection if set to 1.
Network=	You need *dosnet and *vnetbios unless otherwise specified.

Lantastic!

For version 3.x, add the following lines to the **[386enh]** section in **system.ini**:

```
EmmExclude=D800-DFFF
InDOSPolling=True
NetHeapSize=76
NetAsynchFallback=True
NetAsynchTimeout=50
For v4.x:
EmmExclude=D800-DFFF
NetHeapSize=64
NetAsynchFallback=True
NetAsynchTimeout=50
PerVMFiles=0
InDOSPolling=True
```

```
3+Open LAN Manager 2.0
```

Also, make these changes in the **[386enh]** section:

```
TimerCriticalSection=10000
UniqueDOSPSP=True
PSPIncrement=5
```

3COM

The path statement should always be re-established. Don't load drivers for 3Com 3Station diskless workstations with AllCharge cards in upper memory. Make the following changes in the **[386enh]** section of **system.ini**:

```
TimerCriticalSection=10000
UniqueDOSPSP=True
PSPIncrement=5
PerVMFiles=0
```

Banyan Vines

Version 4 can support Windows, but needs patch 1A. Version 4.10 and upwards don't. 4.1(5)1 is best for Windows 3.1, as it doesn't need **netbios** for printing.

- ❏ Logon before starting Windows.
- ❏ Change the **[386enh]** section of **system.ini** for v4.0x:

```
TimerCriticalSection=5000
UniqueDOSPSP=True
PSPIncrement=5
```

- ❏ Change the **[386enh]** section of **system.ini** for v4.1x:

```
Network=*DOSNET,*VNETBIOS.Winesd.386 [baninst.386]
device=vvinesd.386
TimerCriticalSection=5000
UniqueDOSPSP=True
PSPIncrement=5
```

Novell

The latest Windows drivers for NetWare are in a file called **winup9.exe**, available from your favourite bulletin board. In the UK, Apricot is a good source, on 0121 717 0444. Otherwise:

- ❏ Make sure you have shell v3.26 or higher.
- ❏ Never log out from a DOS session under Windows.
- ❏ Increase **File Handles=** in **shell.cfg** or **net.cfg** to 60.

- ❑ With a diskless workstation, set the temporary swap file paging size to 128K and have **ShowDots=On** in **shell.cfg** or **net.cfg**.

- ❑ Have a valid **temp** statement for printers, and make sure the directory is large enough (> 6Mb), not cluttered with other files.

- ❑ Check these **printcon** settings:

```
AutoEndCap
Enable Timeout
PrintBanner
File Contents
Suppress Form Feed
Disable Print Manager
```

- ❑ Add these lines and appropriate settings to **net.cfg**:

```
SPX Abort Timeout
SPX Listen Timeout
Show Dots
NETBIOS Broadcast Count
NETBIOS Broadcast Delay
File Handles
Environment Pad
Search Dir First
SPX Connections
Print Heads
```

- ❑ If using **rprinter**, redirect the local printer through the network, to avoid corrupted printouts.

- ❑ **pserver** should be at least v1.22.

- ❑ **ipxodi.com** should be at least v2.0.

- ❑ **ipx.obj** should be at least v3.1.

- ❑ Cure the Black Screen of Death with **bsdup1.zip**.

Make these changes in the **[NetWare]** section of **system.ini**. The first line restores the network drive mappings when you leave, and the second doesn't allow drive mapping changes in one DOS Session to affect others.

```
RestoreDrives=true
NWShareHandles=true
```

nwpopup.exe may need either replacing or **TimerCritical=10000**, so you get a longer time delay before a timed out sequence is activated.

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NetWare

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Instant NetWare

Netware is an operating system in its own right, which means you don't need DOS or Unix to run it, even though they might be needed to load it (it will run as a task under OS/2). Well, on the server, anyway – workstations need requester (redirector) software to be able to join in the fun. Version 2 works on 286s, 3 on 386s and above, as does 4, which is better than the others at multi-server networking and WAN connectivity. version 4.11 is otherwise known as *IntraNetWare*, implying it’s for businesses with their own private Internet, but it’s really the full blown product. The current issue is version 5. Netware works with Ethernet, Token Ring and ARCNet, together with protocols such as IPX/SPX, NETBIOS, AFP, TCP/IP and FTP.

Later versions of NetWare run dedicated, that is, use the server solely for serving, as running non-dedicated, like with 2.2 and below, saps performance and is not recommended (**routegen** is actually 2.2 with only the routing functions enabled).

Purchasing is done with the number of licensed users, and any software you buy to run under it, such as ArcServeIT (backup software) follows whatever licences the server has. 4.11, for example, starts with 5-user versions and goes right up to 1000. You can combine versions, to save you buying a complete new CD, and you can have more users created than the licence allows, as the restriction only applies to people actually logged on.

NetWare was originally developed around the Motorola 68000 processor, which had nothing like DOS (or even CP/M) that could be used with it, so Novell wrote something of their own from scratch, in C, so it was easily portable when PCs based on Intel's x86 chips became popular. However, since the idea was for multi-users to be multi-tasking, Novell had to bypass the PCs hardware if they wanted an effective fileserver, because it was designed for single user, single tasking applications. Netware uses the X500 directory structure, and is administered through **netadmin** if you’re using DOS, or **nwadmin** from Windows.

As NetWare talks directly to the PC's components, DOS is unable to use the hard disk drives, but Novell uses them more efficiently anyway.

The Hard Disk

DOS allocates space on a disk sequentially, where sectors are used one after the other, so you have to trawl through the whole lot from the beginning every time you want something, because only forward searches are allowed in the File Allocation Table (or FAT), which is what DOS calls the index of a disk. If the next request from block 900 is for data on block 899, then the search starts again at block 1 instead of merely going backwards one sector—this can happen each time a request is made.

NetWare, on the other hand, uses *elevator seeking*, which allocates priorities to disk accesses according to where they are, coordinating disk head movements so that data can be collected or delivered *en route* to other places, rather in the same way that an elevator will stop to collect people on the seventh floor whilst going up to the tenth. This can increase disk throughput by anything up to 50%.

Disk *writing* is also separated from *reading*, which allows the former to become a background task for quiet periods. Data is stored in a *cache block* until that block is full or a certain period has gone by, so all the write requests for the same area of the disk are serviced at the same time.

Volumes

A volume is similar to a DOS partition, but you can have one volume over several disks, or several volumes in one disk. They arise because block sizes on the hard disk (in NetWare 3.12 and below) are set by volume, i.e. between 4-64K. Although larger block sizes are more efficient and use less memory, if you use a lot of small files with them, you could waste a lot of disk space (as you do with clusters in DOS). There's nothing to stop you creating a special volume for a particular application that works best with larger block sizes. Volumes can also handle different file systems.

Many people, when installing NetWare, take the default of 1 volume called SYS and put NetWare and applications/data into it. However, SYS volumes often used to crash when full, and it became a trick of the trade (after 3.11) to create SYS just for NetWare and put everything else in another volume. Thus, when you do crash, you create SYS again and find the other volumes - if everything was in SYS, you would lose the lot. A similar principle applies to NT, but for a different reason; in this case, there is no protection against users taking up too much server disk space, so with two partitions you have a chance of containing it.

It's not a good idea to span one volume over several disks without some sort of protection such as RAID or mirroring. Apart from size restrictions (65,000 directory blocks or 2m directory entries), you might lose one disk and be unable to use the volume.

Disk Cacheing

Many applications use the same files over and over again, and it makes sense to try and store these in memory to make access quicker. NetWare monitors the parts that are used most often and gives them priority storage space.

Most of NetWare's memory is used for cacheing, so if you're short of memory, the amount used for other system purposes may have to be reduced. For versions prior to 4, memory used for cacheing should be between 40-60% of total memory, and never less than 20%. It doesn't help, with NetWare, to use a hardware cache on the server; in fact, it may slow things down.

A useful side-effect of cacheing of whatever sort is the reduction in *file fragmentation*, which is the usual cause of hard disks losing their performance edge. Thus, the more memory you have for cacheing, the less the effects of fragmentation you will suffer.

Memory

Because the memory in the server is used as a cache, you need to increase it as your hard disk gets bigger. The directory information is also kept in memory for faster performance. There is quite a complex calculation as to how much memory there should be, but as NetWare itself takes up approximately 2.5 Mb, and you don’t load less than 4 Mb in a 486-based PC anyway, you're best starting there, which will cover you up till about 512 Mb. 8 Mb per Gb is a good rule of thumb to begin with, but you can never have enough.

What remains after NetWare has loaded and sorted itself out is known as *cache buffers*, and is borrowed freely from by other processes as they load (NetWare 3.x has 5 areas). Unfortunately, they don't always pay it back, and a file server can eventually suffer from a similar resource problem to Windows, where everything slows down as the server's cache memory is used up – Netware 4 only uses one main pool, and memory is completely returned every time. A lot of senior administrators make much of how long their server has been up and running, but it only shows their ignorance. A (3.x) server should be **down**ed approximately once every week to ten days to keep complaints about speed from users to a minimum. When your server starts, a number of cache buffers are allocated, and the amount available can be found by loading the monitor program at the server (**load monitor**). The bigger the gap between the original cache buffers and those remaining, the quicker you need to reboot your server.

Netware is also non-preemptive, which is why it has the edge over NT, as well as providing file locking, for databases that can’t do it themselves. x86 chips are also good at I/O, which helps, as NetWare is not processor-intensive, although an **nlm** might be. In fact, a 486/33 is only noticeably better than a 386 when heavily loaded.

NetWare 4x uses NDS, which presents resources in a logical hierarchy, regardless of how the network is physically constructed. It also allows people to login only once, whereas NetWare 3.x, being bindery-based, requires people using the network to know a little about the system itself, particularly what servers the resources they need are attached to, and how to log on to each one that is en route to them. The Bindery only relates to the server it’s located on, so account information needs to be duplicated across the network. NetWare 4x gets around this by *replication*, so it is accessible from anywhere.

NDS

Netware Directory Services is a hierarchically organised database that came in with version 4, which allows logging on from a single point, rather than hopping from server to server as you had to do with 3.x.

MHS

The Message Handling Service is a network-wide email system, compatible with most systems.

Minimum Requirements

Take a note of these (nudge, nudge, wink, wink)!

Version	CPU	RAM	Free HD Space
2.x	286+	2.5 Mb	20 Mb
3.x	386+	6 Mb	30 Mb
4.x	386+	16 Mb	105 Mb
5	Pentium+	64 Mb	550 Mb

Drive Mappings

If you have a single-user background, you are no doubt used to the idea that floppy drives come in two flavours, A and B, and that everything else is allocated names upwards from C, which is usually the first hard disk. In other words, a physical storage device is described by a letter.

The good news is that NetWare doesn't do things this way! Sure enough, your floppies will still be A: and B:, and local hard drives anything up to E:, but other drive letters will refer to a *directory path on the server's hard disk*, and not a physical device as such; a "logical drive", in other words, so, when people on users log on to drive F:, as far as they're concerned, there is such a drive, but they've really latched on to a path on the file server's hard disk (all of which will become clearer shortly). The first available network drive letter will depend on the **lastdrive** setting in the workstation's **config.sys** file. If this is E:, then they will login on drive F:, as described above. If it is P:, then try Q:. With **vlm**, though, the replacement for **netx**, you would set **lastdrive=z** in **config.sys** and place a **first network drive=** line in **net.cfg** (see later).

The fileserver's NetWare hard disk partition (you will have a DOS one as well, for booting with) is divided up into *volumes* that are given names. The first one is always called **sys**: (short for **sys**tem), because this is where the NetWare operating system files are kept. On a small network it's quite common to put your program and data files in that volume as well, but it's not a good idea.

If, for any reason, the system files get corrupted, you won't be able to get at your data without considerable difficulty, if at all. It's far better to split the hard disk up into separate volumes (say one for each department of the company), and keep only NetWare in **sys**:. Then, if you get a problem, you only need to run **install,** reconstruct that volume and the others will be found automatically (with 3.1x and above).

When the fileserver starts, each volume on the hard disk is *mounted* in turn (you cannot delete a volume without *dismounting* it first). Each one contains subdirectories, and we are back on familiar territory, except that now you allocate drive letters to pathnames, which is known as *Drive Mapping*. It's very similar to the way the **subst** command works in DOS, in that you can take a directory path and substitute it with a spare drive letter, to save you typing the whole lot out when you want to change to that directory.

For example, to allocate drive letter F: to **sys:public**, you would type (from a client PC, having logged on):

```
map f:=sys:public
```

Every time you log on to F:, you will actually be in the **\public** directory in the **sys**: volume. For the first level, NetWare uses a colon instead of a backslash. **map** commands can be placed in a *login script* (of which more later) so they can be established every time a user logs in. It's even possible to allocate different paths to the same drive letter based on the user's *login name*, done with variables (X: is usually the drive letter allocated to a user's private directory).

There are four directories automatically set up inside **sys:** during installation, and they are:

Directory	Use
SYS:SYSTEM	Never usually touched by people.
SYS:PUBLIC	For the main bulk of user programs.
SYS:MAIL	For people' s Email.
SYS:LOGIN	Where people login from.

So if you wanted to map the letter G: to the MAIL directory, you would type:

```
MAP G:=SYS:MAIL
```

Again, note the colon in between SYS and MAIL—it's always used after the volume name. If you went further down the structure, you would use the traditional backslash:

```
MAP G:=SYS:MAIL\FRED
```

Where FRED is the private directory of the user FRED.

There are three types of drive mapping. *Network drive mappings* happen after the manner described above, in that you assign a letter to represent a route to the information you want. *Local drive mappings*, on the other hand, relate to complete drives on the workstation.

A *search drive mapping* (of which there can be up to 16) acts in the same way as the **path** command in DOS, giving the computer a standing instruction where to look for files before it tells you it can't find what you want. The difference is that **map** affects data files as well as program files, unlike DOS, whose **path** command only acts on **.bat**, .**exe** or .**com** ones (so **map** combines the functions of **append** as well, which is useful for large databases).

The complete list of drive mappings appears on the screen when you login, somewhat like this:

```
Good morning, SUPERVISOR
Drive A   maps to a local disk
Drive B   maps to a local disk
Drive C   maps to a local disk
Drive D   maps to a local disk
Drive E   maps to a local disk
Drive F:= [servername]/SYS:SYSTEM
Drive G:= [servername]/SYS:MAIL
Drive H:= [servername]/SYS:LOGIN
SEARCH1:=Z:[servername]/SYS:PUBLIC
SEARCH2:=Y:[servername]/SYS:PUBLIC\DOS
```

SEARCH2 has been mapped to a directory on the file server containing an operating system (i.e. DOS), where everyone can obtain it, so it doesn't take up space on their hard drives. You can improve this by using variables:

```
PUBLIC/%MACHINES/%OS/%OS_VERSION
```

where % represents a variable name you can point to, making it easy to have several types of DOS available. The above could translate to:

```
PUBLIC/IBM/DOS/3.3
```

If you need to see what's what at any other time, type **map**, then **Return**.

There is a convention for drive naming, where the first 5 drive letters (out of the 26 available) are for local drives, and the remainder are for network drives, working forwards. If left to itself, NetWare will create search drive mappings from Z: and work backwards, so there is as large a spread as possible between the two types:

Drives	Use
A-E	Local drives.
F	Network home drive (SYS:).
G-L	Users.
M-N	For single-user software, or that used with difficulty on networks.
X	User's home directory.
Y	DOS for workstation: PUBLIC/%MACHINES/%OS/%OS_VERSION.
Z	SYS:PUBLIC.

Privileges

Directory rights are determined by *trustee assignments*, which are administered by a program called **syscon**, or **netadmin**, or **nwadmin**. Here they are:

Assignment	Use
Read	You can read all files in a directory, or a single file, so you don't need Read for the directory the file is in.
Create	You can create directories.
Write	You can write to files.
Erase	You can delete directories or files.
Modify	You can change the attributes of directories or files, or rename them.
File Scan	You can see filenames when viewing a directory.
Access Control	You can modify file trustee assignments, which means that you can grant rights to other users (except at Supervisory level, where you have to be a Supervisor).
Supervisory	You can grant all rights and enable any user with this right to do the same for users and groups with files or directories they are responsible for.

Security equivalences

To save you time and overworking the brain, you could grant a *security equivalence* to a user. Equivalences only apply to rights *actually* assigned (as opposed to *equivalently* assigned); for example, Fred is equivalent to Sue, but Tom's equivalence to Sue (the actual user) does not include equivalence to Fred. Supervisors have all rights in all directories.

Attributes (Flags)

Files and directories can be given special properties, or attributes (flags), that control the way they are used. For example, you can prevent a file from being deleted or copied by anybody, regardless of what access rights they may have. All access privileges are overridden by file attributes.

In all file operations, the ability to open a file is assumed, whatever the subsequent action (that is, you've got to open a file before you can read from or write to it). The attributes include:

Attribute	Use
Archive needed (A)	This is assigned automatically to files modified since the last backup.
Copy Inhibit (C)	Stops Mac users from copying any file to which this is applied. This overrides the Read and File Scan access privileges, and you need Modify to remove this attribute.
Delete Inhibit (D)	Stops you from erasing directories or files (overrides the Erase right). You need Modify to remove this attribute.
Execute only (X)	Prevents copying or backing up files. Only use it with files that have .com or .exe extensions. This attribute cannot be removed, and only supervisors can apply it, so keep a copy of the files affected, just in case. Some applications may not run properly with this.
Hidden (H)	Hides directories and files from sight, and prevents them from being deleted or copied. However, if you have File Scan rights, you can see them with the NDIR utility.

Attribute	Use
Purge (P)	Purges a file immediately it is flagged for deletion.
Read Only/Read Write (Ro/Rw)	Indicates the ability of a file to be modified. All files are flagged automatically as Read Write upon creation, and thus can be modified at any time, unless Ro is set. Ro automatically activates Delete Inhibit and Rename Inhibit, which thus override access rights. You must have Modify to remove this attribute.
Rename Inhibit (R)	Prevents you from renaming directories or files. You must have Modify to remove it.
Shareable (S)	Allows several people to use a file at the same time; usually used with Ro.
System (Sy)	Hides system files and directories from DIR scans, and stops them from being deleted or copied. If you have File Scan rights, you can see them with NDIR.
Transactional (T)	Activates the Transactional Tracking System, or TTS, so that all intended changes are made to the file, or none at all.

Mostly, you should have *Read* and *File Scan* only, and no rights on the root directory of any volume. Rights stemming from Trustee Directory Assignments filter down the directory tree, so if someone has Write access at the root directory, they have it in every subdirectory below it (unless explicitly limited elsewhere). And these assignments are not located in the bindery, but on each volume.

As well as trustee and access rights, people can inherit them from parent directories, provided that one of the rights in the two directories is granted to a group.

Login Scripts

Just as DOS has an **autoexec.bat** file to do the repetitive start-up sequences at the beginning of the day, so NetWare has **autoexec.ncf**, **startup.ncf** and *login scripts*, for people using the system, created and edited through the administration program.

As with batch files, you can get as complicated as you like, with branches, and conditional commands like IF, THEN, ELSE, etc, but remember it may not be you that has to sort out the mess later! Keep it simple!

There are three types of login script. The *system login script* is operated first (if it exists), then the *user login script*, followed by the *default* if there is nothing else.

In general, it's best to put as many commands as possible in the system login script, and minimise the use of user login scripts, so you don't use up so much disk space (important when you've got a thousand users). Use the **exit** command as the last line, so people can't use their own utilities.

System Login Script

This operates system wide (i.e. global) and is maintained by the supervisor. It is valid for all users and used each time they log on. It is disguised as **net$log.dat** in **sys:public.** Its contents should map a search drive to the **sys:public** and **sys:public\%machines\%os\%os_version** directories (for PCs, this will translate to something like **sys:public\ibm_pc\msdos\v3.30**). Your DOS may not be on the fileserver, of course.

Don't forget **comspec=s2:command.com**, so that **command.com** reloads properly every time you leave an application. The sample lines below are a bare minimum, and will ensure that users are able to access the utilities they need and that **command.com** is reloaded properly when they leave a program:

```
MAP INS S1:=SYS:PUBLIC
MAP INS S2:=SYS:PUBLIC/%MACHINE/%OS/%OS_VERSION
COMSPEC=S2:COMMAND.COM
```

If you want to preserve any current drive mappings, use **map ins** (MAP INSert), so they are not overwritten.

User Login Scripts

These are text files called **login** in the relevant user's **\mail** directory (e.g. **sys:mail\user_id**) and are specific to particular people. They override system login script settings, and are also run at login time. Don't use S1, S2 or S3 designations, since that will override the system settings. In other words, start from S4.

Empty ones prevent the use of the default script (rather like the way an empty **autoexec.bat** file bypasses time and date prompts in DOS).

Default Login Script

Finally, something that is not a login script as such, but a series of commands contained within **login.exe** (in **sys:login**) that act as a default login script if the other two can't be got at for any reason (otherwise it is not normally used). It cannot be edited. This "default" login script is quite simple, establishing a search drive for PUBLIC and a DOS directory—enough to get you up and running, in other words. However, it does overwrite any PATH instructions from DOS, so the only search drives available to that user would be **sys:public** and **sys:public/dos**.

Commands Used In Login Scripts

Command	Use
MAP	Allocates drive letters to directory paths.
MAP INS	As above, but preserves previous path settings.
COMSPEC	Where to find command.com.
WRITE	Displays text in quotes on the screen (for messages).
PAUSE	Means what it says.
REMARK	Allows you to make comments within the script for later debugging.
FIRE PHASERS	Makes a Star Wars type noise to catch someone's attention, like with an error message.
#	Used in front of an external command, such as capture. It runs the command, then returns to the login script, like call in a DOS batch file.
EXIT	Leaves and terminates the login script, which means that if you want to run a program automatically afterwards, you must enclose the command in quotes, so the text will be taken as input to the keyboard buffer.

You can also use normal conditionals (IF...THEN, etc).

Security

Firstly, login security provides authentication and verification of a username, and associated passwords and time restrictions. You also have Trustee Rights that dictate where you can and cannot go, and directory and file attributes.

Most well-known intruder tricks are for NetWare 3.x, so upgrading to v4.11 will be your first step to defeating them, or at least 3.12 (the minimum specification for NetWare 5 is quite high now – you can't get away with a 486 any more).

With 3.x and above, move all **.ncf** files to a more secure location (such as a Zip drive or the **\nwserver** directory in the DOS partition), possibly replacing them with false ones with fake passwords. These files assume the security equivalent of the console (i.e. server), so adding unwanted lines to them can be potentially dangerous.

autoexec.ncf would be the obvious target, because it is part of an automated process (i.e. booting), and therefore not watched an awful lot, but **astart.ncf** and **astop.ncf**, which belong to **arcserve** are good ones, too. For this reason you might want to restrict access to various **nlm**s, such as **setpwd**. Lines like these in any files are a dead giveaway:

```
UNLOAD CONLOG
LOAD SETPWD SUPERVISOR SECRET
CLS
LOAD CONLOG
```

Although **conlog.nlm** will not be operating, you can still see the unloading and reloading process in the console log. **cls** keeps any activities off the server's screen.

rconsole allows you to manage a server from your workstation, allowing just about any *admin* action to be performed, so it's a good target for intruders. The password is contained in the 7th packet (186 bytes long) sent after entering the password, having chosen the remote server you want to connect to. It's in the first 8 hex bytes at offset 3Ah. Any password changes with **syscon** will be in plain text as well, so you might want to add a few strange characters.

One mistake with **rconsole** passwords (in 3.x, anyway) is to use a switch (**/p=**) that looks like it only accepts the Supervisor's password. What it actually does is set the password to the switch, i.e. **/p=.** An undocumented switch is **-np** which is No Password. In 4.02+, there is a file called **ldremote.ncf** in **sys:system** which has all the entries in it. It can be called from **autoexec.ncf**, or its line in there can be edited To ensure the Supervisor's password will work, add the hidden **-us** switch.

Remove **rconsole** from **sys:public**, as by default everyone will have access to it.

Use the *Lock File Server Console* option in **monitor** (3.x and above), so that even if the **rconsole** or admin/supervisor password is discovered, or physical access is gained to the server, a hard-to-guess password on the console will stop someone from getting to it.

Get the [Public] Trustee out of the [Root] object's list of Trustees. Anyone, even those not logged in, can see virtually all objects in the tree, giving an intruder a complete list of valid account names to try. Copy **login.exe** to the local hard drive. Not only does this speed up logging in (well, maybe a bit), but it stops others with trojans being introduced. Just in case the local copy gets affected, copy a new one during the login process.

Lost Your Password?

If you forget your own supervisor password, simply delete the files that contain the security system (actually, renaming them is better), which, in 3.x and below, make up part of the *Bindery*. The information in it includes user names and groups, passwords, server names and how they all relate to each other. Each object has a unique bindery ID and is categorised by its object type (a directory's trustee list is actually a group of bindery objects).

Objects in the bindery are *permanent* when written to the hard disk, and *dynami*c while existing in RAM beforehand. In 2.x, the files are **net$bind.sys** and **net$bval.sys**. 3.x has **net$obj.sys**, **net$val.sys** and **net$prop.sys**. For 4.x, look for **partitio.nds**, **block.nds**, **entry.nds**, **value.nds** and **uninstal.nds** (don't look too hard for the last one as it may not be there). If you just lose the password, try **setpwd.nlm**.

First, you need physical access to a server, and you need to be able to **down** it. Boot with a DOS floppy that has a sector editor on it, and look for the filenames described above, changing their extensions to **.old**, rather than **.nds** or **.sys**. The file names should all be near each other and separated by some code, with at least 32 bytes between them. Look for the other copy as well (NetWare stores the information twice for security), to prevent directory structure problems.

Login from any workstation as Supervisor, and you will not be asked for a password. For NetWare 4, type:

```
load install
```

at the server prompt and install the Directory Services. Once you use your own password at the prompt, you can logon as required.

Here's another way for earlier versions:

Boot the server and look for the **net$bind.sys** and **net$bval.sys** files.

Once you find them, identify the starting offset address of the first letter of **net$bind.sys** (e.g. the letter N), and change it to read O, ot, in other words, from 4E to 4F. Do the same for **net$bval.sys**.

Next, change the file attribute for each file. Directly under the line you just changed will be one like this:

```
00f0 26 00 00
```

Change 26 to 20 in both files. Then save the changes, making sure you do it to the correct sector.

When you reboot in NetWare, the binderies have disappeared, so new ones will be created. If you now logon as Supervisor, no password will be required.
Change to the **sys:system** directory and type:

```
showfile oet$b*.*
```

to make the old bindery visible. Type:

```
del *.old
```

then rename the **oet$b*.*** files to **net$b*.old.** You should now have new, empty binderies with the old ones as **.old** files. Type:

```
bindrest
```

to restore the bindery files to their original status, and all prior users will be restored. As you are logged on as supervisor, use **syscon** to create another user, to whom you will grant supervisor rights (this is so any password changes to the supervisor accounts are undetected). Depending on how long you want to use the system, you might just do this to **guest**, but password-protect the account so no-one else can use it.

And here's a quick way for 3.x – use **lasthope.nlm**, which renames the bindery and downs the server. Reboot and you have Supervisor and Guest accounts, with no password.

Removing NDS

This is dangerous, but it gets your Admin account back. Type:

```
LOAD INSTALL -DSREMOVE
```

As a part of the process of removing it, you will be asked for the Admin password – just make one up and keep going past any errors.

Getting Account Names

The guest account should at least give you the ability to run **syscon**, from which you can get a list of users, including their full name. If you can get better access, run **userlst.exe**.
From a DOS prompt, you can use **map.exe** to map a drive from your workstation. If the account name you try at the prompt is valid, you will be asked for a password. If not you will get an error message. attach.exe can be useful here, too.

During the installation of 4.1, **public** has browse access to the entire tree because it is added to **root** as a Trustee. The Inherited Rights Filter flows this down unless explicitly blocked. If you have the **vlm**s loaded and access to **cx**, you don't even have to log in, and you can get the name of virtually every account on the server.

Out of the box NetWare has the following default accounts:

```
supervisor
guest
admin (4.x)
user_template (4.x)
```

All start off with no password. Here are some typical extra accounts, with easy-to-guess names, which will either have a password of the same name or none at all.

```
PRINT
LASER
HPLASER
PRINTER
LASERWRITER
POST
MAIL
GATEWAY
GATE
ROUTER
BACKUP
WANGTEK
FAX
FAXUSER
FAXWORKS
TEST
ARCHIVIST
CHEY_ARCHSVR
WINDOWS_PASSTHRU
ROOT
```

root is found on Shiva LanRovers, and gets you the command-line equivalent of the AdminGUI (no password by default). Most people just use the AdminGUI and never set up a password. **chey_archsvr** is for **arcserve**, a tape backup program. Its password for v5.0g was **wonderland**. **backup** (or similar) may well have extra privileges, and don't forget **alt-255** or **not-logged-in**.

False Addresses

This will depend on the NIC in the workstation. Typically you can do it in the **Link Driver** section of **net.cfg** by adding the following line:

```
NODE ADDRESS xxxxxxxxxxxx
```

where *xxxxxxxxxxxx* is the 12 digit MAC layer address, assuming you are using NetWare's ODI drivers - if you are using NDIS you will have to add the line to a **protocol.ini** or **ibmenii.nif**, which usually has the lines already in it. **userlist /a** will list all accounts currently logged in, with network and node addresses.

For an IP address, you may have to run a TCPIP **config** program to make it work (depending on whose IP stack you are running). Some implementations will have the mask, the default router and the IP address in **net.cfg**, some in **tcpip.cfg**. There may be others.

Intruder Detection

Novell's way of tracking invalid password attempts. While off by default, most sites will turn it on. There is a setting for how long the server will remember a bad password attempt, usually 30 minutes, but can be anywhere between 10 minutes to 7 days. There is also one for how many attempts will lockout the account, usually 3, but between 1-7. Finally, there is the default 30 minutes for how long the account is locked out, actually ranging from 10 minutes to 7 days.

When an Intruder Detection occurs, the server beeps and a time-stamped message is displayed on the System Console with the account name that is now locked out and the node address the attempt came from. It’s also written to the File Server Error Log. A Supervisor or equivalent can unlock the account before it frees itself up, and the File Server Error Log can also be erased by a Supervisor or equivalent. You can expect a lot of lockouts on a big network, which doesn’t mean you should necessarily ignore them.

You can also restrict peoples’ use by time and workstation location.

Printing

NetWare Print Services can handle up to 256 printers, in several ways, such as a local printer to a PC compatible workstation or a Mac, or a shared printer hooked to a fileserver or the LocalTalk part of an AppleTalk network. Each has its own advantages and disadvantages.

A local printer is attached to a client PC, so the printer serves only that workstation unless special utilities (such as **rprinter**) are used. This makes sense if the printer is either meant for a specific application, is kept busy or needs a lot of attention while it works (some plotters don't have automatic paper feed, or need continuous two-way communication with the application).

NetWare for Macintosh allows PCs and Macs to share printers, but there are limitations regarding the placement of printers for easy access, especially Postscript compatible ones.

PC printers tend not to say too much to their controlling computers, apart from necessary handshaking signals, whereas the Mac expects continual interaction from a LaserWriter—the printer is actually on the network as a device in its own right.

Shared PC printers are attached to the fileserver, up to five attached to either serial or parallel ports. To access a shared printer from NetWare, use the **spool** or **capture** command, depending on your version of NetWare.

As an aside, the default NetWare speed for a serial printer is 9600 bps (it’s hard to find in the menus).

Setting Up A Print Server

First, catch a spare PC, which can be any old thing lying around. Then log it on to the network, as a user with appropriate privileges.

- ❑ Run **pconsole**, go into Print Queue Information, and you'll see a list of print queues.
- ❑ Press Insert.
- ❑ Type in the name of the new queue, and press Return. Don't use the default queues (with names like **printq_0**), because the underscores may cause problems.
- ❑ Repeat until all the queue names are on the list.
- ❑ From the main menu, select Print Server Information.
- ❑ Press the Insert key and type a name.
- ❑ Select Printer Configuration. Pick one of the 16 "Not Installed" selections (the most printers that can be managed). Remember the number if you intend to run a remote printer from a client PC; you may need it later for **rprinter**.
- ❑ Press Return on the printer number.

Use a name that best describes the printer's use (it's only used for menus and status screens). With regard to printer type, if connected to the machine running **pserver**, use *Local*. Otherwise, select *Remote*. Accept the defaults for all the settings.

Return to *Print Server Information* menu, select *Queues Serviced By Printer*.

Select the printer from the list, then press the **Insert** key to link a queue to the printer. Accept the default priority. Repeat this for each printer connected to the print server machine, and each remote printer it will manage. Once the server is running, type:

```
LOAD PSERVER PRINTER
```

at the **:** prompt, where *printer* is the name of the print server. You will see a status screen with a box for each of the 16 printers, in one of which will be the name you called the printer, together with its status.

With NetWare 286, copy **pserver.vap** from **sys:public** to **sys:system**. Down the server and restart it. At some stage you will see: *"Value Added Processes have been defined. Start them?"* Say *Yes*, after which you will be prompted for the name of the print server. From a workstation, just type:

```
PSERVER PRINTER
```

(you can start the print server without logging in if you copy the files to the workstation). Note that you must add the line:

```
SPX=60
```

to **shell.cfg** or **net.cfg**.

Remote Printing

Run **rprinter** on the workstations that have printers attached. Copy **rpr*.*** to **sys:login**, which will enable you to run **rprinter** without logging in.

Add the following lines to **autoexec.bat** (after IPX, etc):

```
RPRINTER PRINTER 1 -r
RPRINTER RPRINTER 1
```

The first line disconnects the remote printer, just in case a workstation has been rebooted. Again, add the line:

```
spx=50
```

to the **shell.cfg** or **net.cfg** files.

Backing Up

NetWare has its own backup software, called **nbackup**, which will use workstation hard disks or tape streamers, if it finds them. However, it 's not sophisticated, and you continually have to enter fresh answers to the questions it asks, which is both inconvenient and hard to work out for inexperienced people.

There are many third party programs that will automate the whole process, and even include workstations by loading memory-resident software at each workstation to talk to the server.

The Bindery

The Bindery is a database containing data on users and network resources, which sits at the heart of every NetWare fileserver (3.12 and below). It consists of three files in the **sys:system** directory. Two of them, **net$bind.sys** and **net$bval.sys**, are locked and hidden (although they are continuously open), while the third, **net$acct.dat**, is updated regularly with accounting data as the network is used.

The information in it includes user names and groups, passwords, server names and how all these items relate to each other. Each object has a unique bindery ID and is categorised by its object type (a directory's trustee list is actually a group of bindery objects).

Objects in the bindery are *permanent* when written to the hard disk, and *dynamic* while existing in RAM beforehand.

Bindery files should be backed up frequently, but restoring them needs extra care—you should never overwrite a current version with an old one.

Changing File Servers

Upgrades happen all too frequently, and it's not just individual bits. Often it's more convenient to change the whole fileserver. It sounds easy, but it isn't! The main problem is how to save yourself the trouble of typing out all the user details again. The easiest way is to install NetWare on the new server (off the network) and then connect it up. When you log on from a workstation, it will identify itself (assuming you gave it a different name than the original; if not, NetWare will get VERY upset and beep at you until you change it).

Use **nbackup** to backup the original fileserver on to your workstation, but only backup the bindery which, of course, contains the details of your users and groups, etc. Then restore to the new fileserver, and your system is as it was. You could, of course, include the data in the backup if you wanted to.

Tip: To upgrade a hard disk, take the server offline, add the new disk and mirror the two. After several coffees you should find the contents of the old disk have been transferred, and you can take the old one out.

Commands And Utilities

Only a selection of the most useful ones are given here, but, like DOS, only 20% are used 80% of the time anyway. There are two types, *menu-driven* and *command line*, which are mostly run from workstations, but some command line utilities are used on the server. They are marked with a C in brackets (C). Almost everything revolves around **syscon**, the admin program.

Loadable Modules (VLMs)

These are memory resident programs that lurk in the fileserver.

Utilities

These live in the **sys:public** directory. Those for supervisors come later.

Command	Use
ATTACH	Access another server while remaining logged in to your current one (normally, you get logged out automatically).
CAPTURE	Use this to capture data sent to a parallel port and redirect it to network printer queues and files. You can redirect up to three LPT ports, and they don't actually have to exist.
CASTOFF	Stops any messages sent to your workstation from appearing on the bottom line of the screen (otherwise any running programs would stop).
CASTON	Does the opposite, of course.
COMCHECK	Checks communications between servers and workstations.
CONSOLE (C)	When using a non-dedicated fileserver (with 2.x), CONSOLE is used in conjunction with the DOS command to toggle between workstation (DOS) or file server mode. Type DOS to get back to being a workstation. You need to run this before you run the DOWN command.
DOS (C)	See CONSOLE
DOWN (C)	Closes down the fileserver properly; files are closed and the cache contents written to disk before the power is switched off, otherwise they would be lost (with NetWare, data is assembled in RAM before being written to

Command	Use
	disk). Note, however, that DOWN does not park disk heads.
FILER	A menu-driven file maintenance program whose major benefit is allowing you to get rid of complete directory structures without deleting files in them first. Its two main functions are selection and maintenance; selection, because it's sometimes like looking for a needle in a haystack when searching for files on a hard disk, and maintenance, because you may not want to keep them anyway.
FLAG	Changes file attributes.
HELP	Gives you quick reference to using other commands.
LOGIN	Allows you to gain access to the fileserver's resources.
LOGOUT	Logs you out of file servers you are logged in or attached to.
MAP	Allocates drive letters to directory paths.
MENU	Lets you set up a menu system of your own. It uses text files created with an ASCII text editor. Some memory hungry applications might not load if you use this.
MONITOR (C)	A fileserver program that lets you know what your users are doing and how the server is coping with the workload..
NBACKUP	Backs up and restores fileservers to and from workstation hard drives and tape streamers. Runs from a workstation.
NCOPY	The same as COPY (in DOS), except that it's used to networks and is faster.
PCONSOLE	Sets up the print server and controls network printing.
PRINTCON	Customises print jobs, and is used in conjunction with PRINTDEF (below).
PRINTDEF	Allows full use of a printer's capabilities on a network. It creates a database of device and form definitions (page sizes, for instance) which you can get with NPRINT and PRINTCON. This is how you would tell the system what control codes your printer needs (and when) to get the results you want.
PSERVER	Runs the print server. PSERVER.VLM is for the fileserver, PSERVER.EXE is for a workstation and PSERVER.VAP is for a NetWare 2.x fileserver. Only use one at a time.
PURGE	Permanently removes files marked for deletion.
RENDIR	Renames directories or subdirectories, assuming you have Parental or Modify rights.
SALVAGE	Recovers files marked for deletion.
SESSION	A short term (e.g. valid for a session) menu-driven management tool that allows you to set up drive mappings as well as send messages to users or groups.
SET TIME (C)	Sets the date and time kept by the server.
SYSCON	The admin program that the whole network revolves around. Use it to create users and groups, grant access rights, sort out passwords, control accounting and edit login scripts. It makes the tea as well.
USERLIST	Displays all users currently logged on to your file server, as well as all users on all the file servers you are attached to. You will see the connection number, user name, network and node address, and the login time of each person.
WHOAMI	For a quick view of what directories you have rights to, together with other information relating to their username. It comes with five options; you can specify the fileserver (servername), groups you can belong to (/G), security equivalence (/S), effective rights (/R), or all of the above (/A).

Supervisors only!

These are in the **sys:system** directory, and are primarily for supervisors, because of the potential problems if the average user got their hands on them. In order to preserve security arrangements, if you need to give anyone else the use of anything listed below, just copy it into their own directory.

Command	Use
BINDFIX	Repairs the bindery. It will make backup copies of the original Bindery files (see below) in the SYS:SYSTEM directory, which will be used by BINDREST (even further below) in case of disasters. These files will have a. OLD extension, and it's a good idea not to delete them until you're absolutely sure they won't be needed. It also purges (with your permission) previously deleted users, trustee assignments, groups and passwords, and is best

Command	Use
	operated with all users logged out, as many facilities won't be available to them while it's working.
BINDREST	If you muck up the bindery even more after using BINDFIX (above), BINDREST will restore the original files that program saved as a safety measure. This is done by renaming the NET$BIND.OLD and NET$BVAL.OLD files in the SYS:SYSTEM directory to NET$BIND.SYS and NET$BVAL.SYS and placing them where they should be.
DOSGEN	For creating a boot file in SYS:PUBLIC so that you can use with remote boot PROMs on diskless workstations.
RPRINTER	A TSR on a workstation that allows its printers to be used by any other workstation.
SYSCHECK	A diagnostic "SYStem CHECK" to determine proper cabling of a (single) network's workstations—it does not cross bridges. Although SYSCHECK normally tests only the workstations' NICs, it is possible to include those on the file server.
VREPAIR	Corrects minor hard disk problems without destroying data in a volume. It is run on the fileserver from DOS.

The Mac (NetWare for Macintosh)

Macs are different for several reasons. Leaving aside the question of whether they're better or not, they have a different file structure (than DOS), for one thing, which allows names of up to 32 characters per file or directory (folder). This therefore means that a Mac user can easily read a DOS filename, but not *vice versa*, as a Mac filename will simply get cut short. However, NetWare caters for this by adding a number to each file transferred from Mac to DOS, to prevent overwriting of files by ones with similar names after truncation occurs.

The file structure is different, too. PC files contain all their information (including data) in themselves; the extension is the only way of detecting what type of file it is. Mac files, on the other hand, are split into two parts, a *data fork*, and sometimes a *resource fork* if it's actually a program, which contains details of system resources, such as code, icons and sounds. Each file also contains *creator code*, which is four characters that identify the program that created it, so it knows which icon to show on the screen.

The Mac operating system also recognises all 256 ASCII codes, whereas DOS only takes note of 128 (it leaves the rest to individual applications).

With Macs, printers and other peripherals are *on a network*, as opposed to just being joined to their computer by a cable.

LocalTalk

This is a network bundled with every Macintosh (well, the hardware, anyway), but it is slow relative to others available, around 230 Kbps per second (even a floppy disk controller is faster!). This makes it unsuitable both for lots of traffic and large graphic files, which is unfortunate, since the Mac has a niche market in the graphics industry. LocalTalk does not have business-level performance, in other words. AppleTalk is the protocol that runs over LocalTalk, but which will also run over Ethernet, which is handy.

The Appleshare workstation is the equivalent of IPX and NETx, and sends messages to the server, where translation takes place courtesy of software running at the server. A server will appear on the Mac screen just as disks do and you can select network printers from the Chooser like normal. Depending on the capabilities of your Macs, you can either put an Ethernet card in the Mac, or put a LocalTalk card in the server.

As far as Macs are concerned, NetWare is used in a server, while AppleShare is used on the workstation (versions 1.1 and 2.0). To a Mac user, NetWare appears just as any other application would, as a folder or an icon on the screen, allowing access to all the security and system audit features that are available. Files from both PC and Mac users can be stored, opened and used in the same directories on the same server. As DOS files are marked to differentiate them from Mac ones (see above), changes in file names on one side of the fence are not necessarily reflected on the other.

There is no attempt to translate between Macintosh and PC files—all NetWare does is transport them around, although programs that are written for the purpose (e.g. Excel) can use files without conversion. Straight conversion programs are available from third parties. Print spooling is also taken care of, so Mac workstations can send print requests through NetWare queues (you don't need to log on). The same is true of PCs, which can also talk to AppleTalk printers.

One point to watch with Macs is that they cannot encrypt passwords to suit NetWare, so there are potential logging on problems (as there are with other users without the encryption feature). The software consists of NLMs for loading on the server, and workstation software for the Macs. In addition, some provided with NetWare 3.11 must also be present, namely:

```
STREAMS
BTRIEVE
CLIB
NUT
MAC.NAM
V_MAC
```

Because configuration files in the **sys:system** directory are created or modified during the INSTALL process, the **sys:** volume must be mounted. In addition, the **startup.cnf** file must be available from the server's DOS boot directory. You should be running NetWare 3.11 or higher. You may need more memory in the server if you're already running a lot of NLMs.

IPX

IPX, or Internetwork Packet eXchange, is a protocol devised by Novell (based on the Xerox Network System) for its networks to handle network packet routing; it directs messages to the network card and out over the "Ether", in most cases the cable joining the computers.

Netware workstations communicate directly with IPX, but although a "best effort" is made to get data packets to their destination, delivery is not guaranteed. The hit rate is over 98%, but if you're running something like a financial database, even this isn't good enough (see SPX).

Messages are sent as packets which include source and destination addresses, so it is *connectionless*, like IP, in that it doesn't care where the packet is coming from or going to. Its sister protocol, SPX, on the other hand, is *connection oriented*, like TCP, which means that a complete connection is setup and monitored from start to finish, with error checking, both ways. A 48-bit node address is used because IPX was originally based on Ethernet.

Originally, IPX had to be generated specifically for each workstation's network card, with a program called **wsgen** (that replaced **shgen**), but it's now part of the ODI (*Open Datalink Interface*) architecture, which is much more flexible. Rather than being specific to a network card, the programs read a text file, **net.cfg**, when loading, so they know what settings to use.

ODI sets up a virtual (i.e. pretend) network card for each protocol you use, and routes each one's data through the one physical card in your PC (up to 4 protocols per card). You can do it the other way, too, for better throughput.

There are three layers to the ODI software in a client, in the order of loading:

- **LSL**, or the *Link Support Layer*. This is what switches between the protocols loaded, by virtualising the NIC and providing a standard interface for them all to talk to. Load this low, in base memory, although it will work when loaded high. It covers part of the data link layer and the lower part of the network layer of the OSI model. When MLID or protocol stacks (see below) are loaded, they register information about themselves with **lsl**, and each is assigned a logical number. **lsl** cannot be exchanged between operating systems.

- *Multiple Link Interface Driver* (**MLID**), or the software to activate the NIC, such as ne2000.com. Can usually be loaded high.

- *Protocol Stack*, like **ipxodi.exe** (or **tcpip.exe**). **ipxodi** is split into:

  - **IPX**.

  - **SPX**, or *Sequenced Packet eXchange*, which guarantees packet delivery (unlike IPX) by ensuring they arrive in the right order, and their receipt is acknowledged. Control packets are sent first to establish a connection (or virtual circuit) and a connection ID issued, which is used in all transmissions. The connection is broken afterwards with a control packet. SPX uses timeouts to decide when they need to be retransmitted. To verify a session is still active, probe packets are sent, the frequency of which can be set in net.cfg. Only really for pserver, rprinter or rconsole.

  - **RDR** (*Remote Diagnostics Responder*), which is used by third party applications to gather diagnostic information.

  You can leave out **spx** and **rdr** to save memory, always bearing in mind that some NetWare utilities, such as **rconsole** and **netver** might need them. Thus:

```
IPXODI D loads IPX+SPX only (saves 4K).
IPXODI A loads IPX only (saves 8K).
```

  ipxodi should be version 2.0 or greater, to support packet burst ODI, SFT III checksums and the NetWare Management Responder. It can be loaded high.

  Just add U to each of the above to unload them (e.g. **lsl u**).

  After they have loaded, you need the *redirector software*, which would be **netx** for IPX or **telnet** for TCPIP, so DOS (or whatever) can access remote disks and printers which it cannot ordinarily do. With NetWare 4, the equivalent for **netx** is **vlm**, described below.

DOS Requesters

Anything you need for the workstation to communicate with NetWare 4 servers comes under the heading of *NetWare Client for DOS or Windows*.

DOS is more network aware these days, and is able to redirect requests, etc, so **netx.com** (the shell) has been replaced by the DOS Requester, **vlm.exe**, which is loaded in association with whatever **.vlm** files it finds in its own directory. Its operation is adjusted from within the **net.cfg** file.

NETX

Netx sits between applications/DOS and the network. When loaded on a workstation, it intercepts activities and determines if they relate to local or network drives; if local, it passes the call to DOS and forgets about it. If it's for a networked drive, the request goes through **netx**'s *connection table*, which defines information about the server and its location. **netx**'s internal tables are similar to those kept by DOS.

netx then converts the request from a DOS request to an NCP one, and the network location information is used to build an IPX packet, which is sent to the server. **netx** hands the reply back to the application.

Up to eight server connections are supported. When you log in to a file server, **netx** stores the login information and drive mappings from login scripts.

VLM

vlm.exe is a TSR program manager which looks after several modules that do much the same as **netx**, and more, working with DOS versions 3.1 or greater. If you need **netx**, for compatibility purposes, use **netx.vlm**.

The modules themselves are either *multiplexers* that coordinate the activities of *child modules*, or those that perform tasks for the workstation. Child modules load before multiplexers, and the first child becomes the default.

You can load **vlm** into any type of memory (see *DOS Requester (VLM) Options*, below), but don't load it into expanded memory when using Windows; you will also need **nwgdi.dll** in the **\windows\system** directory. It comes from a file called **nwdll2.exe**, one of NetWare's update files. Actually, you need this to work with **netware.drv** v3.03.

vlm can support up to 50 connections, as opposed to the 8 of **netx**. If you don't specify anything in **net.cfg**, the default list of VLMs will load in this order on a NetWare 4.0 client using Directory Services:

Module name	What it's for
CONN	Connection Table Manager, which keeps track of and allocates the number of connections (between 2-50), and presents connection table information to other modules. Setting 8 gives you best backward compatibility with NetWare 3.x and below, as well as third-party applications that use netx services. Takes just under 4K of memory.
IPXNCP	IPX/NCP Transport, or a transport protocol implementation using IPX; a child process module of tran.vlm, but not a replacement for ipxodi.com or ipx. com. It takes care of building packets with proper NCP headers, etc, and hands the packets to IPX for transmission. Takes up 5K.

Module name	What it's for
TRAN	Transport Protocol Multiplexer. Coordinates routing between different protocols (usually, IPX through ipxncp.vlm).
SECURITY	Provides additional security as needed. It lives in vlm's transport layer, and offers additional NCP session protection through a message digest algorithm. It precedes the first several bytes in a request packet. You may lose performance.
NDS	Protocol implementation using NetWare Directory Services (e.g. NetWare 4.0). Child of nwp.
BIND	Protocol implementation using Bindery Services (e.g. NetWare 3.x). Child of nwp.
PNW	Protocol implementation Personal NetWare. Takes up 2.5K of memory.
NWP	NetWare Protocol Multiplexer. Coordinates requests to the right network module. Connects to available services, perform logins and logouts, and handle broadcasts through child modules, nds and bind.
FIO	File Input/Output. Used when accessing files on the network. It incorporates File Cache, Packet Burst, and Large Internet Packets capabilities. The latter disables router checks, so is faster.
PRINT	Printer Redirection Module for Directory and Bindery Services. Uses fio to speed printing. Tales up 2.5K.
GENERAL	Miscellaneous functions for the netx and redir vlms, such as creating and deleting search drive mappings, getting connection information, last print queue and server information, search modes, long and short machine names.
REDIR	DOS Redirector
NETX	Used in conjunction with Bindery Services for compatibility with NetWare 3.x and below. Also needed if you have applications that are written for netx's API. If you're using NetWare 4.0 only, or if you only access NetWare 3.x and below without using their utilities, you don't need this, which means you use less memory and enhance performance. Takes up 2.5K of memory.
RSA	Provides RSA encryption for Directory Services.
WSSNMP	Desktop SNMP.
WSREG	MIB registration.
WSASN1	ASN.1 translation.
WSTRAP	Trap module.
MIB2IF	MIB II interface groups support.
MIB2PROT	MIB II support for TCP/IP groups.
AUTO	The Auto-reconnect/auto retry module reestablishes communications with the server after the loss of a connection. As downed servers become available again, auto.vlm reconnects and rebuilds the user's environment, including connection status, drive mappings, and printer connections. Open files are restored, which means your recovery depends on how your application recovers.
NMR	The NetWare Management Responder module provides diagnostic capabilities by acting as a workstation agent. It gathers and communicates workstation and ODI configuration information and statistics.

Notice that **nds** loads before **bind**, attempting to attach to a server running Directory Services before one running Bindery Services. If you only want to attach to servers running Directory Services, you don't need **bind** or **netx**. You can control what modules you load by doing any of the following:

- Deleting modules you don't want loaded.
- Renaming the above.
- Using the vlm= entry in net.cfg.

DOS Requester (VLM) Options

Command Switch	Effect
/?	Produces help screen.
/U	Unloads vlm.exe from memory.
/C=	Specifies the path to a net.cfg file other than the one in the directory you normally load vlm.exe from. Syntax is vlm /c=path\filename.
/Mx and Memory	Allows vlm to use XMS or EMS memory, which will give a conventional memory footprint of 4K or so. Use

Command Switch	Effect
	/mx for extended memory, and /me for expanded (not with Windows). XMS is the default. Use /mc to load vlm.exe into conventional memory.
/PS=servername	Specifies which server to attach to on initial login. Same as preferredserver=servername in net.cfg. Mainly for clients who log in to servers running NetWare 3.x and below, using bind.vlm instead of nds. Attachment will take place for NetWare 4.0 clients, but the preferred tree setting (if any) will be defaulted to. Don't use one for Windows.
/PT=treename	Specifies which Directory tree to use on initial login. Same as the preferredtree=treename parameter in net.cfg. For NetWare 4.0 clients using nds.vlm.
/Vn	Determines how verbose message strings are when vlm initially loads. Possible values are: /V0, which only shows the copyright message and critical errors occurring as modules load. /V1 (default) adds warning messages at loading. /V2 adds the module names as they load. /V3 adds configuration information with module names, including load order with version date and code number, followed by net.cfg parameters different than the defaults. /V4 displays diagnostic messages, which are different from the diagnostic information you see by typing VLM /D at the command line. If you don't specify this, vlm will look to net.cfg's message level= entry or its default value of /V1.
/D	Diagnostic information on vlm's present state.

NET.CFG

The configuration file for DOS clients connecting to a network with ODI, needed if you depart from the defaults for any reason (that is, almost always). It is a text file and can look like this:

```
LINK SUPPORT
        BUFFERS 8 4096
        MEMPOOL 10240
        MAX BOARDS 4
        MAX STACKS 4
LINK DRIVER NE2000
        PORT 300
        INT 3
        MEM C8000*
        FRAME ETHERNET_802.3
        FRAME ETHERNET_II
        PROTOCOL IPX 0 ETHERNET_802.3
        PROTOCOL IP 800 ETHERNET_II
PROTOCOL TCPIP
        BIND NE2000
        PATH TCP_CFG C:\TCP
        IP_ADDRESS 129.121.38.733
        IP_NETMASK 255.255.255.0
        IP_ROUTER 129.121.38.632
NETWARE DOS REQUESTER
        FIRST NETWORK DRIVE=F
        PREFERRED SERVER=FRED
        USE DEFAULTS=OFF
        VLM=RSA.VLM
        READ ONLY COMPATIBILITY = OFF
```

* means optional (if your card needs it).

Settings for each option must be indented at least one space. Place a hard return at the end of every line, including the last one, otherwise it will be ignored. Precede comments with a semicolon. Unless you have a really strange setup, you will probably never need to fine tune anything (but see below), as the defaults produce reasonable performance in almost all cases. Previously, you set **files=** entries in **config.sys** and **net.cfg** for workstation and network drives, respectively. Now, this is only done through **config.sys**. If you see environment errors and can't add search drive mappings, make sure your **lastdrive=** statement is set to Z. If it's already set, increase the environment size in the **shell=** line until you no longer experience the error.

Link Support

This section is referred to by **lsl**. Reduce the **max boards** and **max stacks** settings to save memory.

Setting	Explanation
buffers 8 4096	Sets the number and size of buffers available. You can lower them to save a little memory, but reducing buffers reduces performance (having said that, ipxodi doesn't need them, but tcpip needs at least 2). The buffer size is up to you, but the minimum is 618; The default is 20 buffers of 1514 bytes. For most efficiency, the buffer size should be the same as the packets your workstation will receive, or the largest buffer size your NICs will support. Any packet transmitted over a router is limited to 576 bytes. If you get the message: LSL out of resources, increase the buffers. Total buffer space must not take up more than 64K; header information takes 5K.
mempool	Some protocols use this to configure the size of memory pool buffers maintained by lsl (not ipxodi).

Link Driver

Names a driver for the network card and specifies hard- and software settings for it. You need a separate section for each board you have, although compatible cards can mostly use each other's. PC cards (in portables) will tend to have their own. You can set DMA, IRQ, MEM (start address), PORT, NODE ADDRESS (overrides the card), SLOT, FRAME and PROTOCOL, which are fairly self-explanatory.

You can qualify some with #1 or #2 for the driver's positioning. The frame type specified in PROTOCOL should match that in FRAME, and include a hex protocol ID (0 for 802.3). Popular frame types and IDs are as follows:

ETHERNET_802.3	0
ETHERNET_802.2	E0
ETHERNET_II	8137
ETHERNET_SNAP	8137
TOKEN-RING	E0
TOKEN-RING_SNAP	8137

You would use Ethernet_II for TCP/IP, and 802.2 for Netware 3.12 and above. There are no real speed differences between them, but you could mix them between users for security reasons, since those with the wrong frame type won't be able to see servers. Ethernet II is the revised version of the original Ethernet standard, which is not officially the same as 802.3, which everyone thinks is; Novell had to do something quickly because the standard wasn't laid down. SNAP is short for *Sub-Network Access Protocol*, which supports the MAC.

Protocol

You can use this section to bind a protocol to a particular board (usually, it's the first one found). In DOS, you can only use one anyway. Use this only if you have multiple NICs, which you might have if you're connected to more than one network, or you have defined multiple logical networks using the same cabling.

When the workstation boots, **ipx** binds to all NICs. When it needs to communicate with a new destination on the network, it queries the network for possible routes to it. The primary board is used first (identified either from **config.sys** or this setting) and any possible routes returned from the network are stored. Then it tries the next board, and compares the returned route with that from the first. The better one is stored, and the other discarded. IPX continues with each board in turn until the best possible route has been located, which is then used. This only occurs the first time IPX makes a connection with a destination, and whenever a connection is broken.

NetWare DOS Requester

This section affects VLM connections (**netx** can sort it self out). The **vlm** specifications say you can have up to 50 VLMs loaded at once, but each one is another link that **vlm.exe** must go through when passing information.
Better performance is obtained by only loading the modules you actually need. You naturally don't need any settings below for those that aren't.

Parameters affecting performance *only*

Parameter	Meaning
checksum=1	An IPX checksum, which occurs in addition to any other error checking your network board and driver may already be doing. The settings are: 0 disabled 1 enabled but not preferred (default) 2 enabled and checksum preferred 3 required Because the checksum uses extra code, it can reduce performance. To disable checksumming, use 0, but for compatibility, try 1. This works with all protocols except 802.3; in that case vlm will not use checksums, regardless of what it says here. Affects ipxncp and nwp.
large internet packets=on	ipxncp uses this to allow internetwork packets larger than 512 bytes to pass through a bridge or a router that can handle them. On (default) offers the best performance, especially for larger networks. Affects ipxncp/nwp.
cache writes=off	This ON can give a performance gain, as it's the same as having a write back cache. Affects fio.
message timeout=0	0-10000. For nwp.
true commit=off	For fio, equivalent to a write back cache; On will write data to disk immediately and the client must wait until data is written to disk and FAT tables are updated, which can mean an 80-90 ms delay.
pb buffers=3	Related to the Packet Burst feature. Even though the range is 0-10, packet burst is either On (any number between 1-10, including the default of 3) or Off (0). For fio and ipxncp. Since ODI is fast enough, vlm allocates three ECBs (Event Control Blocks) and packet burst headers (without the full packet size buffers), which should be enough. If you're running Packet Burst at the server, set this to a nonzero value (or leave it at the default); if not, you can set it to 0 to save memory.

Parameter	Meaning
pburst write windows size=10	2-64. For fio.
pburst read windows size=16	2-64. For fio.
lip start size=xxx	xxx can be in the range 576-65535. The default is 0, which means off. This is for those of you that operate across multiple hops, where one segment has smaller packet sizes than local routes, but larger than the minimum of 756 bytes. Improves performance and throughput.

Parameters that affect performance and memory:

Parameter	Meaning
load low conn=ON	This forces conn.vlm (the connection table manager) to load low, into base memory, where it takes up about 3K and keeps track of workstation connections, servers it is attached to, and tasks that are currently being executed.
load conn table ow=off	Working on this one.
load low ipxncp=ON	The IPX transport module takes about 4K when loaded low, which is the default, for performance reasons. Again, UMBs will be used first if available, which is why this needs to be set ON to force it low.
load low fio=on|off	Force fio into base memory. Increases performance for repeated reads/writes. Helps with databases.
load low netx=on|off	Forces netx into base memory. As above.
load low redir=on|off	Force redir into base memory with this. As above.
signature level=1	Designates the level of enhanced security support. Setting this offers NCP packet signature, which is a message digest (like a checksum) that prevents unauthorized access to the network through forged packets. The first several bytes in a request packet go through a digest algorithm. Settings are: disabled (i.e. not loaded) 1 enabled but not preferred 2 preferred 3 required If set to anything other than 0 or 1, this entry can impede performance, but you do get more security. Affects nwp and security.
cache buffers size=512	fio uses this to determine the amount of data that can be cached by vlm. Generally, set it less than or equal to the physical packet size, which varies between 64-4096 bytes. The optimal size is the maximum media packet size, minus 64 bytes. For Token-Ring, you could use 4K minus 64 bytes; for Ethernet, the setting could be 1500 minus 64 bytes.
print buffersize=64	Used by print.vlm. The print buffer is a character catch for Int 17h requests, which are single character print requests. Once the 64 byte buffer is filled, it will call fio.vlm to go through a file write request instead of calling fio for each character. The setting can be between 0-256 bytes. If the majority of your printing is performed through Int 17h, setting this cache larger will make a difference, but it is not so important for most new applications which open LPT1 and perform a file write.
cache buffers=number	Specifies how many buffers vlm can use to cache data from open files. Cache buffers minimize read and write traffic on the network, so the more buffers, the faster the performance and the more memory is used. number can be from 0-30. To turn off caching, use 0 (default 8). For fio.

Memory Related Parameters

Parameter	Meaning
connections=8	For compatibility with utilities in NetWare 3.x and below, as well as applications written to the netx API; the default is 8, but NetWare 4.0 clients using Directory Services may want to set this to 16 (or more). the range is 2-50. Both conn and fio keep track of the connection information for much of what they do. While you can have more than 8 connections active on NetWare 3.x

Parameter	Meaning
	and below, you will see only eight server attachments when you type whoami, and the confusion to the utilities can be too much. Affects conn, fio, nds, security, auto. Each connection takes up about 50 bytes of base memory.
network printers=3	The default for this setting is 3, but can be up to 9 if needed. If 0, the print module won't load. If you set Network Printers to 1 or 2 and have more capture statements than printers, capture will think it has set them up, but the connections won't be allocated to those statements.
auto reconnect=ON	The default is On, but this setting is only activated by loading auto.vlm, with vlm=auto.vlm in net.cfg, and you must load nds.vlm. When off, auto.vlm load fails at pre-initialisation time. auto.vlm keeps a snapshot of its connection information and drive mappings to the respective servers. The reconnection applies to the server connection only. How well an application can recover from a connection loss depends on the application itself.
average name length=48	netx could hold eight 48-byte server names; one for each connection allowed. conn.vlm can hold more through the connections entry. Most server names are relatively short (between 6-12 characters), so you can set the name length to the longest and save a bit of memory. You can set server name lengths anywhere between 2-48 characters. This is an average, so if a server name is longer, the name will wrap to take care of the extended name set. However, if you run out of space and try to add another server, you can lose your connections.
max tasks=31	Indicates the number of tasks vlm can accurately track at any time. The default of 31 is usually OK, but with windowing, multitasking environments running over DOS, you may need an increase. The minimum is 5, maximum 254. Affects conn.
print header=64	For print, allows you to change the size of the print header buffer (you can control the font, size, spacing, pitch, and orientation). There is no easy way to find out how big the buffer needs to be. The size depends on how many functions the largest print mode contains, so go into printdef, determine which one has the most functions, and count every character in each function. Then resize your buffer, allowing one byte per character. The default buffer size is 64 bytes (characters). The settings is between 0-1024.
print tail=16	The print tail always contains the Reinitialize mode functions from printdef. Most such modes are short. For example, Hewlett-Packard's reinitialization sequence is a two-character count starting with esc, but the IBM ProPrinter systematically turns off every function defined in the Proprinter mode. Set your Print Tail size to cope with the largest Reinitialize mode in printdef. If you don't use printdef, use the default of 16 bytes. The settings can be between 0-1024.

Parameters Specific to a DOS Requester Service

Parameter	Meaning
preferred tree=name	When you log in to NetWare 4.0 using nds, you log in to the network, as opposed to a specific file server. This determines the preferred Directory tree for initial attachment, and gives the workstation a group of resources it can initially access.
preferred server=	Designates which server to attach to initially. Use only if you are logging in as a bindery-based client, otherwise you may get authentication problems.
name context=""	This has nothing to do with vlm's functionality, but it does offer a starting point within the Directory tree for NetWare 4.0 utilities. It can also be used to locate your user object in the Directory tree when you log in, or to log you into the area of the tree where you need to perform a specific function. For nds.

Other Parameters That Affect vlm

Not all of the parameters listed below need to be placed under the *Netware DOS Requester* heading, but it's easier to keep track of them if they are:

Parameter	Meaning
vlm=path	You can load modules from any directory you want; just include the path here.
use defaults=ON	You can leave this entry ON and add other modules, such as auto.vlm, so vlm uses its default load list then adds those specified. If you set this OFF, you are telling vlm.exe only to load the modules in net.cfg, with vlm= (above). For NetWare 4.0 without security, the minimum list should include: VLM = CONN.VLM VLM = IPXNCP.VLM VLM = TRAN.VLM VLM = NDS.VLM VLM = NWP.VLM VLM = FIO.VLM VLM = GENERAL.VLM VLM = REDIR.VLM VLM = PRINT.VLM Don't forget preferred Tree and name Context designations. If you try using this list and can't log in, you may have security in place, in which case add the security modules and the correct Signature Level parameter setting. If you don't need printing, don't load print.vlm.
exclude vlm=	Exclude those specified here. For NetWare 3.11 or below using Bindery Services, the bare minimum list should include: VLM = CONN.VLM VLM = IPXNCP.VLM VLM = TRAN.VLM VLM = BIND.VLM VLM = NWP.VLM VLM = FIO.VLM VLM = GENERAL.VLM VLM = REDIR.VLM VLM = NETX.VLM VLM = PRINT.VLM If you don't want printing, remove print.vlm from the list. Don't forget Preferred Server and First Network Drive if you need them. You can sometimes get by without netx.vlm, but you may lose application compatibility.
set station time=on	Whether or not to synchronize the client PC's time with the server it logs in to. If you are remotely typing in across time zones, you would want this OFF.
message level=1	How verbose you wish message strings to be. 0 Always display messages/errors. 1 Display warning type messages. 2 Display program load messages. 3 Display configuration information. 4 Display diagnostic messages. These settings correspond to the numbers you can set as you initially bring up vlm. Otherwise, vlm will look to net.cfg settings or to its default.
first network drive=	Applies to all the network services you may tie into. If you run vlm's installation program, the first network is F as the default, or the first available drive letter. If you don't have this parameter in net.cfg, general.vlm will look at your local drive table and map the first available drive letter as the first network drive.
force first network drive	On or Off. If on, when logging out, the login drive will be forced to the first network drive specified above. Otherwise it will be mapped to the drive you logged out from, other than a local or first network drive.

Parameter	Meaning
local printers=3	Use this to set up to 9 local printers attached to a workstation. If your workstation doesn't have a local printer, leave this to 0; then your workstation won't hang (or appear to hang) if you accidentally press Shift-Prt Sc and you don't have capture running. If you add a local printer to your workstation, or if you run nprinter (NetWare 4.0) or rprinter (NetWare 3.x) to use the printer as a network resource, it won't work if this is set to 0.
search mode=1	Many applications, when started, open a number of other files (such as overlays). This option affects general, and determines when applications can look in your NetWare search drives to find them. Search Mode has five settings: Mode 1 is the default, where vlm will look in the search drives only when no path is specified in the application (and after DOS has searched the default directory). Mode 2 causes vlm not to look in any search drives to find auxiliary files, so the application will behave as if you were running it on a standalone machine with DOS only. Mode 3 is like Mode 1, except that if the application has no defined directory path to search and open files, vlm will look in the search drives only if the open request is a read-only request. Mode 5 causes vlm to always be able to look in the search drives, even if the application specifies a path. Mode 7 is like Mode 5, except vlm will look in the search drives only if the open request is Read-Only. The search mode you set in net.cfg applies to all applications, so you should choose the mode that works for the majority.
read only compatibility=OFF	Some applications open files for read-write access, but then only read from them. If a file is marked Read-only or they have Read-Only access to it, the file could fail to be opened. When this is ON the application is allowed to open the file and still deny the user to write to it, delaying the failure to when they try to write to the file rather than when the file opens. This helps overcome situations where setup files (i.e inis) are written to by setup programs at the end of an installation; it will fail if the file is set to read-only. This is the default for netx and the latest versions of vlm (see vlmup3).
show dots=OFF	Allows programs to use the "." and ".." options to change directories. It's best to leave this OFF if you're not running programs that use dots to move around directories. If you're using Microsoft Windows, set ON. Otherwise, Windows assumes it's in the root directory, which may not be the case.
dos name=MSDOS	Allows you to tell vlm which type of DOS the workstation is running, including DR DOS. You can have between 1-5 characters.

long machine type=IBM_PC	The long machine type is used with the %machine variable in the login script. IBM_PC is the default. If you are using a non-IBM workstation that runs its manufacturer's own version of DOS (such as a COMPAQ), you can place this version onto a network directory and use the long machine type to indicate what you want the login script to replace the %machine variable with. For example, you can create two DOS directories:
	`sys:public\ibm_pc\msdos\v5.00`
	`sys:public\compaq\msdos\v5.00`
	If you place long machine type=compaq in net.cfg, those workstations will access the Compaq DOS directory instead of the IBM one. Affects netx and general. Max 6 characters.

short machine type=IBM	Some older monitors emulate colour with grey scales, so they need to use the cmpq$run.ovl file in sys:public, instead of the default ibm$run.ovl. Use short machine type=cmpq instead. The entry can't be more than four characters long; the default is IBM. Affects netx and general. Max 4 characters.
netware protocol=	List all separated by commas, as in nds, bind, pnw, in order of priority.
auto retry=0	0-3640. For auto.
auto large table=off	For auto. When off, user name and password maximum lengths are 16 characters each.
bind reconnect=off	auto, bind.
maxIPG=0-63,257	The maximum value that IPG (Inner Packet Gap Time) could reach. Provides a forced max IPG for high speed networks.
Reset Printer Flags=On|Off	The default is off. This provides compatibility with netx behaviour when it comes to printer flags, which were not reset when a print capture was deleted. They are reset with vlm.
confirm critical error action	On or off. Intercepts Int 24 (critical error) and allows you to retry manually before Windows intercepts it and stops the connection. Needs netware.drv v3.03 and

Parameter	Meaning
	netware.drv=netware.drv in the [boot] section of system.ini.
eoj=on|off	Turns the end of job automatic closing of files, locks, etc on or off. Default is on. Affects netx and redir.
lock delay=xxx	xxx can is between 0-255; default 1. It's the delay between "lock retries", or the number of 64K empty loops to execute between them. This is dependent on CPU speed, so increase it if running faster.
lock retries=xxx	xxx can be between 0-255; default is 3. This determines the number of retries to be executed if a share violation or failure occurs when opening or locking a file.
dos name=msdos	5 characters, affects netx and general.
handle net errors=on	For ipxncp.
message timeout=0	0-10000. For nwp.

For Personal NetWare

Parameter	Meaning
responder=on	
preferred workgroup=	
workgroup net=	
broadcast retries=2	0-255.
broadcast send delay=0	0-255.
broadcast timeout=3	1-255.
mobile mode=0	0-65535.

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Linux for DOS Users

This document is meant to get an experienced DOS user up and running with Linux, taking advantage of common elements between both operating systems.

Aside from keeping track of the different versions of components needed for a complete system, one of the most frustrating things about Linux is the documentation – you will frequently find that not all instructions are actually present, as a lot of knowledge is assumed. Linus Torvalds himself has acknowledged that this is not his strong suit, which is apparent when you try to use his instructions for updating the kernel. Also, you are always referred to other documents which are never to hand when you want them, nicely breaking your train of thought. We aim to address these two problems in particular.

I don't think this document will ever really be finished, but I shall certainly be updating it from time to time - if you feel I've got something wrong, or you've got something to add, please feel free to get in touch though my website, at www.electrocution.com. You will be given full credit for your input.

Phil Croucher
paco@electrocution.com

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Introduction

Linux is a free collection of programs that form a Unix-like operating system, supported on an informal basis by programmers all over the world, with changes and suggestions usually dealt with through the appropriate newsgroups. However, there are commercial versions that have additional programming or facilities (and pretty boxes) for which you can expect to pay a little extra. The word *free* here not only concerns money, but intellectual freedom, or the ability to change and/or modify any code for your own use, provided you respect the usual copyrights under GNU. What this means in practice is that you can adjust the operating system to your own specifications by removing code your system doesn't need to save memory (such as drivers), or just for the hell of it. You can add stuff as well, but, the point is, you can recompile it as and when you like, *and redistribute it*, whereas with DOS or Windows, all you can usefully do is adjust configuration files. It is not a Unix clone, but a modular system that runs many Unix programs, meaning that you can recompile the kernel at any time and not have to reboot. Some commands are also different.

Its history is irrelevant for the purposes of this book, but Linux was actually based on Minix, and written by several people, including Richard Stallman, Eric Raymond and several others, not forgetting Linus Torvalds, who wrote the kernel and therefore finished the job. His kernel was called Linux, and it has come to be thought of as the whole system.

Being free, there is no warranty and very little formal support (unless you bought a commercial version), so installation should only be undertaken by those who are familiar with computers, because it's only that sort of knowledge that will get you out of trouble should it arise, and those already in the Linux/Unix community will expect you to read as many FAQs as possible before bothering them in the newsgroups – Linux is, after all, a programmer's operating system, and you have to do your bit first. This book therefore assumes you have a better than medium knowledge of DOS. If you don't, read the chapter on DOS first, which will introduce many basic concepts, especially some aspects of system management, such as partitioning, formatting, and handling directories and files. You also need to know a lot more than average about the hardware in your machine when it comes to installation, because often you have to start again if you get the answers wrong.

However, you will be pleased to know that much of DOS was based on CP/M, which was in turn derived from a Unix-type system, so the learning curve may not be as high as you think.

Meanwhile……

A Bit About Unix

The name allegedly stands for *Uniplexed Information and Computing System*. It's a minicomputer or mainframe operating system which, unfortunately, seems to have as many different versions as there are platforms on which it runs. The most used is AT&T's System V, but most of what follows is relevant to all types, especially to Linux which, you will not be surprised to hear, also comes in several versions. But more of that later.

Unix was written (in C) as an environment for software development (that is, an operating system for programmers) and is a terminal-based, multitasking, multiuser system, meaning that several people can communicate with the host computer at the same time, doing several things at once, with terminals of varying descriptions, which only send *screen and keyboard information* over the cable connecting them (you can use an old PC with terminal software if you want, or even a Newton or Psion with a VT100 emulator), which means you can do quite a lot over a telephone line. Thus, all the work is done in the host, unlike on a typical network. The terminals are usually connected with serial cables which, for a PC, means adding more COM ports to the basic design with a multi-serial port card, which can add up to 64 more, with quite a strain on the power supply, so any more than, say, 16, would use an additional supply of their own. It's not a good idea to use a clone-type I/O card, like those with IDE and floppy connections on as well. However, ways of using network cabling have been developed, to provide speed.

You can cycle round any programs you may be running with a combination of the **alt** and function keys **F1-F6** – anyone who has used Concurrent DOS or played on a NetWare server will know exactly what I mean, but it's similar to cycling through programs in Windows with **alt-tab**. Some processes don't need a screen, and will therefore run out of sight – these are *daemons* (or *phantom processes* in CDOS), and are like TSRs in DOS. Their names will have a *d* at the end, as in **pppd**, which looks after Internet connections over a modem.

Unix is meant to be used between platforms, so devices are represented by files, which can be written to or read from like any other, reducing incompatibilities as much as possible. Because Unix uses the concept of multiple file systems mounted through one point, instead of changing to a drive letter representing a CDROM, for example, you change to the directory containing a drive's device file (such as **\mnt\cdrom**) and refer to it from there. You can mount DOS partitions in the same way, or floppies. The effect is to have lots of storage space as one entity which is actually made up of several devices. The **join** command in DOS does a similar job, by making a hard drive appear as a directory in another. You can also do this in Windows 2000.

Like any other operating system, Unix consists of several elements of program code acting as a link between you and the machine, including a *shell*, which is used by you to communicate with the *kernel*, which coordinates and controls the computer's internals (except graphics and networking), and is always memory resident (the shell is similar to **command.com** in DOS, which, as you know, is officially known as a *command line interpreter)*. Just to complicate the issue, there are various kinds of shell, notably the Bourne and the C shells, which can be used at the same time by different people, the main difference between them being the command language. However, you'll probably end up using *bash*, the **B**ourne **A**gain **Sh**ell, like most others. Once logged in, you can execute another shell just like any other program and maybe do lots of interesting things with multiple shells that will be looked at later. A *shell script* is the equivalent of a batch file.

You can make your own shell, just as you can use a different **command.com** in DOS, or even use a program as a front end, in the same way that Windows allows you to change from the default Program Manager or Explorer using **shell=** in **win.ini**, but make sure it doesn't allow *chaining* (e.g. exiting to the equivalent of **command.com**) for maximum security.

As for graphics, the X protocol, which is not an integral part of Linux, allows a program to run on one machine and yet have its display on another, which harks back to its terminal-based origins. This occurs even if the display terminal is less capable than the one the program is running on – configurations are adjusted automatically. It has two components, that run on a server and client, respectively, which means it can run over two machines (they are normally combined on one). The server component must match the video card on your system. **Xfree86** (or similar) is the server that provides graphics for Linux, but the whole X system runs on top of a *Window Manager*, such as **fvwm**, or **fvwm95**, which are luckily included in two of the most commonly used graphical environments, **kde** or **gnome**. **AnotherLevel** more closely resembles Windows 95, which itself is Red Hat's version of **fvwm95**.

Because more than one person can use the system, Unix uses IDs and a login procedure. It doesn't worry so much about account names, but rather the number associated with them, which is the UID (*user-id*) of the account—ID0, for example, is reserved for the *SuperUser*, or *root*, to give the proper name. User information is kept in the **passwd** file in the **/etc** directory, which is where configuration files normally live. Those specific to a user are in a *home*, or personal, directory, which is where you start from when you log in.

There are no default passwords, and, if used, they must contain no more than 11 characters of any description, but may have a minimum set. They are case-sensitive and may have an expiration date. A good bet for an intruder, having gotten the name of a valid account, is to try the name of the account itself as a password.

Usernames, on the other hand, are up to 14 characters long, but usually between 1-8. They can contain almost any characters, including **ctrl** and special characters, but except:

ctrl-d End-of-file character.

ctrl-j Sometimes used as the return character, as opposed to ctrl-M.

ctrl-delete	The kill character, which will automatically end your current process.
@	Sometimes used as the kill character—normally for deleting an entire line.
****	The escape character, used mainly to differentiate between upper- and lower-case characters on a terminal that only supports upper-case.

which have other meanings as described above (though they can be changed with the **stty** command). In Unix, an account has full or no privileges—Superuser accounts are of the former persuasion, and are not therefore bound by file and directory protections (root always has superuser status). You can't login remotely (like over a telephone line) with a superuser account, which means logging on as a user when you get in and switching over with **su** (**s**ubstitute **u**ser). There are several default accounts, some of which are superuser and others user-level. These have superuser privileges:

```
root
makefsys
mountfsys
umountfsys
checkfsys
```

These are some user-level default accounts:

```
lp
daemon
trouble
nuucp
uucp
bin
rje
adm
sysadm
sync
```

bin owns many important directories and files, including others used by binary files, such as **login**, but especially **/etc/passwd**, which you can edit and add a root entry in for yourself. You will find others which are common, such as **public, admin** or **demo**, that could be seen with **ftp**, or even variations on usernames, such as **fredn** or **susant**.

Usernames will be in lower case characters, because the system assumes your terminal cannot produce them if the first one it sees is in capitals, and that is what you will get back, with a **** (backslash) in front of \any \character \that \is \actually \supposed \to \be \in \upper \case – not easy to read.

The File System

Linux uses the *Filesystem Hierarchy Standard*, or FHS, which replaced all the different systems that existed before and made it easier to switch from one distribution to another (yeah, right), and to share files. Version 2 is shortly to be ratified.

Files and directories behave in the same way as they do in DOS, except that the backslash becomes a forward slash, and file and directory names are case-sensitive. In addition, file extensions are not as important, as an internal number is used for file identification, and full stops (periods) are allowed in filenames. Drive letters are not used, either, being replaced with *mount points*, through which you can attach devices or partitions, similar to the DOS **join** command. In this way, it doesn't matter that you are mounting a directory, drive or partition locally or on a different network. All you see is one file system, parts of which can be formatted or reinstalled without affecting others. Also, if you find yourself running out of disk space, you can copy the excess directories to a new location and replace them with a symbolic link (shortcut).

Any filesystem lives in its own partition on a hard disk, and the bits required for a Linux system to boot and operate properly thereafter live in the *root* partition (the *root directory* is for root, the user – it can be anywhere), which is the highest level. Typical directories included in it with a standard installation are:

```
bin          executable files
sbin         Systems Admin binaries
boot         Anything required for booting
dev          Device files
etc          Configuration files, etc
lib          Compiler libraries & kernel modules
mnt          Temporary mounting points for devices
tmp          Scratch area for applications
```

```
opt                   Add-on software
lost+found            Orphaned code – look here after crashing
usr                   User stuff
```

non-essential system files may be found in **/usr/bin** if you can't find them above. Other partitions are discussed under *Installation*.

Files beginning with a full stop, or period, are called *initialisation,* or *hidden files*. They describe your environment to the shell, and are sometimes called *dot* files. They are only revealed if you issue a special command. File and directory names can be up to 14 characters long, containing any ASCII character, including control characters, except spaces.

Files

Almost everything comes in some sort of archive, and will need compiling. Although awkward, it does mean you are not restricted to certain platforms, as you would be if the file was compiled already. Typically they are first put into a **tar** file, which keeps them in one place, then they are compressed in ZIP format, though they won't have that extension (it's actually something like **tgz** or just **z**). To uncrunch a typical file, place it in a temporary folder and issue a command like:

```
tar xvfz file.tar.gz
```

x means extract, **v** stands for verbose mode, **f** indicates that the archive is local and **z** means filter the output through **ungzip**.

The next thing to note is that you won't get messages like:

```
Are You Sure?
```

because Linux assumes you know what you're doing. If you issue a delete command, for example, the system will just go ahead and do it. As an example, this command is supposed to remove all files and directories ending in **bak**:

```
rm –rf *.bak
```

However, one space in the wrong place will delete everything, and remove a **bak** directory:

```
rm –rf * .bak
```

There are 3 types of files in Unix—*text*, *binary* or *device* (shell scripts are executable text files). Users with access to a file fall into one of three groups:

u (user) the file's owner
g (group) users in the same group
o (other) everybody else

These are their access modes:

r (read) read, examine, copy data in a file
w (write) modify, delete a file
x (execute) use the file as a command

+ adds, and **—** takes away any rights, using **chmod**, which does similar things to **attrib** in DOS. Use **=** to set several at once (see *Commands*, overleaf).

0-7 can also be used this way:

Octal	Binary	Permissions
0	000	---
1	001	--x
2	010	-w-
3	011	-wx
4	100	r
5	101	r-x
6	110	rw-
7	111	rwx

Every time a 1 occurs in the binary number the corresponding permissions are set – they are denied with a 0.

One real world example of this would be after you've uploaded some new web page files to your ISP and you want to allow people to both enter your directory and access them. This means you will have to go to the directory above yours and make your personal directory accessible to others with **chmod 755** (use the **cd** command to get there), then go back into it and work on the document, which typically will need:

```
chmod 644 filename.ext
```

which gives your file world read permissions. **chmod 711** gives your home directory executable permissions for all.

Non-deletable files can be created, if they were created with a C program or script file, using character sequences that cannot ordinarily be typed from the shell, such as **ctrl-h** (usually delete). This script will create a file with the name **ctrl-h** (use **vi** or similar).

```
echo'' > 'a^h'
```

To actually get **ctrl-h**, type:

```
ctrl v
ctrl h
```

ctrl-v tells **vi** the next character is ASCII, and not to be interpreted. Once you create the file, change the access and execute it. It will look like it's called **a**, but it won't be deletable.

Notes

Commands

As with DOS, there are many commands to choose from, but only about 18 or 20 that are actually useful from day to day. Also, like DOS, commands normally take their input from the keyboard and display the output on the screen, but you can use the pipeline commands, **<** and **>**, to gather input from a file and send the output to another so that nothing gets displayed on the screen at all. In other words, the output of each utility can be the input to any other program, allowing you to build up custom applications very easily. The pipe character, **|**, is mainly a shorter way of using the two characters above.

The **&** character can be used after a command to make sure it doesn't tie up the terminal, meaning you can do something else while the task executes (that is, it's made to work in the background). The system will print out a number and return you to the system prompt. The number is the *process number* of the command, which can be stopped before its completion with the **kill** command.

Command switches are preceded with a dash, as opposed to the slash in DOS, as in **ls –a**.

As before, not all commands are mentioned below, just the more useful ones. For a full reference, check out a Linux manual.

Getting Help

Enter this command:

```
man <command>
```

for an on-line manual beginning with the command name and a one-line summary followed by the syntax. Options and arguments are enclosed by [square brackets], followed by a detailed description with examples. Related files and commands are also listed.

Command Login

A command login is an account that logs in, executes one command, and logs out again, like the cat in the crypt, and it won't usually have a password. Believe it or not, there is one called **reboot**. Here are some others:

Who A good one for intruders to obtain valid user names with before actually logging in. It displays a list of users currently on the system and is the shell for command login.

time Displays the time.

date Displays the current date.

sync A default account which merely executes the **sync** command, causing any data meant for storage to be written to disk.

The Command Line

Erasing Characters

You can backspace up to and over a mistake by pressing the erase key (#) once for each character you wish to delete. The # will appear on the screen, and the character preceding it will be discounted.

Deleting a Line

Do this any time before pressing **return** with the *kill key*, which is usually @. When you press it, the cursor moves down to the next line and over to the left. The line with the mistake is not removed, but ignored.

Aborting Program Execution

Just press **delete**. A terminal interrupt signal is sent to the shell, which displays a prompt and waits for another command when it receives it.

Controlling Output to the Screen

ctrl-s suspends the flow of characters to the screen. Resume with **ctrl-q**. You get the same results on a VT 200 with the **Hold Screen** key.

finger

(with no options) will list the login name, full name, terminal name, write status, idle time, login time, office location, and phone number (if known) for each person logged in.

ls

This one lists the files and subdirectories in a directory (the same as **dir** in DOS, which you can use as well). If you simply type **ls**, it will assume the current directory, but you can specify the pathname of another one. It will not display hidden files (like those whose name begins with a full stop), but the **–a** option makes it display all files, as in **ls –a.**

cd

Moves you from one directory to another. To go to one directly below your current directory, type:

```
cd <dirname>
```

To move up, type **cd..** You can also jump sideways by including the pathname of the one you want to go to, such as **cd /usr/src**.

pwd

Prints out the pathname of the current directory (e.g. **p**resent **w**orking **d**irectory). Useful if you forget where you are, as only the last part of the path is usually displayed at the prompt.

cat

Displays the contents of a text file on the screen (similar to **type**). The format is:

```
cat <filename>
```

rm

Deletes a file (e.g. **r**e**m**ove). Syntax:

```
rm <filename>
```

cp

Copies a file.

```
cp file1 file2
```

where *file1* is the file you wish to copy, and *file2* the name of the new one. If it already exists, it will be overwritten. You may specify pathnames.

stty

Displays or sets terminal characteristics. To see the current settings, type **stty**. To change a setting, use these options:

`echo`	System echoes back your input.
`noecho`	System doesn't echo your input.
`intr arg`	Sets break character, i.e. **^c** for **ctrl-c**. **"** means none.
`erase arg`	Sets backspace character, i.e. **^h** for **ctrl-h**. **"** means none.
`kill arg`	Sets the kill character (i.e. ignore the last line you typed), as for **intr** and **erase**.

lpr

Prints out a file on the system printer. The format is:

```
lpr <filename>
```

ed

A text file line editor, with the same status as **edlin** in DOS, i.e. crude, basic and nowadays used strictly by showoffs. The format is:

```
edit <filename>
```

The file you wish to modify is loaded into a buffer, and changes are made when you issue a write command. If the file does not already exist, it will be created at that point. The command prompt is:**.** Other commands include:

`#` Any number, like 1 or 2, referring to the line you wish to edit.

`d` Deletes the current line, moving you back to the previous line.

`a` Begin adding lines to the file, just after the current line. This command puts you in text input mode, where you just type in the text you wish to add. To return to command mode, type **return** to get to an empty line, and press the **break** key (which is whatever character you set as your break key with **stty** before you use the editor).

`/` Searches for a pattern in the file.

`I` Insert. Similar to **a**, except that the text is inserted before the current line.

`p` Prints out a line or lines in the buffer. **p** by itself will display the current line. **#p** will display the line **#**. You can also specify a range of lines, such as **1,3p** for lines 1-3. **1,$p** will print the whole file.

`w` Write the changes in the buffer to the file.

q Quit.

grep

Searches for strings of text in text files, as in:

```
grep [string] [file]
```

It will print out every line containing the string you need. To print out lines that don't contain it, use the **v** option (In**v**ert).

who

Shows people currently logged onto the system, listing their login name, terminal line, and the time they logged in. The answer might look like this:

```
root console May 10 02:00
uucp contty May 20 14:00
fred tty02 May 20 14:00
```

The first field is the username of the account, the second shows which terminal the account is on (**console** is always the system console itself). Where there is only one dialup line, its terminal is usually called **contty**. The **tty##** terminals can usually be either remote (dialups) or local. The last fields show the date and time that the person logged on, using 24 hour format.

In the example, root logged in a good deal earlier than anyone else, but use **ps**, below, to see if they are actually online.

The list of users logged on is kept in **/etc/utmp**

who followed by these flags:

-b Displays time sys as last booted.
-H Precedes output with header.
-l Lists lines waiting for users to logon.
-q displays number of users logged on.
-t displays time sys clock was last changed.
-T displays the state field (+ indicates possible to send to terminal, i.e. message function is on,—means not)*
-u Complete listing of those logged on.

The **-HTu** combination is used a lot.

ps

Displays information about system processes. The **u** option will show you a specific process, as in **–uroot**.

```
PID     TTY          TIME         CMD
1125    console      01:00  sh
1324    ?            00:00  cron
1666    console      13:00  who
1876    tty09  12:03  sh
```

The first field in the above example is the *process number*, which is unique. The second is the terminal the process is being run on and the third tells you when it was started. The last is the name of the program or command being run.

The lowest process number is the login (shell) process, which, above, is 1125, being run on **tty**, meaning the superuser is logged on at the system console. However, the entry for process 1666 (**who**, on *console*), shows the superuser executing **who**, so is currently on-line. Anything with a question mark in the TTY column is being carried out by the system under that user's id.

The next entry shows that root also has a shell process on tty09, meaning that someone else is logged in on the account. If more than one person is using an account, the **u** option will display information for all of them, unless you specify **t**, which lets you select processes run on a specific terminal. For example, **ps -tconsole** will show all processes currently being run on the console. You can combine the above options; **ps –uroot –tconsole** will show all the root user's processes on the system console.

kill

Kills processes. The syntax is kill [-#] process# (you must know the process number to kill it). Its power increases with the numbers 1-9, as certain processes, like those from the shell, can be quite stubborn. **kill -9** will stop anything, but use this as a last resort, as **kill** by itself will allow a bit of a clean up and you might be able to salvage a backup file or something. **–9** stops a process dead. You must be a superuser to kill other users' processes, unless they are using root themselves.

crypt

A file encryption utility. Just type **crypt**. You will then be asked for a password, then the text you want secured. Each line is encrypted when you press **return**, and the encrypted form is displayed on the screen. So, to encrypt a file, you must use I/O redirection. Typing:

```
crypt [password] < [file1] > [file2]
```

will encrypt the contents of *file1* and place the encrypted output in *file2*, which will be created if it doesn't exist.

passwd

The command used to change the password of an account. The format is:

```
passwd <account>
```

You must be a superuser to change the password for accounts other than the one you are logged in under (otherwise, just type **passwd)**. You will then be prompted to enter the current password, then the new one, and a verification. Some systems require least 2 non-alpha characters for security.

su

Allows you to temporarily assume the id of another account (e.g. **s**ubstitute **u**ser - the default is root). Use:

```
su <account>
```

If the account has no password, you will then assume that account's identity. If it does have one, you will be prompted to enter it.

mkdir

Creates a directory – use:

```
mkdir <dirname>
```

rmdir

Deletes a directory, which must be empty first. The format is:

```
rmdir <dirname>
```

mv

Renames a file. The syntax is:

```
mv [oldname] [newname]
```

You can use full pathnames, but the new name must have the same pathname as the old one, except for the filename itself.

man

Gets you the online manual, if there is one. Use:

```
man <command>
```

Typing **help** might produce something as well.

cat

This is used for viewing text files, but it can create them as well, in a similar way as you would use the **copy con** command in DOS. Use it with the > (redirector) symbol:

```
cat > textfile
text in the file
```

Use **ctrl-D** to finish (not **ctrl-Z**, as in DOS).

Equivalent DOS Commands

DOS	Linux	Notes
ATTRIB		No equivalent, as system attributes don't exist. Just rename the file with a dot at the front. Use **chmod** to change the read attribute.
CD	cd	Almost the same syntax
COPY	cp	Almost the same syntax
CLS	clear	Clears the screen
DEFRAG	fsck	Nearest equivalent – checks and repairs after improper unmounting
DEL	rm	Works on directories and files. No undelete!
DELTREE	rm –r	No undelete!
DIR	ls	Different syntax
DIR /S	find. –name	Different syntax
DISKCOPY	cp	
ECHO	echo	
EDIT	vi, pico or joe	
EXIT	exit	Exit the shell
FIND	find	
FORMAT	mkfs	Formats a partition and builds a filesystem
HELP	help or man	
MD	mkdir	
MEM	top	Displays process status as well as memory used and available
MORE	more	
MORE <	less	
MOVE	mv	
PRINT	lpr	
RD	rmdir	
REN	MV	
SCANDISK	fsck	
UNDELETE	-	
TYPE	less	
VER	uname	
XCOPY	cp	
PKZIP	gzip	

Intruder Tricks

With regard to intruders, anyone breaking in to your system will try to be as inconspicuous as possible because, for one thing, they don't want to get caught, but, in order to do this, they will have to know your system inside out. They will change as little as possible, trying to leave the accounts they logged in with in the same state as when they started, relying on laziness or stupidity to succeed, and calling late at night when nobody is watching, or maybe during business hours where the log files are being used heavily and will be subject to less monitoring (each method has its own advantages and disadvantages). The routine will be to get in and type:

```
cat /etc/passwd
```

which will give a list of usernames, and the encrypted passwords. The **who** command will then give a list of users actually online.

Anyway, here are a few things to look out for.

Logging on under another user's name

This will not be done under any ID that can be associated with them, and not with another person's ID more than once. The first problem is getting past the login prompt, which will mean obtaining a valid account and password, with the object of getting root access with a high level account and therefore full privileges.

A command login like **who** or **finger** will show who is logged on at the moment. Often, the password is the same as the login name, such as a test account, or one with the name of the company.

This command can be used to look at the file with all the user names and accounts:

```
cat /etc/passwd
```

/etc/passwd

Contains a list of all of the accounts and their passwords, although the accounts that have them are encrypted. Where *password shadowing* is in force, the password field is replaced by an *x*, and the actual information stored in **/etc/shadow**, which is readable only by root. The format is:

```
username:password:UserID:GroupID:description:homedir:shell
```

Lower numbers for user and group IDs mean higher access. If an account jumps from the account name to the numbers, it is unpassworded.

The *password* would be encrypted with a slightly defective version of the DES encryption standard, and may have an expiry date afterwards, also encrypted – the system is purposely defective so easily-available hardware is useless for attempts at key-searching. A star (*****) means you won't be able to login with that account. Actually, the password itself is never decrypted – the one you enter is encrypted and compared against the original encryption. The best cracking program for Unix passwords seems to be **crack** by Alec Muffett. For DOS, try **crackerjack**, available from the ftp site at **clark.net/pub/jcase**/.

To defeat password shadowing on some systems, a program can be written that uses successive calls to **getpwent()** to obtain the password file. For example:

```
include <pwd.h>
main()
{
struct passwd *p;
while(p=getpwent())
printf("%s:%s:%d:%d:%s:%s:%s\n", p->pw_name, p->pw_passwd,
p->pw_uid, p->pw_gid, p->pw_gecos, p->pw_dir, p->pw_shell);
}
```

NIS (*Network Information System*) in the current name for what was once known as **yp** (Yellow Pages). It allows many machines on a network to share configuration information, including password data - it is not designed to promote system security. If your system uses NIS, you will have a very short **/etc/passwd** file with a line that looks like this:

```
+::0:0:::
```

To view the real password file, type:

```
ypcat passwd
```

Some passwords can only be used for a limited time. This is called *password aging*. In the password file example below, the **D.a3** is the password ageing data:

```
fredn:123456,D.a3:6348:56:Fred
Nurk:/home/dir/fredn:/bin/fredn
```

The characters stand for the following:

- Maximum weeks a password can be used without changing.
- Minimum weeks a password must be used before being changed.
- 3&4. Last time password was changed, in number of weeks since 1970.

/etc/group

Contains the valid groups, usually defined as this:

```
groupname:password:groupid:users in group
```

Passwords are encrypted here too—if you see a blank in the password entry you can become part of that group by using **newgrp**. Usually, if the last field is blank, anyone can use **newgrp** to get that group's access. Otherwise, only people mentioned in the last field can enter.
newgrp is just a program that will change your *group current group id* to one you specify. The syntax is:

```
newgrp groupname
```

/etc/hosts

Contains a list of hosts connected to through a hardware network (like X.25), or sometimes **uucp**. This is a good file for an intruder, since it indicates which systems can be used with **rsh** (Remote Shell), **rlogin** and **telnet**, amongst others.

/usr/adm/loginlog

or **/usr/adm/acct/loginlog**. A log file, supposed to keep track of logins, but not present if logging isn't recorded.

/usr/adm/errlog

or just **errlog**. The error log, located anywhere keeps track of all serious errors, and usually will contain an error code, then a situation. The code can be from 1-10; the higher the number, the worse the error. 6 is usually for intruders, while 10 essentially means a system crash.

/usr/adm/culog

Tells when **cu** was used, etc.

Escaping detection

The **sulog** (or **su_log**) file in the **usr/adm** directory (it can be elsewhere) can be removed or edited (see **su**). It is a record of who uses **su** and when, so is the system usage logfile.

A command could be copied to an account's directory, being given an unsuspicious name. If it can't be copied, a program like this (in C) could be used and placed somewhere safe:

```
main()
{
 execl("/bin/ls","program.ext","-l",(char *)0);
}
```

This will execute the **ls -l** command, which will generally show up as **program.ext -l** whenever someone tries to see what is going on. **/bin/ls** is the path to **ls**—put the path of whatever it is to be executed here. **-1** is the flag being passed to **ls**, which can't be covered up anyway.

Locking Out Others

Place a **vi.login** file in the target's default directory, containing the command:

```
logout
```

As the file is automatically executed when a person logs on, the logout command is carried out immediately.

Creating a file owned by someone else

chown

```
chown newownername filelist
```

Assuming the file is owned by the person changing it.

chgrp

Similar to **chown**, for changing group ownership. This must be done before **chown** when undoing a change.

Using Another Screen

The **mail** utility sends messages to people, who do not have to be logged in. To send, type **mail <username>.** Enter your message, then **ctrl-d** to send. To read mail, just type **mail**. It actually delivers the message to a file belonging to the recipient, who will be notified that a message exists. Messages can be saved or deleted and a reply sent. **talk** allows people to send messages simultaneously – similar to **phone** in VMS, or **chat** in Windows. Both must be logged in, as their output appears in separate windows on the screen. **write** is for one-way communication, and the other person must be logged in. Just type **write <username>,** and **ctrl-d** to quit.

Otherwise, you can put anything you want onto someone's screen. Every terminal (or device, for that matter) has a file corresponding to it, in the **/dev** directory, which never changes in size. They are character specific files, and whatever you put in them will go straight to the terminal it corresponds to, so whenever a user logs in, the **mesg n** command should be issued to turn off write access to it. However, if **cat** can be used before **mesg n** is issued, you can continue writing to that terminal, possibly setting up a buffer to capture everything typed. Some terminals have a command called *transmit screen*, which does what it says—it transmits everything on the screen, as if the person had typed it.

To log someone off, therefore, send a *clear screen* (usually **ctrl l**), followed by *exit* then a Carriage Return, then the transmit screen code. However, you could also wipe directories or files.

Type:

```
chmod 777 $HOME
chmod 777 $MAIL
```

then clear the screen. Now their directory can be looked at, as well as their mail.

Adding Accounts

Many administrators don't expect female names for false accounts, so look out for them.

Installation

For the purposes of this book, we assume a standard clone machine, that is, IDE hard drive, CD, etc. Mostly, any old machine will do, from a 386 with 8 Mb RAM and a 100 Mb HD upwards, but the more powerful, the better, naturally. A 100 Mb HD will take a (very) basic installation only, so expect to use something bigger if you want to add programming support (you will need some if you expect to hack the kernel). The normal rules about construction also apply, such as not mixing RAM in the same bank, which gives you the best chance of a successful installation, as Linux can be quite sensitive to hardware – you might get only one version out of four to work on a particular machine without bombing out at some point. For example, Red Hat 5.2 consistently fails to see a (genuine) NE2000+ which is seen by other versions on a machine with a C6 (WinChip) installed, and X with SUSE v6 refuses to start on a 486/50 on which Red Hat works fine (SUSE also fails to see the Adaptec SCSI card on the C6). Storm Linux fails to see just about anything SCSI. Note also that CD-ROMs must be set as Masters if they are the only drive on an IDE channel. Some of the installation aids are quite rough around the edges, and it's often best to get your hands dirty and use the traditional tools, which is the approach taken here. Another tip is not to use cutting edge equipment, as the drivers might not be available, and to write down the details of what you have before you start, particularly the type of video card, what memory is on it and details about the monitor.

As to which distribution to use, **Red Hat** is popular, with a lot of industry backing, and is very much in evidence in the corporate world, with good hardware detection capabilities, but you need to use X a lot to set it up, which means a fairly hefty machine. **Caldera** is good for NetWare integration, as it's backed by ex-Novell CEO Ray Noorda. It is primarily aimed at the desktop, so uses graphics a lot. **SuSE** is well known in Europe, and comes on several CDs, so you don't need to do too much downloading. **Slackware** (good for servers) is one of the oldest (it came from the SLS version), is simple and stable, and can still be installed from floppies, so is for people who like to get their hands dirty. **Debian** is the only non-commercial version, and the least user-friendly, but is powerful. It is the basis of **Corel** and **Storm** Linux (the Corel version doesn't have a root password). **TurboLinux**, the leading distribution in Asia, tends to rename all the packages to its own specification, though it comes with IBM's DB2 database. **Mandrake** is based on Red hat, but optimised for the Pentium rather than the 386, and uses KDE in a better way. It can also be run from inside Windows.

There are several ways of installing Linux, but only one or two of the easiest will be covered here, both to save space and for speed, and you likely won't have the facilities, anyway. For example, you could load from an **ftp** site or a server, but mostly, you will use a directory called **\dosutils** on the CD, in which is a batch file called **autoboot**. When run, this file runs **loadlin** to start an installation process that is relatively easy to follow (depending on the version) – all you then need to worry about is what to do if things go wrong. Also look in that directory for **fips.exe**, which is able to split your DOS partition in two, making the second part empty so you can delete it to make room for a new Linux partition if your hard disk is already full (backup first, then defrag to give you the maximum space). **fips** is run from DOS. You could also try something like *Partition Magic*.

Before You Start

You need to know what equipment you have in your machine, such as the amount of memory and chipset on your graphics card, IRQs, I/O addresses, etc as, even though autoprobing exists, it sometimes fails, especially if you have non-standard equipment (use industry-standard stuff whenever possible, especially a hardware modem – software-based winmodems won't work. In fact, anything Plug and Play will be suspect, although Linux can cope with it).

Linux has its own version of **fdisk**, described later, but some distributions have disk management software that may or may not be easier to use. You will need at least two partitions; one for swap space, for when memory runs out and paging takes place. Its maximum size is 127 Mb (if you need more, just create another - although you can create a swap file, a partition is better). Later, when you're more experienced and are not likely to reformat the hard drive for a while, you might want to use several partitions, for system files or data, just as you can create multiple volumes with NetWare. However, having too many runs the risk of running out of space inside them too soon, which won't help with temporary files.

For example, 100-200 Mb is a good size for **/root**, especially if your **/tmp** directory is to be in it. Another good ploy is a **/spare** directory of the same size, which is copy of **/root** that can be booted from if it gets damaged, not to mention having copies of your configuration files in **/spare/etc**.

Some people suggest putting the swap partition in the middle of the drive to minimise head movement, though this is probably more valid for older drives (a better location for speed is on the outside edge of the platter as more data can be shifted per second there). It should not be larger than your memory, say 32 Mb, if you have 64 Mb RAM. A 1 Gb read-only partition for **/usr** is also useful, and will probably be the largest, depending on what applications you intend to load, like X (don't forget to change the attributes before installing a package). This is *not* the same as one for user home directories for personal files, graphics, etc., which could also occupy their own partition in case any software screws up the system (remember, Unix was originally intended for programmers). We will cover creating one each of Linux Native and Swap partitions.

Once the partitions and filesystems are created, they have to be mounted, through a *mount point*, which can be thought of as the name of the partition. As there are no drive letters, these will be accessed through a directory on root, such as **/usr**, which is actually the entry point into that partition, should you have one. A complete list is kept in the **/etc/fstab** file, which can be edited directly when adding new filesystems and partitions.

If you can't boot from a CD, or don't have a boot floppy with your distribution, you will have to make boot floppies, two, called *boot* and *root*. The boot disk contains the kernel to get you started, and root has all the other stuff, like **setup** and **fdisk**, to keep you going. If you have non-standard equipment, or even PCMCIA, you may need more, for the drivers, but this depends on the version you have. **rawrite** will transfer the boot images for you. It runs under DOS and can be copied to your hard drive and run from there, which puts it in the DOS path and saves you remembering the include it when you invoke the command. Use two *brand new* disks, change to the location on the CD where the boot or root images are (try **\bootdisks** or or **\images** or similar) and type:

```
rawrite
```

You will see this message:

```
Enter disk image source file name:
```

Type in whichever one you are using, such as **boot.img** (or **supp.img**, or whatever). Those ending in **.I** are likely to be IDE based, while those with **.S** will be SCSI (there will be a text file in the directory with a complete list). You will then be asked for the destination drive and invited to insert a formatted diskette. The reason for using brand new disks is that the compressed file system takes up almost all of the space, and is sensitive to errors.

You can create your disks under Linux, too, with the **dd** utility, assuming you can boot from the CD. Once you've done that, insert a floppy in the drive, and change directories to the correct directory on the CD (use **cd**, but don't forget it's a forward slash). Type something like:

```
dd if=boot.img of=/dev/fd0 bs=1440k
```

Once you've made all the disks, boot up with the boot disk, and swap to the root when prompted for the RAMdisk.

To use the Linux version of **fdisk**, assuming it's on a floppy, type:

```
fdisk drive
```

where *drive* is where you want to alter partitions. The default device is **/dev/hda** (that is, the first IDE drive), but you could specify **/dev/sda**, for the first SCSI one, **sdb**, for the second, and so on. Partitions on drives are labelled from 1 onwards, so you might start with **/dev/hda2** for the second partition on the first hard drive, if you already have a DOS one there, and go on to **/dev/hda3** for a swap partition. It's not hard to work out, but here's a quick chart:

```
fd0    1st floppy
fd1    2nd floppy
hda    1st hard drive
hda1   1st hard drive, 1st primary partition
hda2   1st hard drive, 2nd primary partition
hda3   1st hard drive, 3rd primary partition
hda4   1st hard drive, 4th primary partition
hda5   1st hard drive, 1st logical partition
hda6   1st hard drive, 2nd logical partition
hdb    2nd hard drive
hdb1   as above
sda    1st SCSI hard drive
sbd    2nd SCSI hard drive
```

Anyway, you have to run **fdisk** for each drive you have, and you have to keep a mental picture of the whole situation, although there is an overview of the current status with **p**. The most useful options you have are as follows (type **m** to get the full list on screen):

```
d      delete a partition
l      list known partition types
m      help
n      add a new partition
p      print the partition table (on screen)
q      quit without saving changes
t      change a partition's system id
v      verify
w      write to disk and exit
```

You can expect to start with **n**, then create at least 2 primary partitions (one for swapping), change the ID of that one to swap status with **t** (it's type 82), then **w**, making sure they don't overlap, but you will be given the first available cylinder number for every partition anyway. As a very rough rule of thumb, 1 block is equal to 1K of disk space. Expect to reboot at this stage, but you may not have to.

Next, you need your swap space, which, essentially, is formatting the swap partition:

```
mkswap –c partition size
```

which might translate to:

```
mkswap –c /dev/hda3 9336
```

partition is the name of the device and *size* is in blocks. **–c** tells **mkswap** to look for bad blocks. Afterwards, enable it with:

```
swapon /dev/hda3
```

(for example). Next, format your main partition(s) with the **ext2fs** filesystem:

```
mke2fs –c partition size
```

After all that, you have to mount all your filesystems and copy over the system. Most distributions seem to have a **setup** program for all this anyway.

During the installation, you may be asked if you want a *Server, Workstation* or *Custom* installation – choose *Custom*, as the others will likely wipe out the whole hard drive. It might still happen, but at least you will have the choice!

LILO

Linux (along with OS/2 and REAL/32) can load on any BIOS-accessible drive partition, whereas DOS and/or Windows must use a primary partition on the first hard disk. As the BIOS is involved, this means being inside the first 1024 cylinders of the drive, although you can still use a partition over that once you've booted by other means (e.g. floppy). To sort all this out, you need a bootloader in the Master Boot Record…….

lilo is a low-level OS-independent utility that talks to the BIOS directly, and can load several operating systems. It can be put on the MBR, always remembering that Windows will do its best to ruin it, or in the first sector of the (Linux) boot partition, which is where any boot managers you already have will find the code they need. It will create a text file called **/etc/lilo.conf** that tells **lilo** where the kernel is (hold down the **ctrl** key during boot to get a menu of operating system choices).

Once installed, a boot loader (see below) will be installed in your Master Boot Record to give you the choice of Linux or whatever other operating system you may have (see also *Dual Booting with NT,* below). Unfortunately, this can interfere with other systems, such as Real/32 or Multiuser DOS, so look for a utility called **loadlin**, which finds and loads Linux for you from a DOS prompt. One version of Slackware can even be loaded from a DOS partition, and is small enough to run from a Zip drive. It's called **zipslack**, and should be available on the Net somewhere.

Sometimes, you might have to pass special options to **lilo** at boot time, such as how much memory your system has if you are using more than 64 Mb (this is due to the BIOS reporting a maximum of 64 Mb to the operating system, so you need to tell the kernel how much it actually has to play with - take off 1 Mb for shadowing, etc).

Dual Booting With NT

Install **lilo** on the first sector of its partition, rather than the MBR, otherwise you will overwrite the NT boot loader. You then need to create a boot sector file that tells NT's bootloader where to find Linux. The command:

```
dd if =/dev/hdc
of=/bootsect.lnx bs=512
count=1
```

creates a file in / (root) which is an image of the boot record, called **bootsect.lnx**. Copy this to the primary partition. Add a reference to it, **C:\bootsect.lnx="Linux"** to the end of the **[Operating Systems]** section of NT's **boot.ini** file, on C:. To copy the file to the floppy, log in as root, **cd** to **/mnt**, **mkdir floppy**, if there isn't one already then enter:

```
mount –t msdos /dev/fd0 /mnt/floppy
```

You might try substituting `vfat` for `msdos` if that doesn't work. The **/mnt** directory is where any device files live relating to anything you might attach to your machine. Copy with:

```
cp /bootsect.lnx /mnt/floppy
```

After Installation

OK – so now you've got it installed, what can you do with Linux?

Adding Users

You need to login as **root** before you can do anything, and then add another account for your daily use, which will reduce the chances of causing a major fubar by accident (root privileges are extensive, and it is assumed you know what you are doing, as we said before, so a **delete** command will do just that, without any queries), and save the root account from being unattended for any period of time.

Another reason is that use of the root account is not logged (**su** is), so you're giving an intruder a good way to avoid detection if a process can be run that takes over a quiet root account. Not only that, if you have lots of administrators, you can keep track of what configurations they change. So, create an account for daily use, and use **su** occasionally to perform any action that needs root privileges. Use the command:

```
useradd –u 1007 –g users –d /home/<name> -s /bin/bash –m<name>
```

It may be **adduser** instead. **<name>** is the name of the user. The **–u** switch concerns the userID, which here is 1007 - you can find the next available one by looking in **/etc/passwd**. **–d** creates the new home directory, **-s** dictates the shell they will use and **–m** is the new name. Once you carry out the command, the contents of the **/etc/skel** directory are copied to the new home directory. It follows that you can use templates here to make your life easier.

To create a password, type:

```
passwd <name>
```

To create a user account by hand, edit the **/etc/passwd** file, create a home directory and copy some empty configuration files to it (look in **/etc/skel**). Change the owner like so:

```
chown –R –v <name>.users /home/<name>
```

-R tells **chown** to recurse down the directory tree, and **–v** means *verbose*, that is, it displays what's happening on the screen. **<name>.users** means change the owner to <*name*> and the group to *users*.

One problem with just using a user account is that you need root privileges to use a dial-up Internet account, because **pppd** needs them to change routing tables and the like. This command allows you to start **pppd** (only) as root:

```
chmod u+s /usr/sbin/pppd
```

After that, anyone on your system can call an ISP. Also, do all the work on your system as the same user, as permissions could get a little confused if you mix it with root.

Getting to the Internet

You can do this with a direct **ppp** connection for one computer, with a network through a masquerading firewall or with an IP address for each machine, with your Linux box being used as a gateway (you need to be real friendly with your ISP for this). For the latter options, see the *Router or Gateway* section, below.

Direct PPP connection

Linux needs to know about your modem, the COM port it is using (using the **/dev/modem** device) and the telephone number of your ISP at the very least, to be set into the ppp daemon (**pppd**), which gets its information from **/etc/ppp/options**. There will be a **chat.config** file that contains the login scripts for your entry point. Red Hat's **netcfg** program is useful here.

Having loaded **netcfg**, or similar, you need to add a **ppp0** interface, which may also require the phone number, user ID and password for your ISP.

Next, set up your serial port. The information about it will be in the device file in the **/dev** directory (or it could be **/device**). The file itself could have the letters **cua** or **tty** in it. If you don't have **/dev/modem** as the default, here are Linux equivalents of DOS ports:

DOS device	Linux device
COM1	/dev/cua0, /dev/ttyS0
COM2	/dev/cua1, /dev/ttyS1
COM3	/dev/cua2, /dev/ttyS2
COM4	/dev/cua3, /dev/ttyS3

You may need to use one of the above instead of **/dev/modem** for smoothest operation. Use the **dmesg** command to see if your serial ports are operating, or at least mentioned on the display. Test with this command:

```
# echo "ATDTXXX-XXXX/n" >/dev/cuaN
```

XXX-XXXX is a phone number, and the *N* at the end refers to the number of the serial port.

The equivalent for Windows' Dial-Up Networking is **kppp**, which, as its name implies, runs under the **kde**, and is probably the easiest way to get going, but you could try **wvdial**. However, as the name also suggests, it uses **ppp** as the basis of its operations, which also relies on certain other services, such as **chat**. Make sure you have the latest versions of everything, including the kernel. K stuff can be obtained from **www.kde.org**.

The **ppp** daemon dies occasionally – the trick here is to make sure that the **/etc/ppp/options** file not only exists, but doesn't have conflicting entries. The cheat's way to do this is leave it empty.

For simple email access, **fetchmail** is the best to get started with. **kmail**, which comes with K, is also worth a try.

First, catch your ISP, that is, obtain an account with one. Run **kppp**, select *Setup* then *New* under the *Accounts* tab. Under the *Dial* tab, type in the Connection Name, then the phone number. You'll have to use trial and error with CHAP or PAP for Authentication. Leave the IP tab as *Dynamic*.

Under the DNS tab insert your IPS's primary and secondary server numbers and select a decent connection speed.

Click on **OK** twice, then type in your account details, like login name and password. You should be able to click *Connect* then fire up your browser at this point.

Stopping Linux

As with Windows, this should be done in an orderly fashion, or you may not be able to get back in again. Use the command:

```
shutdown now
```

Or logout with **ctrl-d**, and use **ctrl-alt-del**.

To restart, use:

```
shutdown –r now
```

Changing Kernels

Most of the device drivers you need come supplied in the kernel (graphics cards, printers and scanners are handled elsewhere), and are often not needed, so you may want to delete some of them to save space, or, if you're like me, you want enough code hanging around in memory and no more. Because of the BIOS, the compressed kernel image must reside in the first 640K of memory. You also need to have installed the GNU C Compiler. Also, the more memory you have, the better.

Kernel version numbers look like this:

```
2.2.2
```

The first number is the major version, the second the minor, and the last the revision level, which is always even-numbered for stable, "production" versions. Odd-numbered revision levels denote beta development code, and should be avoided unless you actually want to play around to that extent. On your machine, you will find the kernel disguised as a set of C source files in **/usr/src/linux**, which should actually be a symbolic link to another directory with the full name. As usual, make sure you're backed up, and have a boot disk (that works) to hand in case things get screwed up. You may either want to play with your present kernel, or use a new one (try not to use patches, which were the vogue when modems were slower). Assuming the latter, kernels are usually downloadable from various sources, but if you got yours on a CD, you first need to mount it:

```
mount –t iso9660 /dev/cdrom /mnt/cdrom
```

Then change to it:

```
cd  /mnt/cdrom
```

Judicious use of **ls** or **mc** (a Norton Commander clone) will find the file you want. It will be in compressed format and may look like:

```
linux-2.0.0-2.tar.gz
```

Copy the file to the relevant directory on your hard drive:

```
cp /cdpath/linux-2.0.0-2.tar.gz /usr/src
```

Change to that directory:

```
cd /usr/src
```

Remove or move the link to your old Linux directory:

```
rm
```

Uncrunch the distribution file:

```
tar –xzvf linux-2.0.0-2.tar.gz
```

Change to the new Linux directory, which hopefully will have been created:

```
cd /usr/src/linux
```

On a new installation, whether this directory exists or not seems to depend on whether you installed kernel development or not. If it uses a different name, create a symbolic link to it with:

```
ln - /usr/src/linux-2.2 /usr/src/linux
```

If it exists already, it may also be a good idea to rename the directory before you start so nothing gets overwritten.

Start the process with either of:

```
make config
make menuconfig (lots easier)
make xconfig (done in an X window)
```

The responses to the questions, are either Y, N or M. The latter makes the choice concerned a module so it can be dynamically loaded, i.e. the support is in the kernel, but the code is loaded separately, useful for less used equipment. However, modules should be avoided on slower machines, and network/PPP support should always be included. Do this also for SCSI, so you don't need RAM disks at startup.

If you are curious about what the configuration settings mean, you can open the documentation in another virtual console. Use **alt-F2** to do this, log in again, then change directory:

```
cd /usr/src/linux/documentation/
```

and open up **configure.help** in **vi**, **pico**, **joe**, **jed** or whatever text editor is flavour of the month.

The default is to compile for a 386, but you can select variations for leaner code. For AMD processors, use the equivalent Pentium settings. Also, turn off maths emulation, unless you're using a 386SX.

Now type:

```
make dep
make clean
```

These prepare the source code. The first one prepares the dependency tree, that is, what gets compiled and what doesn't, while the second erases all traces of a previous exercise so there are no mistakes. Once all the disk thrashing has stopped, type:

```
make bzImage
```

This creates a file called **bzImage**, which is your new kernel. Other commands, such as **make Image**, make different types of kernel, in this case a standard one. You can also create older and smaller ones, or those that can be loaded from a diskette. **bzImage**, as used here**,** works around a kernel size limitation - the kernel is compressed during build and decompressed at boot time, which must be done inside the first 1 Mb of RAM. If you feel your kernel is small enough, use **zImage** instead. About an hour later (on a 486), you can add your modules, but make a backup of the existing ones first.

Rename the old image:

```
mv /boot/vmlinuz vmlinuz.old
```

Copy the new kernel to /boot:

```
cp /usr/src/linux/arch/i386/boot/bzImage /boot/vmlinuz
```

Edit your original **lilo.conf** file (you did make a backup?) so that it has two entries for the kernel, one for the old and one for the new, using the names above, so you get the choice on boot up and you can recover from a problem if one occurs.

It might look like this:

```
boot=/dev/hda
map=/boot/map
install=/boot/boot.b
prompt
timeout=50
image=/boot/vmlinuz
        label=linux
        initrd=/boot/initrd
        root=/dev/hda1
        read-only
image=/boot/vmlinuz.old
        label=oldlinux
        root=/dev/hda1
        read-only
```

If you have a modular kernel, go to **/lib/modules** and rename the current kernel version number. For example, if the current version is 2.2.9, try:

```
cd /lib/modules
mv 2.2.9 2.2.9x
```

This way, if the new modules don't work, you can revert to the old ones after naming them back again.

Now type:

```
make modules
make modules_install
```

This will also take some time. They will end up in a directory looking something like **/lib/modules/2.2.xx-xx**, depending on what kernel you built. You will see it on the screen. Go there and type:

```
depmod -a
```

for a new list of dependencies, that is, the order in which the modules should be loaded when needed. They will be in a **modules.dep** file.

Rerun **lilo**, then reboot. Go to the **/sbin** directory and type:

```
lilo
```

It will tell you what it added. Shutdown with:

```
telinit 6
```

and reboot.

Updating The Kernel

Uncompress the patches you can get from **www.kernel.org**, change to **/usr/src** and type:

```
patch -p0</path to uncompressed file
```

Then recompile the kernel as described above.

Changing The Boot Process

In **/etc/rc.d/rc2.d**, you can find the files that are executed on startup and shutdown. Typing:

```
ls -la
```

will show you a list of files beginning with S followed by numbers in the order they are processed (the ones beginning with K are used for shutdown). Changing the number changes the order they are dealt with. In particular, to start PCMCIA services earlier, because you need to get the interface working before the Ethernet, you can edit **/etc/rc.d/init.d/pcmcia** and alter the second numbers in the **chkconfig** line. Then type:

```
chkconfig -del pcmcia; chkconfig -add pcmcia
```

to regenerate the links.

Adding Packages

The standard distribution method is by source code, mainly because it's easier to install on more than one platform. This means that once you transfer the suff to the hard drive, you have to compile it before you can use it, which is in keeping with Linux (i.e. Unix) being a programmer's operating system, although you don't actually need to be a programmer to do this – it just helps when things go wrong, but the process is mostly automatic. Linux programs use library files, like **dlls** in Windows, which are added when you run them, hence dynamic linking. As libraries are backward-compatible, you don't have to have every version that was made, and neither do you have to tell the software which one to use (as we all know, this doesn't always work in Windows).

Different libraries suit different kinds of program. The basic is **libc**, as used for compiling the kernel, but KDE uses **Qt** and still others use their own stuff.

Installation is usually done with **rpm** (**R**emote **P**ackage **M**anager) for Red Hat. Other distributions may have something similar. First, navigate to the directory containing the **rpm** file (see the instructions above for mounting a CD if you need to), then type:

```
rpm –ivh –replacefiles samba-1.0.1.i386.rpm
```

or whatever it's called. It should be installed in all the right places automatically. The **replacefiles** parameter is included just in case another package placed one on with the same name as one you are installing. Otherwise, you can leave it out. There are other similar parameters, notably **replacepkgs**, but refer to the documentation for them.

To uninstall a package, type:

```
rpm –e samba
```

You don't need the name of the original file, just whatever the process itself is called.

Adding A Hard Drive

And moving a directory to it. First, install the drive, and check that it is recognised by the kernel with:

```
dmesg | more
```

look for it amongst all the messages. Use **mk2efs** to partition it:

```
mk2efs –c /dev/sdb1
```

The above assumes a second SCSI drive, the first partition. Then create a temporary mount point:

```
mkdir /mnt/home
```

Assuming you are calling it *home*. Then mount it:

```
mount –t /dev/sdb1/mnt/home
```

Copy your old data to it. Rename the old partition, so you keep the data intact for a short while, then add the new partitions to your **/etc/fstab** file, so the system knows where to find it. Try a line like:

```
/home /sdbext2 defaults 1 2
```

Reboot. Check the new partition's existence with **df –h**, then delete the old directory.

Securing The System

Strip the kernel of redundant features and services. However, make sure you include IP Firewalling, TCP Syn Cookies and Drop Source Routing Frames. The first allows you to set up access lists from the command line, the second helps prevent denial-of-service attacks the last stops intruders specifying routers packets should go through, which will bypass your own methods. Disable services in **inetd.conf** that you don't need (use secure services, or **ssh**, instead) – this file tells **inetd** what processes should be executed once a connection is made on a listed socket. **rc** files are the equivalent of **autoexec.bat**, from inside which you can disable daemons such as mount.

You can also change the ports that certain services traditionally listen out on. For example, **lpd** usually listens out for connections on 515 – change this with the *#port* argument in **/etc/hosts.lpd** or the equivalent for different services.

X applications send screen and keystroke information around the system, so consider disabling it or limiting machines and people that can display on your server.

Emulating Other Systems

You can run programs that work under other operating systems by using an emulator, such as **dosemu** and **wine**, for DOS and Windows, respectively (the latter is built in to Red Hat version 6). There is also Caldera's **wabi**, that runs a copy of Windows 3.1. Naturally, neither of them is perfect (yet, anyway).

Notes

Networking

Linux uses TCP/IP (but it can also communicate with Windows and NetWare machines in their native languages). As such, each machine has an IP address, like 192.168.0.1 (in fact, the range 192.168.0.1 to 192.168.255.254 has been specifically reserved for private networks, and the Internet, which also uses TCP/IP, knows not to use them). Each machine will also need a *subnet mask*, probably 255.255.255.0 (this is a pattern of bits that tell you what subnet your network is on when it's overlaid on the IP address).

Three configuration files are used for Linux networking; **/etc/hosts**, for translating computer computer names into IP addresses, **/etc/networks**, for converting network names to numerical network addresses, and **/etc/netconf.**

Samba

This is used to make Linux work on a Windows network. For it to run properly, you need two daemons, **smbd** and **nmbd**. The former provides file and print sharing and the latter sorts out NETBIOS name server support. To check if samba is enabled, type:

```
cat /proc/filesystems
```

If it isn't there, check to see if it is a module:

```
ls /lib/module/2.2x/fs/
```

Look for **smbfs.o**. Use **lsmod** to see if it's loaded in the kernel. If not, type:

```
modprobe smbfs
```

After installation, make sure the daemons are placed in **/usr/sbin** and the binaries in **/usr/bin**. For a permanent file server, run the daemons from **inetd** so they can be restarted if they die, but for now, just change to their directory and run them manually. For automation, include these lines in their own section in **inetd.conf**:

```
# SAMBA
netbios-ssn stream tcp nowait root /usr/sbin/smbd smbd
netbios-ns dgram udp wait root /usr/sbin/nmbd nmbd
```

You will see that the separate commands above occupy their own column in the file. You may find they are already there. Restart **indetd** with:

```
killall –HUP inetd
```

This will force the system to reread the file. Samba itself is setup through the **smb.conf** file, in the **/etc** directory. If it is not there you can copy it from where Samba was built, but **swat** (see below) often doesn't like one present and likes to start afresh.

This file is where you dictate the resources you want to share and the restrictions on them, and closely resembles a Windows' **ini** file, in that it has sections that look after certain aspects of Samba's operation. It can be edited directly with your favourite text editor, but it is designed to be administered by the **swat** utility, or *Samba Web Administration Tool*, with the aid of a web browser, but if you have a file you've developed over the years, be aware that it will be overwritten, so back it up. **swat** is run from **inetd** and is meant to be used from a browser, which means you can do it from any machine on the network.

First, go to the **/etc** directory and open the **services** file with a text editor. Add a line like:

```
swat          901/tcp
```

Add this line to **inetd.conf** in the relevant columns:

```
swat   stream tcp    nowait.400    root   /usr/sbin/swat swat
```

Again, you might find it's already there with a **#** in front of it – just delete the hash to activate the line. It usually lives in **/usr/sbin/swat**. Send a HUP signal to **inetd** so the files are reread. Use:

```
kill –1 ProcessID
```

You will need to find the Process ID for the **inet** daemon to include in the above command (try 1). Having said all that, **smbd** and **nmbd** check **smb.conf** every 60 seconds anyway. After that, you can point a browser to:

```
http://host:901
```

where *host* is the address of the machine concerned and 901 the port (doing this remotely leaves passwords open to sniffing as they are sent in clear). However, test the network connection first by pinging from machine to machine, as there is no point carrying on if the hardware is duff (on the Windows box, you need to use the DOS prompt). Try with Windows NETBEUI first (make sure the workgroup is the same!) as that is easier, but for **ping**, the command is:

```
ping 10.0.0.1
```

or whatever the number of the machine you want to contact is. At least then you know the hardware is working. If the ping doesn't work, you know your TCP/IP is at fault.

If the **ping** to your Linux box works, but **telnet** and **finger** don't (that is, you get refused connections, or it doesn't connect), make sure **inetd** is running, and a ftp daemon, like **wuftpd**, making sure there is a line in **inetd.conf** to load it. Use the command:

```
ps aux | grep
```

to see what's alive. The connection may be being denied by *tcpwrappers*, in which case check **/etc/hosts.allow**, **/etc/hosts.deny** and **/var/log/syslog**. Also check the **ftp**, **finger** and **telnet** lines in **inetd.conf**. If **smb** isn't there, type:

```
cd /etc/rc.d/init.d
su
./smb start
```

You should see **smb** and **nmb**.

Change to the **/etc** directory and test the integrity of the **smb.conf** file with this command:

```
testparm smb.conf
```

This will test for syntax errors. The file consists of several sections, just like a Windows **ini** file, each of which deals with a single resource to be shared, such as **[homes]** or **[printers]**. In each section is a description of the access rights granted to whoever wants to use it. A guest service does not require a password to be accessed, and there is a **[guest account]** for this.

[global]

Variables used to define sharing for all resources, or to provide defaults, such as the workgroup name, etc. Bearing in mind that Windows '98 uses encrypted passwords, add the last three lines listed here, otherwise you will be denied access:

```
workgroup = your workgroup name
netbios name = your computer name
guest account = guest
printing = bsd
log file = /var/log/samba-log.
lock directory = /var/lock/samba
share modes = yes
security = share
```

```
encrypt passwords = yes
smb passwd file = /etc/smbpasswd
```

Also use the **smbpasswd** command to add the user concerned to the encrypted password list:

```
smbpasswd –a paco
```

The list will be created automatically if it doesn't exist, so don't worry if you see a message saying it doesn't.

[homes]

For remote users to access their own directories, for which they must have an account on the Linux box. If guest access is specified here, all home directories will be visible without a password. Again, for Windows '98, add the last lines:

```
browsable = no
read only = no
create mode = 0750
guest ok = no
```

[tmp]

Deals with temporary file space.

```
path = /tmp
read only = no
public = yes
guest ok = yes
case sensitive = no
mangle case = yes
preserve case = yes
```

[public]

For sharing with the Public.

```
path = /home/public (use / for everything)
public = yes
only guest = no
writable = yes
printable = yes
write list = @group
```

The last entry makes the directory readable by the Public but only writeable by people in the sales group.

[printername]

For printers.

```
path = /spooldirectory
printer name = printername
writable = yes
public = yes
printable = yes
print command = lpr –Pprintername %s; rm %s
```

/spooldirectory could be **/tmp** or similar (try **/var/spool/lpd**)

Use **smbclienta** to look at drives on Windows machines, and **smbmount** to attach to them.

Use **smbpasswd** to tell the Linux system what password you use on your Windows machines.

Printing

You won't get anywhere without **lp** support in the kernel. The equivalent command to **copy filename.txt lpt1:** is:

```
cat filename.txt > /dev/lp1
```

It's very similar, and just as basic. To add queueing, use the line printer daemon (**lpd**), but you will need some sort of filter (printer driver) to use a specific device, such as a Postscript printer.

lpd uses a file called **printcap**, which is a text-based database of printer capabilities. It lives in **/etc**. A typical line in it looks like:

```
name:lp=/dev/lpx:sd=/var/spool/lpd:sh:mx#0:if=/path/printfilter:
```

where *name* is the name of your printer. **lpx** is the device name. The bit at the end is the path to your filter, which should be made executable and readable:

```
chmod 755 /path/printfilter
```

Printers need a spool directory, in this case **/var/spool/lpd**. To restart, type:

```
killall –HUP lpd
```

To share your printer with Windows machines, you will need Samba, for which see above.

Security

- Close ports, e.g. 80 (http), 22 (ssh)
- Remove modules not used

- Use **ipchains** (packet filtering) to deny incoming packets coming in from outside interfaces with local network Ips (deny traffic from rp (ip?) coming in from **eth0.** Stop spoofing by blocking all private IPs (10.0.0.0-8, 192.168.0.0-16) coming in from outside IPs.
- Shadow passwords
- Don't allow root to login remotely (i.e. use **su**)

Forgot your password?

You don't need one if you load Linux in single-user mode at the **lilo** prompt, which puts you in a root shell:

```
linux –s
```

(or whatever name you gave to **lilo**).

Alternatively, use a boot disk, mount the root filesystem on **/mnt** and blank out the password field for root in **/mnt/etc/passwd**:

```
root::0:0:root:/:/bin/sh
```

Red Hat has the **passwd** command on the rescue floppy.

Using X remotely

```
export DISPLAY=(your IP):0 xterm &
```

Router or Gateway

Linux has routing built into the kernel, which usually only needs to be activated with **ipfwadm**, for later copies, at least. For older versions (say before 5.1, 5.2 or something), you may have to reinstall and specifically switch it on – there is a **readme** file in **/usr/src/Linux** with some instructions in (a router is what Linux really means when it asks for a default gateway).

Masquerading

This is what turns a machine into a router, provided it has an Ethernet card and a modem (or, more correctly, a PPP interface), which means it can be seen by the Internet on one side and other machines in the network on the other, keeping track of packets going both ways. The Ethernet is given private IP addresses (by you) and the PPP interface uses one from an ISP. Thus, if you use such a machine as a masquerading firewall, the Internet only sees one machine with one IP address, but the other machines can see out. The IP addresses used for your internal network should be 192.168.1.*, with the * being a different number for each machine on the network (these numbers are reserved for private networks). Use 198.168.1.1 for the Linux box itself, which should also be the *Default Gateway* setting on the other machines, but their DNS settings should point to a valid DNS server, such as that on your ISP. The subnet mask will be 255.255.255.0.

Masquerading is controlled with **ipfwadm** (**ipfwchaqin** for the 2.2 kernel). You need at least kernel version 2.0.36, and preferably 2.2 or above for best performance and stability. In it, you need support for Networking, TCP/IP, Network Device and possibly Ethernet/PPP support. Turn off IP forwarding and turn on IP firewalling.

With Red Hat, there's an entry in **the /etc/sysconfig/network** file called FORWARD_IPV4 that needs to be set to *True*. Otherwise, use this command to activate forwarding:

```
echo “1” > /proc/sys/net/ipv4/ip_forward
```

Stuff like X isn't needed for this, so you can use a relatively small hard drive. When installing, make sure you select the following:

```
pppd (dial-up Internet access)
diald (dial-on-demand)
apache/httpd (Web server)
squid (cacheing proxy server)
sendmail (message transfer agent)
fetchmail (POP3 mail retrieval)
ipop3d (POP3 server)
imapd (IMAP4 server)
samba (Windows networking – see below)
webmin (remote administration)
bind (name server)
```

You will notice that many of these include the letter **d** at the end, which means they are daemons and therefore lurk around in memory while the machine is on.
The Linux machine's IP address becomes the default gateway for the workstations.

Certain blocks of addresses are reserved for private networks, which you should use or you might find you get confused with a real address on the Internet.Since the Internet knows that these addresses are reserved, it helps firewalling because it won't try to use them:

```
10.0.0.0
172.16.0.0
192.168.0.0
```

Usually, the router is the lowest number in the block – remember that any address ending in 0 is reserved, as is anything ending 255. The netmask should be 255.255.255.0. Workstation DNS settings should be the same as the firewall's (i.e. the same as the ISP) and the gateway address should be the IP address of the firewall.

The firewall will also have an address assigned by the ISP, so you need to start routing to move between the two. How you do it depends on the kernel. These commands (for 2.2.x) can either be entered manually, or placed in a startup script somewhere (try **/etc/rc.d/rc.local**):

```
ipchains –P forward DENY
ipchains –A forward –s 192.168.0.0/255.255.255.0 –j MASQ
```

The first line sets the default policy, and the word DENY only allows the machines specified on the next line to get Internet access. The IP address used in it is the network address and the subnet mask after it tells it the range, that is 192.168.0.1 – 192.168.0.254. You can specify single machines as follows:

```
ipchains –A forward –s 192.168.0.12/255.255.255.255 –j MASQ
```

The commands are similar with 2.0.x kernels, except that you can restrict access to individual machines on the Internet with the **–D** option (in this case all of the Internet is available, with 0.0.0.0):

```
ipfwadm –F –p DENY
ipfwadm –F –a m –S 192.168.0.0/255.255.255.0 –D 0.0.0.0/0
```

A web site about Masquerading is available at **http://ipmasq.cjb.net**.

Configuring a Firewall

A firewall in an aeroplane stops flames passing from the engine into the cabin. One in a network serves a similar function by stopping unwanted traffic from outside reaching yours, which is quite possible in the home these days as IE 5 allows modem sharing for Internet connections, and relevant where the network is connected permanently to the Internet with something like a cable modem. This is much easier to do with versions 2.2 of the kernel and above.

A firewall rewrites requests from your network to look as if they originated from it, and reverses the process with the replies (it remembers the original transaction). One drawback is the extra steps needed to get past it from your end, and some software won't work with one, notably Netscape, which is why you need a proxy server, for redirecting requests to the proper places.

Firewalling uses IP filtering, where every packet is inspected and acted on according to instructions you give it, concerning the port involved or the IP address of certain machines that are suspect. Actually, the instructions are given to the router, which does all the inspecting.

Packet filtering involves three of the four layers of the TCP/IP stack, and three fields in the IP packet, the Source and Destination Addresses and the Protocol Identifier (PID).

First, disable anything running on the server you don't need, done with **inetd.conf**. Just comment out the ones you don't want. To restart, as usual, type:

```
killall –HUP inetd
```

ipchains is used again. The rules for dealing with a packet are grouped into chains, hence the name. Three are used by default, *input*, *output* and *forward*, which are usually enough, providing control for packets being accepted, sent or passed on to other networks, respectively.

The easiest way is to block all incoming data, then specifically re-enable that which you intend to allow:

```
ipchains –P input DENY
```

which has the effect of blocking traffic to the kernel as well, so type this straight after:

```
ipchains –A input –i to –j ACCEPT
```

Anything coming in on the network loopback device is now accepted by the kernel. Now tell the machine to connect to itself with its real IP address:

```
ipchains –A input –d xxx.xxx.xxx.xxx –j ACCEPT
```

You can also use a device instead of the address, such as **ppp0** or **eth0**. Check what rules are current with:

```
ipchains –L
```

Here is the complete list of chains:

```
-N    Create a new chain
-X    Delete and empty chain
-P    Change the policy for a complete chain
-L    List the rules in a chain
-F    Flush the rules out of a chain
-Z    Zero packet and byte counters on all rules in a chain
```

And one of rules:

```
-A    Append a new rule to a chain
-I    Insert a new rule
-R    Replace a rule
-D    Delete a rule
```

If you want people from the outside to access a web page on your system, you need to enable access to port 80:

```
ipchains –A input –p TCP –d xxx.xxx.xxx.xxx 80 –j ACCEPT
```

To allow access to all but one machine:

```
ipchains –A input –p TCP –s xxx.xxx.xxx.xxx –d
xxx.xxx.xxx.xxx 80 –j DENY
```

All the above should be on the same line. It tells the kernel to block requests from the source (-s) to the destination (-d) for Web access (port 80).

More information from www.rustcorp.com/linux/ipchains.

Testing a Firewall

First, ping the Internet from it, or at least somewhere not connected to your network. If that doesn't work, your PPP is at fault. Next, ping between hosts on your network, then every machine should be able to ping the firewall. If you can't ping the PPP address of the firewall, you need to turn off IP forwarding in the kernel. Lastly, ping each machine from the firewall, then you know your hardware is OK.

Turn off everything in **inetd.conf** that isn't needed, including **netstat**, **systat**, **tftp**, **bootp** and **finger** (just put a hash in front of the line).

Proxy Server

You will likely need extra software for this, obtainable from good Linux sites everywhere. Try **squid** (**squid.nlanr.net**).

Useful Sources

General

www.linux.org
ftp://metalab.unc.edu/pub/Linux/system/printing
www.redhat.com
www.linux-mandrake.com/en/
www.suse.de/en/
www.debian.org
linux.corel.com
www.linuxapps.com
www.slashdot.org
www.freshmeat.net

Network Administrator's Guide

http://sunsite.unc.edu/LDP/LDP/nag/nag.html

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Troubleshooting

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Troubleshooting

This subject requires application of your knowledge, and is the real test of a professional. There are many doctors, for example, who can pass exams, but who have very weak diagnostic skills.

Actually, problems are usually quite simple, although they never seem so at the time! Fault finding should be done in a logical way, following a definite procedure, which may at times seem involved, but is actually shorter in the long run. There are some questions below that it's worth asking *every time* someone rings in. Many support companies have a sheet with these questions on to go through. The general technique is to define the problem, isolate it, then solve it, for each of which you will get very little help from people using the system, or the machines themselves, and everything will happen just before 5 o'clock on a Friday.

Your first indication of trouble will be a somebody saying something like "The network doesn't work!", without giving you a further clue. They might have seen an "Access denied" error message from Windows, or printing has slowed down, or whatever. My point is that they might think it's the network, but it very often isn't—*Access Denied* from Windows often just means "not enough file handles", and a file can't be opened, or instead of saying who is using a file, you might get *Abort, Retry, Fail* messages, because the network system has to emulate messages and has to use what's there. Alternatively, and more commonly, you might receive a system box on your workbench with absolutely no information at all.

Information is precious, so any data should be backed up, although it's worth checking with the customers, if you can identify them, to see if they have one already and to get permission to reformat the hard drive as necessary. That's when you find they've got 10 years' worth of work on the hard drive, *not backed up* (don't laugh – this one happened to me).

Time is precious, too. In a large company, the person to whom a dead machine belongs only has one objective – to get their work done. For this reason, as well as having the normal spares in your workshop, a complete machine or two is also a good idea, so you can swap out a defective machine and repair it in your office. That way, the person gets their work done and you don't have someone who can't do anything else breathing down your neck and making suggestions. You also don't get involved in rearranging all the personal stuff that people collect around their desks, which always seems to end up on the base unit.

When you do repair the machine, you will just be replacing circuit boards – they're so cheap it's not worth the effort to try and repair them. You therefore need a handy supplier on hand so you can get things quickly if you need them.

So—start with your users, and any potential finger trouble. If you're in a tech support department, it's worth mentioning the value of encouraging feed back, and not giving everyone the impression that you will come down on them like a ton of bricks if they do anything wrong. Fear is not an option when you're running a network!

Some useful questions for defining the problem could include:

- When was the problem first noticed?
- What was happening the moment the error occurred?
- Was it working up till then, or just limping along and no-one bothered to report it?
- What, therefore, has changed between then and now?
- Has it happened anywhere else?
- Can it be duplicated?
- Has the password expired, or is there a typo in the one being used?

You could probably think of many more. Having got that far, try and isolate it:

- Is the problem at the server end, or at the client PC?
- Check that the PC concerned works by itself, with another operating system.
- Try logging in elsewhere, or as another user at the same place.

You will notice that the above ideas are more or less based on common sense. The trick is to establish a process of elimination, starting with the big picture, so you don't limit yourself. This means starting with the whole system first, then working downwards by cutting the problem in half every time. For example, if your printer is not producing what you expect, try it with another PC; if that works, then you're left with the PC, on which you can try changing the software. If that's OK, then it's a hardware problem on the PC, and so it goes on.

During the course of the above, document what you do, and reduce the complexity until the system is just working, and increase it till it stops (or starts working again). Either way, you have an idea of where to look.

You should always try to work with probabilities rather than prejudice, as good troubleshooting needs a completely open mind. For example, you could say that a particular hard disk is probably the cause of the present trouble, because it's got a track record, but you still need look at the rest of the system. If you were prejudiced, you would close your mind to other possibilities, just change the hard disk and waste a lot of time in the wrong area, assuming the hard disk has gone.

Don't assume that because something worked well up till now, it will continue to do so. Troublesome items may well, for once in their lives, be performing as they should.

When faced with a dead system, the power supply is the first candidate for inspection. ATX machines have two switches, one on the front connected to the motherboard and one on the power supply itself. With the power applied, see if the fan is turning. If not, the cable is suspect – I have seen some with a break in the middle somewhere, or you could be in a country that requires a fuse in the plug, which may have gone.

If the cable is known to be a worker, and the fan is turning, check that the front switch is actually connected – they can come loose in transit. If you want to check the output of the power supply, make sure there is a load on it; usually there is a spare connector you can connect a multimeter to. The Power Good signal should be 5 volts.

Check all the boards are seated properly – AGP ones are good candidates for stopping a machine completely if they aren't in right.

Random crashing or rebooting indicates a conflict somewhere, usually IRQs, but sometimes it is exotic video software. Turn the machine off completely. wait a few seconds and restart, especially with portables.

After Fixing

It's a good idea to reduce the chances of being called out again, firstly by making sure that the problem has been fixed, and does not create other ones, because very few problems exist in isolation. The customer must also agree. Write it down, not only for the company, but for your own records, which, believe it or not, is how I got started on all this!

Aids To Diagnosis

Self Tests

A self-test is where the equipment concerned tests itself internally, the successful passing of which is supposed to indicate that all is well. For example, a common one for printers is to hold down the *Line Feed* button while turning the thing on. When you let go of the button, the printer should demonstrate what it's capable of.

Unfortunately, few of these procedures actually test everything—a self-test on a modem may not test all of the RS232 pins, only the most commonly used. It may also only tell you that a bulb is working, as opposed to the whole circuit. Wherever you can, use external test procedures, either as a substitute or as a backup for self-testing. RS232 sockets as a whole can be tested with a *breakout box*, of which more in a moment.

Loopbacks

In a loopback test, the output of any item is routed straight back into the system on the return path and the results at both ends are compared. You can do this first with the computer, then do it with a modem attached, then do it with the line which the modem is on, then put the other modem on, and so on.

For the computer, you need a *loopback connector*, which is a plug wired in such a way that signals can be sent to and received from a communications port without anything being connected to it.

This wiring is based on IBM universal loopback plugs:

Plug	Wiring
9 pin serial (female)	1-7-8, 2-3, 6-4-9
25 pin serial (female)	2-3, 4-5-8, 6-11-20-22, 15-17-23, 18-25
25 pin parallel (male)	1-13, 2-15, 10-16, 11-17, 12-14

With one of these attached to the relevant port, what you type should appear directly on the screen—it's good for testing terminals.

A word of caution here; most analogue circuits are designed to operate with a substantial difference in signal level from input to output, so the difference between a 1 and a 0 is known. Usually the output signal is lower than the input, and the difference could be anything up to 16 decibels.

If you perform a loopback (that is, routing the output straight back in to the input), the input signal will be very much lower than what it should be which could cause receiving equipment to operate improperly and give false signals.

Systems with loopback tests built in sort this out automatically, but something other than a loopback should be used otherwise (maybe an assistant at the other end to compare results).

Modems

Talking of self-tests and loopbacks, one of the registers in a Hayes-compatible modem will have a variety of self-test modes which, when activated, perform analogue loopback tests on the modem (or a remote modem) by turning the transmitter to the same frequency as used by the receiver.

The code for this is

```
AT S16=1 C1 D
```

assuming you're in originate mode and register S16 covers the test. The response will be

```
CONNECT
```

with all transmitted data echoed back to your screen.

Monitors And Analysers

You can monitor network traffic with software or hardware based tools.

Protocol Analysers

Protocol Analysers can look at the traffic and pinpoint congestion, signal retransmissions, timeouts, response times and general performance but, since the cost is high, is probably overkill for small networks. The most well known is *The Sniffer*, but there is one based on the HP 200LX. These have already been looked at under *Performance*.

Time Domain Reflectometer (TDR)

Used for cable testing, these effectively read a returned signal to determine the status of a cable. In fact, there shouldn't be a reflection if the cable is OK, assuming it is properly terminated, and not attached to the network.

Each fault has its own signature, which will be programmed into the TDR, so you don't have to remember anything. You will even be told the approximate distance of the fault, to within a foot or so. Optical TDRs use lasers, for fibreoptic cable.

You could always use a multimeter, but this naturally takes longer. Then again, it's cheaper.

Inside The Toolbox

Some suggestions!

Breakout Box

A small box with an RS232 socket at each end, LEDs and a means of crossing wires in the middle. You place it between the devices at either end of the cable you have a problem with and set things in motion.

The LEDs indicate the presence or not of output or input and you can swap the leads or short-circuit them until you get the wiring arrangement you want. Then you just get a lead made up to those specifications. Don't forget to turn the switches *off* on those leads that you short circuit or cross over.

Multimeters

Although cheap, these are quite useful, if a little slow to use, especially for checking voltage levels and resistances, especially continuity. A good example is detecting cable problems in conjunction with terminators on coax cable. Terminators contain a resistor that connects the core and the shield, placing them in parallel and making the effective resistance half the value. The resistance between the core and the screen at any workstation should therefore be about 25 ohms for Ethernet, allowing 2-3 ohms per 100 feet from the terminator.

If the cable is open, you'll get 50 ohms instead. At this point, take off a terminator and see if the resistance changes. If it does, the cable is good on that side. With it still off, move in the other direction, and when you read 50 ohms again, you've just gone past the open circuit.

A sound capability, for those occasions when you're testing cables that you can't see the other end of, or the meter display.

Tone Generator

Useful when trying to find two wires in a bundle, as used by phone companies. Otherwise known as a *fox* and *hound*, the generator is clamped to one end, emitting a frequency. The detector beeps when it approaches the wire concerned.

Sundries

The usual odds and ends around a workshop:

- Mains testers.
- Converters for cabling.
- Cheapo AM radio, to check for cable radiations.
- MAU testers. These make sure the relays don't stick.

Modems (again)

Let's have a look at some of the more obvious things first:

- Have you paid your phone bill? (Don't laugh—this one happened!).

- Have you got the modem connected to the serial port (and not confusing it with the printer?). Is your software sending to the same port? This can be done with the mode command in MS-DOS or the **stat** command in CP/M, if not.

- Is your cable "straight through" for the modem, and a null modem cable otherwise?

- Is it connected to the phone line?

- Is it switched on?

- Is only one device trying to use the COM port? (i.e. you haven't got an interrupt clash). Be careful with COM 3 and COM 4, which share IRQ 4 and IRQ 3 with COM 1 and COM 2, respectively. DOS was never designed for these, and different software has different ideas about how to use them.

- What lights are showing when you turn your modem on? You should expect to see at least DTR, RTS and CTS once your software has loaded.

- Are you operating in Full Duplex, or whatever the receiver is expecting, and are you in Originate mode?

- Some software (particularly Sage ChitChat) requires all connections to be properly made, since its operation depends on the status of the lines. If one is loose, nothing will happen.

Otherwise, one of the first places to start is the transmission speed. These must both be the same at each end, as must be:

- The number of bits per word (7 or 8, usually).
- The number of stop bits (try 1).
- Parity (none).

The above will either be set up with software or by a selection of DIP switches on the modem, which usually live in a small plastic box about an inch long.

If you're connecting, but still not getting through, then things are a bit more serious. Try pressing **Esc** or sending a carriage return (some systems require two in quick succession to wake them up. Sometimes this just toggles them through speed changes until they match yours).

However, if you are getting results, but it's gobbledegook, it's almost certainly the speed or parity. Go for the latter if about half the characters are recognisable (try 7 bits and even parity). Recheck your settings first, but if you've connected and are still getting strange characters, try dropping the baud rate down one speed. If the text makes some sense, but has a lot of strange symbols and numbers embedded, try using an ANSI terminal emulation.

If your modem dials, but obviously hasn't caught the line (you can still hear the dialling tone after the numbers have been sent), try changing the dialling method from *Tone* to *Pulse*. You may need to combine Pulse and Tone dialling on some exchanges, such as pulse dialling the 9 to get the outside line, then using Tone for the rest. Just place a **T** after the 9.

Also, check the cable to the telephone socket, especially with cheap internal modems and conversions from American to British. The data carrying wires on the American (RJ11) type go on the inside, and the ones on the British to the second ones in from the outside. The ones you get from Tandy or Radio Shack don't always work!

The remote modem may not be working to the same standard—you may be calling an American system without sending the expected Bell tones, or calling a European one without using CCITT procedures, although this is not a problem these days. If using a Hayes modem, you can get it to "blind dial" by setting the **ATX** command (X1 or X3).

V.32*bis* modems use phase reversals every half second that may confuse the speed sensing circuitry in lower ones, such as V.22*bis*. You can get around this by forcing the modem to a particular speed. Try **ATF5** to set 2400. Similarly, the beep emitted by K56 technology at the beginning of a session can fool your modem into thinking it is further into the handshake than it really is. A couple of commas at the end of the telephone number will delay your modem's initialisation enough to take it past the beep.

You can also do a more extensive check on your (Hayes) modem with software. Connect everything up except the telephone lines, and go into terminal mode. An initialisation string will be sent from the terminal and you can therefore expect a reply from the modem. If you issue the command **AT** by itself, you should get **OK** back (check that the same characters as you type appear on the screen), otherwise you will be told that nothing is connected.
The command **AT A** should get a high pitched tone (if you've got a speaker). If you type anything, the tone should stop and **NO CARRIER** appear on the screen. Issuing **ATDT1234** will get a dialling sound from the modem, and **ATH1** when connected to **LINE** a dialling tone. **ATH0** will hang up.

If you get the **CONNECT** signal, then **NO CARRIER**, the modem is probably dropping the line when the computer drops DTR, (e.g. the modem is not getting a DTR). You could enable DTR permanently (with software or hard wiring the cable) or using **AT&D0** to disable this entirely.

WWhheenn yyoouurr cchhaarraacctteerrss aappeeaarr ttwwiiccee, it means you're in half duplex and *local echo* is on—what you send is being echoed to the screen as well as what the remote host sends back as part of its echoplex error-checking procedure. Switch to Full Duplex or turn local echo off. Conversely, you need to switch this on if you're getting no characters at all on the screen when you type. Echo can be useful when you're using simple error checking, like parity; where two bits have been corrupted and not detected you can see on the screen that something is wrong.

Fax Modems

Fax software writers tend to assume that nothing else will use the equipment, so may not reset the modem properly once they've finished. A command that *may* fix this is **AT+FCLASS=0**, which could be added to an initialisation string. It doesn't always work.

If you want to find out what type of modem you have (e.g. class 1 or 2, type **AT+FCLASS=?**. The answer **0,1** means class 1 and **0,2** means class 2.

Continual Reconnections

"Call Waiting" services don't actually issue an engaged signal, but use a plastic voice to tell you that the line is busy. The beeps that tell you someone is calling can confuse a modem, so it's a good idea to turn off Call Waiting before transmitting. This is sometimes done with **#43#**. Turn it on again with ***43#**. In the USA, ***70,** turns it off for one call, so you can issue it with your modem commands, but check with your local phone company. In summary, if your communicating is not proceeding as expected, you have several choices:

- Incorrect modem installation and configuration.
- The same for software.
- And the serial port (you may have two COM ports).
- Wrong dialling method (tone instead of pulse).
- Poor line quality.
- Poor cable connections.
- Incompatibility with connecting service.
- Printers and Terminals .....

If you get garbage, go straight for the baud rate and parity. Text instead of graphics means that 8-bit ASCII needs to be set at both ends. Getting garbage presupposes that your cable is OK (it must be pretty near if you're getting anything at all), but check it anyway.

Networks

Check the cabling in particular, even if you have used a self-test. After checking everything is on, make sure that every wire in every junction box is positioned properly and every screw is tight, particularly T-pieces and the BNC connections (cheap T-pieces have been known to crack under pressure, as have network managers). The military spec ones are the best. Check all connections between interface boards, jack sockets, transceivers and/or junction boxes.

You may also be using the wrong frame type; NetWare 3.12, for example, defaults to 802.2, whereas previous products used 802.3.

Software Utilities

PING

Tests the protocol stack, and is really the first thing to be used when testing a network – if you get an answer with this, the hardware is definitely OK. Pinging the loopback address of 127.0.0.1 will test your own computer. The equivalent for ipx networks is **ipxping**.

IPCONFIG

Gets the details of your workstation – **winipconfig** is the Windows version.

NSLOOKUP

Connects directly with the DNS and accesses the information in the hosts configuration files, that provide the translations from number to name and back again.

TRACERT

This finds the route from one place to another, giving you the number of hops and the times taken to reach them.

PCs

- Usual stuff first; check the fuse, mains is there, etc.
- Check the fan is working. If the power supply appears to be OK, an expansion card may be shorting. Take as many out as possible, and put them back till the machine stops again.
- Check the DC and AC ripple voltages coming out of the power supply. The tolerance allowed can be up to 5%, but cheaper power supplies may fluctuate by up to 10%.
- Check the Power Good circuitry by pressing reset a few times, or turning the PC on and off a lot. Some systems get a reset from the power supply after the DC is stable, and others just allow enough time for it to happen.
- Check the BIOS ROM(s) are secure, and in the right positions, High and Low.
- Check all motherboard jumpers, and chips are the right way round, including CPU.

Electricity

Luckily, you don't need to know much about this subject, but it's often useful for its own sake to know how things work, as it helps you with your diagnoses.

An atom consists of a nucleus with tiny vortices of energy called *electrons* spinning round it. Electrons are negative, while protons in the nucleus are positive – since they are opposite charges, they attract one another, and electrons are held in their orbits. However, like charges repel, so how do you keep several protons in the nucleus place without them shooting apart, in atoms that have more than one? The answer is to use neutrons, whose only job is to sit between protons and act as an attractant to them, since they have no charge by themselves. The positive charge in a balanced atom is the same as the number of electrons spinning round it. When there is an imbalance, the atom becomes ionised in one direction or another. Too many electrons makes it a negative atom, and too few makes it positive. Actually, protons and neutrons are tiny vortices as well, so when you think about it, there's nothing (that is, no thing) in an atom at all – it's only when they collect into a molecule that we begin to see the results of this activity, and then only because they are vibrating at such a rate that our senses are fooled into thinking they are solid, but that's the subject of another book.

As you might expect, atoms are tiny; in fact, the relationship of an electron to its atom is similar to that of a gnat in a cathedral.

Anyway, if you line up a series of atoms and add an electron at one end of the line, it will push them all along till one falls off the end, giving you an electric current. Some atoms don't have much of a hold on their electrons, and allow electricity to move easily, called *conductors*. Those that keep a tight hold and therefore allow no movement are called *insulators* and are used to keep conductors from touching each other, otherwise electricity would flow where you don't want it – if electricity takes a short cut (known as a *short circuit*) it generates massive amounts of heat, relatively speaking, with the obvious consequences.

Materials used as conductors allow electricity to move at different rates – in other words, they resist its movement to varying degrees. If you make electrons work harder to get through a material, they will get hot through friction, and we make use of this quality in electric fires. If you make them work even harder, they get white hot, and emit light, hence light bulbs. Copper has the least resistance to the movement of electrons, and is the standard by which other conductors are judged. Although gold and silver are frequently used, it's only because they don't corrode easily and break a connection, which is why electrical engineers often pull equipment apart and reassemble it before doing anything else – problems are more frequently caused by bad cabling and connections than anything else (the second thing they do is check the power supply – the third is pour another coffee).

Somewhere between a conductor and an insulator is a *semiconductor,* which is created by adding a certain amount of impurity to a material normally considered to be an insulator. Electricity will then flow under certain circumstances, namely the influence of an electromagnetic field, which is where the movement of *holes* becomes relevant, an effect caused by electrons going the other way. The end result is that positive charges (holes) go one way and negative ones (electrons) the other. Materials conducting with holes, that is, a deficiency of electrons, are known as **p-type** materials, where *p* stands for positively charged. The opposite is therefore **n-type**. If you join the two together, electricity will flow across the junction, according to the polarity of the source of current. This is a *rectifier*, or a device that can be used to convert AC to DC, as used in power supplies. It's not perfect, of course, since there is some leakage, but it is cheap, and small in size. Essentially, it acts like a non-return valve and a capacitor is used to retain the charge for a short while and smooth out the peaks or, rather, avoid the jerks.

When you start using AC, however, the current flows on the outside of the cable, increasing the resistance (many times) because the effective cross-sectional area is reduced (this is called the *skin effect*). A resistor can also be used to slow the rate of charge of a capacitor, which is two conductors with a gap between them, either of air or an insulating substance. When a capacitor is in a closed circuit, the negative side gains electrons from the negative side of the battery, and the positive side loses them to the positive end. When the current is broken by the switch being opened, this state of affairs remains and you have a stored charge, which will gradually get weaker over time as the charge leaks away. If you kept the switch closed, the movement of current would stop anyway, as the electricity would not be able to cross the gap without a powerful charge behind it.

There are three types of electricity:

- ❑ That which stays right where it is, called *static electricity*.
- ❑ That which goes in one direction only, usually at one speed, called *Direct Current*..
- ❑ That which flip-flops back and forth, or *Alternating Current*.

The essential point is movement, since nothing much happens when everything is still. As little as 35 volts of static electricity is enough to fry a chip – the minimum voltage for you to actually see a spark is 650! This is why ESD (*Electro Static Discharge*) precautions are so necessary. It is not a good idea just to use just a metal strip, as shop-bought wrist straps (properly grounded) have a resistor to limit the current if it shorts.

You can achieve the same effect by connecting a power cord between the computer and a three pronged (grounded) electrical outlet, ensuring the computer's power is off, and keeping hold of an exposed metal surface of the computer when handling any internal components.

Note: It is **illegal** in some countries to work on the insides of anything electrical with the mains cord plugged in, and unsafe in many others because of the way circuits are designed—very often, the switch may as well not be there at all! In addition, the grounding wires in the building may not actually be connected to ground.

Never place circuit boards of any kind on to conductive surfaces like aluminium foil, as you might short circuit something – batteries will explode, since a short circuit generates relatively vast amounts of heat almost instantaneously.

If you move a lot of electrons, you have a high *current* – if you do so with a lot of pressure, like with water, you will be doing it with a high *voltage*. The current, measured in *amperes* (amps) is the dangerous one – even 100 milliamps is enough to give you cardiac arrest – compare touching a car battery (12v) with absorbing a 650v static spark.

Mixing certain chemicals with some metals causes a current to flow, and the loss of electrons from one plate of a battery, which is why metal plates get eaten away – since the atoms comprising it lose electrons, they cease to be the same atoms and therefore cease to exist in their former state – if you could contrive to put the electrons back, you would regain your metal plate.

Monitors

The most dangerous voltages inside a monitor are found in all electrical equipment, e.g. the mains. In fact, as mentioned above, the voltage itself is not the problem, but the amount of current that flows. The mains has a very low impedance and if you touch it a high current will flow. It is for this reason that current leakage trips are fitted in domestic/industrial installations. If any current in excess of 30ma flows to earth (i.e. through your body) the mains supply is removed.

On the other hand, the EHT (*Extremely High Tension*) in a colour monitor (25KVish) is relatively high impedance and only a small current will flow if you touch it; that doesn't mean to say it's not dangerous, as, if you do touch the EHT, you will still feel like you are about to die, but a bigger problem is injuries caused when you drop what you are doing or your hand moves away from the contact at high speed.

Twiddling

- Only twiddle with things you know about

- ❏ Always work with one hand behind your back, and touch everything else with the back of the other hand, since reflex action tends to contract muscles, and you won’t otherwise be able to let go of whatever you’re holding.
- ❏ If possible, view the screen with a mirror so you don’t have to reach round the back and take your eyes off what you’re doing.
- ❏ Mark the positions of controls before twiddling.
- ❏ Use an isolating transformer.
- ❏ Don't twiddle with the little tabs around the neck of the tube
- ❏ Don't work alone if possible
- ❏ Use well insulated tools
- ❏ The charge on a tube remains for some time (this varies) after switching off, so assume it’s always there

POST Codes

During the POST on AT-compatibles and above, special signals are sent to I/O port 80H at the beginning of each test (XT-class machines don't issue POST codes, although some with compatible BIOSes do). Some computers may use a different port, such as 84 for the Compaq, or 378 (LPT1) for Olivettis. IBM PS/2s use 90 or 190 (20-286), whilst some EISA (Award) machines send them to 300H as well. Try 680 for Micro Channel. Those at 50h are chipset or custom platform specific, and you might find a few go to the parallel port (AT&T, NCR).

POST Diagnostic cards, such as the **POSTmortem** from Xetal Systems (see *Useful Numbers*) can display these POST codes, so you can check your PC's progress as it starts and hopefully diagnose errors when the POST stops, though a failure at any given location does not necessarily mean that part has the problem; it's meant to be a guidepost for further troubleshooting. In this chapter, some general instructions are given for a typical POST card, which were provided by Xetal Systems, together with some of the more obscure POST codes. Having obtained a POST code, identify the manufacturer of the chipset on the motherboard, then refer to the tables that follow. The POST checks at three levels, *Early, Late* and *System Initialisation*. Early POST failures are generally fatal and will produce a beep code, because the video will not be active; in fact, the last diagnostic during Early POST is usually on the video, so that Late failures can actually be seen. System Initialisation involves loading configuration from the CMOS, and failures will generate a text message. Consistent failures at that point indicate a bad battery backup.

Shutdown or Reset Commands

The Reset command stops the current operation and begins fetching instructions from the BIOS, as if the power has just been switched on. The Shutdown command, on the other hand, just forces the CPU to leave protected mode for real mode, so the system behaves differently after each one. Before issuing the shutdown command, the BIOS sets a value into the *shutdown byte* in the CMOS, which is checked after a reset, so the BIOS can branch to the relevant code and continue where it left off.

One of the problems with shutdown handling is that the POST must do some handling before anything else, immediately after power-on or system reset. The path between the CPU and the BIOS ROM, as well as basic control signals, has to be working before the POST gets to its first diagnostic test (usually the CPU register test), so some of the circuitry that the CPU test is supposed to check will be checked by the shutdown handling instead, and you will get no POST indication if a critical failure occurs.

Manufacturing Loop Jumper

The phrase *Check for Manufacturing Jumper* in the tables refers to one on the motherboard that makes the POST run in a continuous loop, so you can burn in a system, or use repetitive cycling to monitor a failing area with an oscilloscope or logic analyzer. It usually forces a reset, so the POST has to start from the beginning every time. Compaq used the shorted jumper to make the POST to jump to another ROM at E000 just after power-on, which could have diagnostic code in it. IBM and NCR used a germanium or silicon diode to short together the keyboard connector pins 1 (cathode, bar) and 2 (5-pin DIN) or 1 (anode, arrow) and 5 (6-pin mini-DIN), so the POST checks the keyboard controller to see if the jumper is there.

What is a POST Diagnostic Card?

Note Under no circumstances shall the publisher, author any manufacturer of POST diagnostic cards, or their agents be held liable in any way for damagesluding lost profits, lost savings, or other incidental or consequential damages arising out of the use of, or inability to use, any product designed to make POST diagnostic codes visible on your system.

A POST card is an operating system independent expansion card designed to be used with any x86-based computer with an ISA/EISA expansion bus (although the cards are usually 8-bit, XT class machines do not generally issue POST codes). There may be conversion products for purely Micro Channel and PCI systems, depending on the manufacturer. Some POST cards also use LEDs to provide information on the status of the power supply and other devices.

Who would use a POST card?

POST cards can be used by:

- ❑ Systems Integrators and Technicians in the field, plant, office or service centre, diagnosing faults in non-booting systems to determine components to exchange.
- ❑ Computer Manufacturers, to display POST codes of system boards or partial systems set to loopback/manufacturing test mode during burn in.

- Computer Hobbyists and End Users, to determine if their hardware is faulty or just set up wrong. Faulty components can be identified before being sent out for service, saving hours of trial and error module swapping at service centre repair rates (less than one hour of labour or one module saved would often have the card pay for itself). Many hobbyists report very high success rates with non-booting or unrepairable systems obtained for next to nothing at flea-markets or surplus stores .
- The faults most of them found did not even involve soldering, just:
  - wrong switch settings or setup information
  - bent and shorted component leads or bus-connector pins
  - bad RAM chip(s)
  - faulty 8042 Keyboard chip (quite often socketed)
  - defective BIOS ROM

Installation

CAUTION CMOS!!! STATIC ELECTRICITY WARNING!

Your system's circuit boards and the POST card may contain CMOS based logic devices or chips which can be DAMAGED through careless handling. Though most CMOS devices these days are protected by internal diodes and resistors against *ElectroStatic Discharge* (ESD) the following precautions should be taken:

- BEFORE touching, installing or removing any circuit board or CMOS logic chip, ground yourself by touching any bare metal that is connected to earth and NOT to a live electrical outlet. Touching the computer case only really works if the PC is actually plugged into a grounded electrical outlet, but this may be illegal in some countries, and in some others the switch may as well not be there at all!
- Handle the CMOS device by its ends so static will be conducted away by the supply pins.
- Use a special static free/conductive insertion tool which shorts together all the package pins during insertion.
- Never keep CMOS devices in white polystyrene foam.
- Leave the CMOS devices in their anti-static packaging until they are required.
- Touch the circuit ground and the anti-static packaging together before removing devices.
- Use a grounded soldering iron.

CAUTION: There are two types of anti-static bags/packaging. The first is treated with a conductive coating, normally carbon-based and black/dark grey in colour. Then there are coatings which are not conductive but inhibit the plastic from generating electrostatic charges, normally being pink, light green or light blue. When storing circuit boards with batteries on them, use the latter type of bag so as not to damage/discharge the battery. Otherwise remove battery or open-circuit it.

Obtaining Information About Your Computer

At least the BIOS ROM's manufacturer and firmware revision number should be known, so you can check the codes in the following pages (see the front of the book for BIOS IDs). The manufacturing port or POST address port should also be known.

Required Tools

To access the memory chips and circuit boards in most computer cases you should have a selection of the following tools:

- ❑ Phillips –type screw driver(s)
- ❑ Slotted screw driver
- ❑ Torx driver
- ❑ Needle nose pliers
- ❑ Tweezers
- ❑ IC inserter
- ❑ IC extractor

To perform repair work on circuit boards, try also the items listed below.

WARNING! These tools would only be of use to qualified engineers and computer technicians. As a typical end/business user of a POST card, please DO NOT attempt any system board repair. Such activities would void your warranty and may cause accidental damage to your computer. The potential savings would be minuscule with respect to the repair cost and wasted time. Please consult your dealer/repair centre or manufacturer.

- ❑ POST card
- ❑ Low end multimeter for resistance and voltage measurement (AC and DC)
- ❑ Plastic Leadless Chip Carrier (PLCC) Removal Tool
- ❑ Pin Grid Array (PGA) removal tool
- ❑ Grounded soldering iron (NOT soldering gun—the current will fry most components)
- ❑ Vacuum hand pump solder pull (Antistatic tip preferred)
- ❑ Resin core solder, 63% Tin and 37% Lead. The solder wire diameter to be approximately 0.025 to 0.031 (0.040 diameter solder will do).

NOTE: DO NOT use acid core flux based solder, as it leaves a corrosive and conductive residue. Do NOT use water soluble flux based solder unless you plan to wash the board well, since the residue is both conductive and a mild corrosive.

Opening The Computer Case

Turn OFF the computer's main AC power and unplug the AC power cable. Disconnect all cables to the peripherals. Remove the case in accordance with the manufacturer's service manual/instructions. The most common desk-top case has a lid that slides off backwards and is held in place by four or six screws at the rear. Be careful not to confuse these screws with the four that look the same but normally hold the power supply in place.

Card Configuration

The less expensive cards only support I/O address 80h. Others have selectable port addresses. Ensure your card is set properly for your motherboard.

Installing The Card

Locate any empty 16 Bit or 8 Bit expansion slot. The 8 Bit portion of the connector is the one closest to rear of the computer (where the L shaped blanking covers or add-on card mounting brackets are located). For our purposes, the front is where in most cases the floppy drives are located. Since most POST cards do not have a mounting bracket (the first thing any technician removes from diagnostics and test boards to save time), they can easily be inserted the wrong way, especially if small.

CAUTION! Please NOTE the ARROW with the marking REAR OF COMPUTER: DO NOT REVERSE THE BOARD! on any POST card you might have.

Insert the card into the 8-bit part of any 8- or 16-bit expansion slot so that the above mentioned ARROW points to the REAR of the computer system/board. Also note the components should be facing the same way as the components on any other board in your system's bus (the exception may be some old network boards, and PCI cards, which have their components on the opposite side to ISA ones).

CAUTION! Some 386, 486 and Pentium based systems have 32 Bit bus extensions or some special additional high speed expansion slots towards the front of the computer, or may use riser or slot extender cards that are electrically different. Even if it sort of fits, DO NOT insert your card into any of these, as the consequences may prove to be disastrous and expensive!

Testing The POST Card

If uncertain whether your computer support s a POST card, or yours may have become damaged, there is an easy way to test it with some programs that come with DOS, such as **gwbasic.exe** or **basic.com**, not forgetting **debug.com**.

Using GWBASIC/BASIC:

Insert your card into a working computer system and execute the following little program:

```
10 PRINT Enter a value between 0 and 255 :;INPUT X
20 H$ = HEX$(X)
30 PRINT X Decimal is  H$  Hexadecimal as shown on
POST card
40 FOR L=1 TO 500
50 OUT 128,X
60 OUT 132,X
70 OUT 640,X
80 OUT 644,X
90 NEXT L
100 PRINT
110 GOTO 10
RUN
```

Enter a value between 0 and 255 ? 165

165 Decimal is A5 Hexadecimal as shown on the POST card.

Enter a value between 0 and 255 ?

To break out of this endless loop press **Ctrl-C** or **Ctrl-Break**.

Note: Regarding the OUT statement:

```
128 Decimal is 80 Hexadecimal
132 Decimal is 84 Hexadecimal
```

which are the 2 most common addresses. The FOR-NEXT loop is just a timing loop re-sending the codes to all 4 ports 500 times because on some (XT) system boards Bus/DMA activity will overwrite the value as soon as it has been written to the card and it will flash only once. This way it will flash 500 times or more depending on the value you may choose for this loop. In-between the 500 port writes other activity may occur on the Bus (depending on System board design) which the POST card will display if it is within the set POST port range. So some other segments on the 7 segment display may flicker.

Using DEBUG:

If jumper selectable, set the port address jumper to 80 and insert the card into a working computer. Execute **debug**. At the - prompt type the sequence below followed by **Enter**:

```
-o 280 b6
```

where:

- ❑ is letter O as in Oscar.
- ❑ 280 (Two Eight Zero) in Hexadecimal is the POST Port Address.
- ❑ b6 in hexadecimal is the data which will display on the card and show you the difference between a b and a 6 on a seven segment display.
- ❑ The above debug command is not case sensitive, but here it is shown in lower case to emphasize the differences in points a) and c).

To exit **debug** press **q** and then **Enter**.

You can repeat the above with different data and different POST address ports. Since DEBUG writes the data only once it may only display as a short flash on system boards as described in the note for the above BASIC program.

Operation and Technical Information

After the power has been turned on and the CPU's Reset input is past the reset state, the system starts to execute the program stored in the system's Firmware/BIOS ROM chips. First the system executes the program in the system board's BIOS then it goes to the programs stored in the expansion board's BIOS ROMs. Upon execution of the program in the system board BIOS, the POST is performed first before the system boots. The POST routines initialize the system's circuitry and test it (clear registers and memory locations and set them to their default values). *Rephrased more technically*: after a system reset or power-up the BIOS ROM's program located at the top of the highest paragraph in the system's memory map (8086/8088 at F000:FFF0 or 80286 and up at FFFFF:0000) executes a long jump to F000:E05B which is the start of the POST sequence.

The POST Display

POST codes are normally just 1-byte or 8-bit codes, so 256 possible ones can be sent. They are customarily displayed in hexadecimal format allowing values between 00 and FF hex. Most cards have two 7-segment displays at the top of the board which display the hexadecimal POST code. Please note that B and D have to be displayed in lower case on a 7-segment display.

Hexadecimal Display and Conversion

Dec	Hex	Display	Binary
0	0	0	0000
1	1	1	0001
2	2	2	0010
3	3	3	0011
4	4	4	0100
5	5	5	0101
6	6	6	0110
7	7	7	0111
8	8	8	1000

9	9	9	1001
10	A	A	1010
11	B	b	1011
12	C	C	1100
13	D	d	1101
14	E	E	1110
15	F	F	1111

In order not to confuse the 6 and the lower case B, the 6 has a serif/bar at the top.

Power Supply Status LEDs and Voltage Measurement Points

Some POST cards have four DC power indicator LEDs which show the presence of DC power on all the system board's/expansion bus' voltage supply rails. There may also be test points for a VOM which may not have fusing or a current limiting circuit, so take care when performing measurements. A fifth reference Ground test point should be there as well.

Troubleshooting/Diagnostic Strategy

Though the following strategy is not the most complete, it is an outline of a system repair procedure using the information a POST card provides.

System will not boot, power fan not running, Power LEDs do not light

Check if the power supply receives AC and is switched on. The presence of AC can be tested with a multimeter at the power supply's monitor outlet. If you see 115/230 VAC at this point and the power supply is plugged correctly into the system/motherboard, some peripheral board or disk drive may trigger the overload/short-circuit protection. Unplug all drives and peripheral cards except the POST card with the power off and try again. If the LEDs light and fan is running, reinstall peripherals one at a time until the defective one(s) is/(are) found. Check the system board and peripherals for burnt components or capacitors since they may short circuit when they fail. If this is not it, replace the power supply.

NOTE: Switching power supplies require some minimum load at the DC output to work correctly, so with no load, or a load below the minimum, the power supply would shut down or provide DC power at voltages out of specification respectively.

System will not boot, power supply fan is running, one or more Power LEDs do not light, are dim and/or flicker

Check if the system's power supply outputs the correct voltages by using a volt/multimeter in DCV mode between the test-points described earlier. Also check the ripple voltage on the power supply by setting your multimeter to ACV and measure between ground and the test-point for the voltage rail in question. On the -5V and +5V lines the ripple should be not more than 0.25V AC and on the -12V and +12V lines you should see less than 0.5V AC. If one or more voltages or the ripple are out of range, replace the power supply.

System will not boot or show POST codes (except for 00 or FF) but Power LEDs do light solid and the DC voltages and ripple are within specification

Press the hardware reset button (if there is one) repeatedly, otherwise switch the system on and off a few times. If the system boots and you see POST codes, the Power Good/Reset circuit of either the power supply or the motherboard is defective. Determine where the reset originates and replace either the power supply or motherboard. Some systems receive their reset from the power supply after its DC output is stable and some others have a reset circuit which allows enough time for most power supplies to stabilize. Note that the reset/power good from a PC/XT supply is not of sufficient duration to reset most AT/286 and upsystem/motherboards which do not have their own on-board reset circuit.

If that is not it, remove with power off all peripherals from the system board except the POST card and try again. If the system boots and POST codes appear, one or more peripheral boards may have been shorting the bus and thus hanging the system. Reinstall them one at a time until the culprit is found.

The next thing to try would be the ROM chips, exchanging them against another set, ensuring that High and Low chips are in the correct sockets, if required. Check the ROM jumpers on the system/motherboard are set correctly (for ROM chip size and memory map location). Also check the clock lines on the bus with a logic probe to see if the clocks are working and check all bus connectors on the motherboard for bent under and shorted pins.

Check if any components are cracked or their pins are shorted together due to mechanical abuse when peripheral boards were inserted.

Is the POST card set for the correct POST port address and does the system/motherboard BIOS generate POST codes? Check with your manufacturer's manuals.

System will not boot but shows POST codes other than 00 or FF, Power LEDs light solid and DC voltages and ripple are within specification.

Look up the POST code for the BIOS of the system/motherboard tested in the listings below or in the manufacturer's manual. The code displayed in a boot sequence does point to the part of the circuitry which is defective and hanging the system. Check the part of the circuit in question again for mechanical abuse and/or shorts, wrong jumper settings. If the chip of the circuit flagged as defective is socketed, replace it. If your system has an Award AT BIOS, for example, and the code displayed is 02 it could be a defective keyboard controller.

ACER

Based on Award BIOS 3.03, but not exactly the same. Port 80h.

Code	Meaning
04	Start
08	Shutdown
0C	Test BIOS ROM checksum
10	Test CMOS RAM shutdown byte

Code	Meaning
14	Test DMA controller
18	Initialise system timer
1C	Test memory refresh
1E	Determine memory type
20	Test 128K memory
24	Test 8042 keyboard controller
28	Test CPU descriptor instruction
2C	Set up and test 8259 interrupt controller
30	Set up memory interrupts
34	Set up BIOS interrupt vectors and routines
38	Test CMOS RAM
3C	Determine memory size
XX	Shut down 8 (system halt C0h + checkpoint)
40	Shutdown 1
44	Initialise Video BIOS ROM
45	Set up and test RAM BIOS
46	Test cache memory and controller
48	Test memory
4C	Shutdown 3
50	Shutdown 2
54	Shutdown 7
55	Shutdown 6
5C	Test keyboard and auxiliarv I/O
60	Set up BIOS interrupt routines
64	Test real time clock
68	Test diskette
6C	Test hard disk
70	Test parallel port
74	Test serial port
78	Set time of day
7C	Scan for and invoke option ROMs
80	Determine presence of math coprocessor
84	initialize keyboard
88	Initialise svstem 1
8C	Initialize system 2
90	Invoke INT 19 to boot operating system
94	Shutdown 5
98	Shutdown A
9C	Shutdown B

ALR

See also *Phoenix*.

Code	Meaning
01	80[3,4]86 register test in progress
02	Real-time clock write/read failure
03	ROM BIOS Checksum failure
04	Programmable Internal Timer Failure (or no video card)
05	DMA initialization failure

Code	Meaning
06	DMA page register write/read failure
08	RAM refresh verification failure
09	1st 64-KB RAM test in progress
0A	1st 64-KB RAM chip or data line multi-bit
0B	1st 64-KB RAM odd/even logic failure
0C	Address line failure 1st 64-KB RAM
0D	Parity failure 1st 64-KB RAM
10	Bit 01st 64-KB RAM failure
11	Bit 11st 64-KB RAM failure
12	Bit 2 1st 64-KB RAM failure
13	Bit 3 1st 64-KB RAM failure
14	Bit 4 1st 64-KB RAM failure
15	Bit 5 1st 64-KB RAM failure
16	Bit 6 1st 64-KB RAM failure
17	Bit 7 1st 64-KB RAM failure
18	Bit 8 1st 64-KB RAM failure
19	Bit 9 1st 64-KB RAM failure
1A	Bit A 1st 64-KB RAM failure
1B	Bit B 1st 64-KB RAM failure
1C	Bit C 1st 64-KB RAM failure
1D	Bit D 1st 64-KB RAM failure
1E	Bit E 1st 64-KB RAM failure
1F	Bit F 1st 64-KB RAM failure
20	Slave DMA register failure
21	Master DMA register failure
22	Master interrupt mask register failure
23	Slave interrupt mask register failure
25	Interrupt vector loading in progress
27	Keyboard controller test failure
28	Real-time clock power failure and checksum calculation in progress
29	Real-time clock configuration validation in progress
2B	Screen memory test failure
2C	Screen initialization failure
2D	Screen retrace test failure
2E	Search for video ROM in Progress
30	Screen believed operational - screen believed running with video ROM
31	Mono display believed operable
32	Colour display (40 column) believed operable
33	Colour display (80 column) believed operable

Ambra

See *Phoenix*.

AMI

Not all tests are performed by all AMI BIOSes. Those below refer to 2 Feb 91 BIOS.

POST Procedures

Procedure	Explanation
NMI Disable	NMI interrupt line to the CPU is disabled by setting bit 7 I/O port 70h (CMOS).
Power On Delay	Once the keyboard controller gets power, it sets the hard and soft reset bits. Check the keyboard controller or clock generator.
Initialise Chipsets	Check the BIOS, CLOCK or chipsets.
Reset Determination	The BIOS reads the bits in the keyboard controller to see if a hard or soft reset is required (a soft reset will not test memory above 64K). Failure could be the BIOS or keyboard controller.
ROM BIOS Checksum	The BIOS performs a checksum on itself and adds a preset factory value that should make it equal 00. Failure is due to the BIOS chips.
Keyboard Test	A command is sent to the 8042 (keyboard controller) which performs a test and sets a buffer space for commands. After the buffer is defined the BIOS sends a command byte, writes data to the buffer, checks the high order bits (Pin 23) of the internal keyboard controller and issues a No Operation (NOP) command.
CMOS	Shutdown byte in CMOS RAM offset 0F is tested, the BIOS checksum calculated and diagnostic byte (0E) updated before the CMOS RAM area is initialised and updated for date and time. Check RTC/CMOS chip or battery.
8237/8259 Disable	The DMA and Interrupt Controller are disabled before the POST proceeds any further. Check the 8237 or 8259 chips.
Video Disable	The video controller is disabled and Port B initialised. Check the video adapter if you get problems here.
Chipset Init/Memory Detect	Memory addressed in 64K blocks; failure would be in chipset. If all memory is not seen, failure could be in a chip in the block after the last one seen.
PIT test	The timing functions of the 8254 interrupt timer are tested. The PIT or RTC chips normally cause problems here.
Memory Refresh	PIT's ability to refresh memory tested (if an XT, DMA controller #1 handles this). Failure is normally the PIT (8254) in ATs or the 8237 (DMA #1) in XTs.
Address Lines	Test the address lines to the first 64K of RAM. An address line failure.
Base 64K	Data patterns are written to the first 64K, unless there is a bad RAM chip in which case you will get a failure.
Chipset Initialisation	The PIT, PIC and DMA controllers are enabled.
Set Interrupt Table	Interrupt vector table used by PIC is installed in low memory, the first 2K.
8042 check	The BIOS reads the buffer area of the keyboard controller I/O port 60. Failure here is normally the keyboard controller.
Video Tests	The type of video adapter is checked for then a series of tests is performed on the adapter and monitor.
BIOS Data Area	The vector table is checked for proper operation and video memory verified before protected mode tests are entered into. This is done so that any errors found are displayed on the monitor.
Protected Mode Tests	Perform reads and writes to all memory below 1 Mb. Failures at this point indicate a bad RAM chip, the 8042 chip or a data line.
DMA Chips	The DMA registers are tested using a data pattern.
Final Initialisation	These differ with each version. Typically, the floppy and hard drives are tested and initialised, and a check made for serial and parallel devices. The information gathered is then compared against the contents of the CMOS, and you will see the results of any failures on the monitor.
Boot	The BIOS hands over control to the Int 19 bootloader; this is where you would see error messages such as non-system disk.

AMI BIOS 2.2x

Code	Meaning
00	Flag test
03	Register test
06	System hardware initialisation
09	BIOS ROM checksum
0C	Page register test

Code	Meaning
0F	8254 timer test
12	Memory refresh initialisation
15	8237 DMA controller test
18	8237 DMA initialisation
1B	8259 interrupt controller initialisation
1E	8259 interrupt controller test
21	Memory refresh test
24	Base 64K address test
27	Base 64K memory test
2A	8742 keyboard self test
2D	MC 146818 CMOS test
30	Start first protected mode test
33	Memory sizing test
36	First protected mode test
39	First protected mode test failed
3C	CPU speed calculation
3F	Read 8742 hardware switches
42	Initialise interrupt vector area
45	Verify CMOS configuration
48	Test and initialise video system
4B	Unexpected interrupt test
4E	Start second protected mode test
51	Verify LDT instruction
54	Verify TR instruction
57	Verify LSL instruction
5A	Verify LAR instruction
5D	Verify VERR instruction
60	Address line 20 test
63	Unexpected exception test
66	Start third protected mode test
69	Address line test
6C	System memory test
6F	Shadow memory test
72	Extended memory test
75	Verify memory configuration
78	Display configuration error messages
7B	Copy system BIOS to shadow memory
7E	8254 clock test
81	MC 146818 real time clock test
84	Keyboard test
87	Determine keyboard type
8A	Stuck key test
8D	Initialise hardware interrupt vector
90	Math coprocessor test
93	Determine COM ports available
96	Determine LPT ports available
99	Initialise BIOS data area
9C	Fixed/Floppy controller test
9F	Floppy disk test
A2	Fixed disk test

Code	Meaning
A5	External ROM scan
A8	System key lock test
AE	F1 error message test
AF	System boot initialisation
B1	Interrupt 19 boot loader

AMI Old BIOS (AMI Plus BIOS); 08/15/88—04/08/90

Code	Meaning
01	NMI disabled & 286 reg. test about to start
02	286 register test over
03	ROM checksum OK
04	8259 initialization OK
05	CMOS pending interrupt disabled
06	Video disabled & system timer counting OK
07	CH-2 of 8253 test OK
08	CH-2 delta count test OK
09	CH-1 delta count test OK
0A	CH-0 delta count test OK
0B	Parity status cleared
0C	Refresh & system timer OK
0D	Refresh link toggling OK
0E	Refresh period ON/OFF 50% OK
10	Confirmed refresh ON & about to start 64K memory
11	Address line test OK
12	64K base memory test OK
13	Interrupt vectors initialized
14	8042 keyboard controller test OK
15	CMOS read/write test OK
16	CMOS checksum/battery check OK
17	Monochrome mode set OK
18	Colour mode set OK
19	About to look for optional video ROM
1A	Optional video ROM control OK
1B	Display memory read/write test OK
1C	Display memory read/write test for alt display OK
1D	Video retrace check OK
1E	Global equipment byte set for video OK
1F	Mode set call for Mono/Colour OK
20	Video test OK
21	Video display OK
22	Power on message display OK
30	Virtual mode memory test about to begin
31	Virtual mode memory test started
32	Processor in virtual mode
33	Memory address line test in progress
34	Memory address line test in progress
35	Memory below 1MB calculated
36	Memory size computation OK
37	Memory test in progress

Code	Meaning
38	Memory initialization over below 1MB
39	Memory initialization over above 1MB
3A	Display memory size
3B	About to start below 1MB memory test
3C	Memory test below 1MB OK
3D	Memory test above 1MB OK
3E	About to go to real mode (shutdown)
3F	Shutdown successful and entered in real mode
40	About to disable gate A-20 address line
41	Gate A-20 line disabled successfully
42	About to start DMA controller test
4E	Address line test OK
4F	Processor in real mode after shutdown
50	DMA page register test OK
51	DMA unit-1 base register test about to start
52	DMA unit-1 channel OK; about to begin CH-2
53	DMA CH-2 base register test OK
54	About to test f/f latch for unit-1
55	f/f latch test both unit OK
56	DMA unit 1 & 2 programmed OK
57	8259 initialization over
58	8259 mask register check OK
59	Master 8259 mask register OK; about to start slave
5A	About to check timer and keyboard interrupt level
5B	Timer interrupt OK
5C	About to test keyboard interrupt
5D	ERROR! timer/keyboard interrupt not in proper level
5E	8259 interrupt controller error
5F	8259 interrupt controller test OK
70	Start of keyboard test
71	Keyboard BAT test OK
72	Keyboard test OK
73	Keyboard global data initialization OK
74	Floppy setup about to start
75	Floppy setup OK
76	Hard disk setup about to start
77	Hard disk setup OK
79	About to initialize timer data area
7A	Verify CMOS battery power
7B	CMOS battery verification done
7D	About to analyze diagnostic test results for memory
7E	CMOS memory size update OK
7F	About to check optional ROM C000:0
80	Keyboard sensed to enable setup
81	Optional ROM control OK
82	Printer global data initialization OK
83	RS-232 global data initialization OK
84	80287 check/test OK
85	About to display soft error message
86	About to give control to system ROM E000:0

Code	Meaning
87	System ROM E000:0 check over
00	Control given to Int-19; boot loader

AMI Plus BIOS

See AMI Old BIOS (above)

AMI BIOS 04/09/90-02/01/91

Code	Meaning
01	NMI disabled and 286 register test about to start.
02	286 register test passed.
03	ROM BIOS checksum (32K at F800:0) passed.
04	Keyboard controller test with and without mouse passed.
05	Chipset initialization over; DMA and Interrupt controller disabled.
06	Video disabled and system timer test begin.
07	CH-2 of 8254 initialization half way.
08	CH-2 of timer initialization over.
09	CH-1 of timer initialization over.
0A	CH-0 of timer initialization over.
0B	Refresh started.
0C	System timer started.
0D	Refresh link toggling passed.
10	Refresh on and about to start 64K base memory test.
11	Address line test passed.
12	64K base memory test passed.
15	Interrupt vectors initialized.
17	Monochrome mode set.
18	Colour mode set.
19	About to look for optional video ROM at C000 and give control to ROM if present.
1A	Return from optional video ROM.
1B	Shadow RAM enable/disable completed.
1C	Display memory read/write test for main display type as set in the CMOS setup program over.
1D	Display memory read/write test for alternate display type complete if main display memory read/write test returns error.
1E	Global equipment byte set for proper display type.
1F	Video mode set call for mono/colour begins.
20	Video mode set completed.
21	ROM type 27256 verified.
23	Power on message displayed.
30	Virtual mode memory test about to begin.
31	Virtual mode memory test started.
32	Processor executing in virtual mode.
33	Memory address line test in progress.
34	Memory address line test in progress.
35	Memory below 1MB calculated.
36	Memory above 1MB calculated.
37	Memory test about to start.
38	Memory below 1MB initialized.
39	Memory above 1MB initialized.
3A	Memory size display initiated. Will be updated when BIOS goes through memory test.
3B	About to start below 1MB memory test.

Code	Meaning
3C	Memory test below 1MB completed; about to start above 1MB test.
3D	Memory test above 1MB completed.
3E	About to go to real mode (shutdown).
3F	Shutdown successful and processor in real mode.
40	Cache memory on and about to disable A20 address line.
41	A20 address line disable successful.
42	486 internal cache turned on.
43	About to start DMA controller test.
50	DMA page register test complete.
51	DMA unit-1 base register test about to start.
52	DMA unit-1 base register test complete.
53	DMA unit-2 base register test complete.
54	About to check F/F latch for unit-1 and unit-2.
55	F/F latch for both units checked.
56	DMA unit 1 and 2 programming over; about to initialize 8259 interrupt controller.
57	8259 initialization over.
70	About to start keyboard test.
71	Keyboard controller BAT test over.
72	Keyboard interface test over; mouse interface test started.
73	Global data initialization for keyboard/mouse over.
74	Display 'SETUP' prompt and about to start floppy setup.
75	Floppy setup over.
76	Hard disk setup about to start.
77	Hard disk setup over.
79	About to initialize timer data area.
7A	Timer data initialized and about to verify CMOS battery power.
7B	CMOS battery verification over.
7D	About to analyze POST results.
7E	CMOS memory size updated.
7F	Look for <DEL> key and get into CMOS setup if found.
80	About to give control to optional ROM in segment C800 to DE00.
81	Optional ROM control over.
82	Check for printer ports and put the addresses in global data area.
83	Check for RS232 ports and put the addresses in global data area.
84	Coprocessor detection over.
85	About to display soft error messages.
86	About to give control to system ROM at segment E000.
00	System ROM control at E000 over now give control to Int 19h boot loader.

AMI New BIOS; 02/02/91—12/12/91

Code	Meaning
01	Processor register test about to start and NMI to be disabled.
02	NMI is Disabled. Power on delay starting.
03	Power on delay complete. Any initialization before keyboard BAT is in progress.
04	Init before keyboard BAT complete. Reading keyboard SYS bit to check soft reset/ power-on.
05	Soft reset/ power-on determined. Going to enable ROM. i. e. disable shadow RAM/Cache.
06	ROM enabled. Calculating ROM BIOS checksum, waiting for KB controller input buffer to be free.
07	ROM BIOS Checksum passed. KB controller I/B free. Going to issue BAT comd to kboard controller.
08	BAT command to keyboard controller issued. Going to verify BAT command.

Code	Meaning
09	Keyboard controller BAT result verified. Keyboard command byte to be written next.
0A	Keyboard command byte code issued. Going to write command byte data.
0B	Keyboard controller command byte written. Going to issue Pin-23 & 24 blocking/unblocking command
0C	Pin 23 & 24 of keyboard controller is blocked/unblocked. NOP command of keyboard controller to be issued next.
0D	NOP command processing done. CMOS shutdown register test to be done next.
0E	CMOS shutdown register R/W test passed. Going to calculate CMOS checksum, update DIAG byte.
0F	CMOS checksum calculation is done DIAG byte written. CMOS init. to begin (If INIT CMOS IN EVERY BOOT is set).
10	CMOS initialization done (if any). CMOS status register about to init for Date and Time.
11	CMOS Status register initialised. Going to disable DMA and Interrupt controllers.
12	DMA Controller #1 & #2, interrupt controller #1 & #2 disabled. About to disable Video display and init port-B.
13	Video display disabled and port-B initialized. Chipset init/auto mem detection about to begin.
14	Chipset initialization/auto memory detection over. 8254 timer test about to start.
15	CH-2 timer test halfway. 8254 CH-2 timer test to be complete.
16	Ch-2 timer test over. 8254 CH-1 timer test to be complete.
17	CH-1 timer test over. 8254 CH-0 timer test to be complete.
18	CH-0 timer test over. About to start memory refresh.
19	Memory Refresh started. Memory Refresh test to be done next.
1A	Memory Refresh line is toggling. Going to check 15 microsecond ON/OFF time.
1B	Memory Refresh period 30 microsec test complete. Base 64K memory test about to start.
20	Base 64k memory test started. Address line test to be done next.
21	Address line test passed. Going to do toggle parity.
22	Toggle parity over. Going for sequential data R/W test.
23	Base 64k sequential data R/W test passed. Setup before Interrupt vector init about to start.
24	Setup before vector initialization complete. Interrupt vector initialization about to begin.
25	Interrupt vector initialization done. Going to read I/O port of 8042 for turbo switch (if any).
26	I/O port of 8042 is read. Going to initialize global data for turbo switch.
27	Global data initialization is over. Any initialization after interrupt vector to be done next.
28	Initialization after interrupt vector is complete. Going for monochrome mode setting.
29	Monochrome mode setting is done. Going for Colour mode setting.
2A	Colour mode setting is done. About to go for toggle parity before optional ROM test.
2B	Toggle parity over. About to give control for any setup before optional video ROM check.
2C	Processing before video ROM control is done. About to look for optional video ROM and give control.
2D	Optional video ROM control done. About to give control to do any processing after video ROM returns control.
2E	Return from processing after the video ROM control. If EGA/VGA not found then do display memory R/W test.
2F	EGA/VGA not found. Display memory R/W test about to begin.
30	Display mem R/W test passed. About to look for retrace checking.
31	Display mem R/W test/ retrace check failed. About to do alternate Display memory R/W test.
32	Alternate Display memory R/W test passed. About to look for alternate display retrace checking.
33	Video display checking over. Verification of display with switch setting and card to begin.
34	Verification of display adapter done. Display mode to be set next.
35	Display mode set complete. BIOS ROM data area about to be checked.
36	BIOS ROM data area check over. Going to set cursor for power on message.
37	Cursor setting for power on message id complete. Going to display the power on message.
38	Power on message display complete. Going to read new cursor position.
39	New cursor position read and saved. Going to display the reference string.
3A	Reference string display is over. Going to display the Hit <Esc> message.
3B	Hit <Esc> message displayed. Virtual mode memory test about to start.
40	Preparation for virtual mode test started. Going to verify from video memory.
41	Returned after verifying from display memory. Going to prepare the descriptor tables.
42	Descriptor tables prepared. Going to enter in virtual mode for memory test.

Code	Meaning
43	Entered in the virtual mode. Going to enable interrupts for diagnostics mode.
44	Interrupts enabled (if diagnostics switch is on). Going to initialize data to check memory wrap around at 0:0.
45	Data initialized. Going to check for memory wrap around at 0:0and finding the total system memory size.
46	Memory wrap around test done. Memory size calculation over. About to go for writing patterns to test memory.
47	Pattern to be tested written in extended memory. Going to write patterns in base 640k.
48	Patterns written in base memory. Going to find out amount of memory below 1Mb.
49	Amount of memory below 1Mb found and verified. Going to find out amount of memory above 1M memory.
4A	Amount of memory above 1Mb found and verified. Going for BIOS ROM data area check.
4B	BIOS ROM data area check over. Going to check <Esc> and clear mem below 1Mb for soft reset.
4C	Memory below 1M cleared. (SOFT RESET). Going to clear memory above 1M.
4D	Memory above 1M cleared.(SOFT RESET). Going to save the memory size.
4E	Memory test started. (NO SOFT RESET). About to display the first 64k memory test.
4F	Memory size display started. This will be updated during memory test. Going for sequential and random memory test.
50	Memory test below 1Mb complete. Going to adjust memory size for relocation/ shadow.
51	Memory size adjusted due to relocation/shadow. Memory test above 1Mb to follow.
52	Memory test above 1Mb complete. Going to prepare to go back to real mode.
53	CPU registers are saved including memory size. Going to enter in real mode.
54	Shutdown successful. CPU in real mode. Going to restore registers saved during preparation for shutdown.
55	Registers restored. Going to disable gate A20 address line.
56	A20 address line disable successful. BIOS ROM data area about to be checked.
57	BIOS ROM data area check halfway. BIOS ROM data area check to be complete.
58	BIOS ROM data area check over. Going to clear Hit <Esc>message.
59	Hit <Esc> message cleared. WAIT. . . message displayed. About to start DMA and interrupt controller test.
60	DMA page register test passed. About to verify from display memory.
61	Display memory verification over. About to go for DMA #1 base register test.
62	DMA #1 base register test passed. About to go for DMA #2 base register test.
63	DMA #2 base register test passed. About to go for BIOS ROM data area check.
64	BIOS ROM data area check halfway. BIOS ROM data area check to be complete.
65	BIOS ROM data area check over. About to program DMA unit 1 and 2.
66	DMA unit 1 and 2 programming over. About to initialize 8259 interrupt controller
67	8259 initialization over. About to start keyboard test.
80	Keyboard test started. Clear output buffer, check for stuck key. About to issue keyboard reset
81	Keyboard reset error/stuck key found. About to issue keyboard controller i/f test command.
82	Keyboard controller interface test over. About to write command byte and init circular buffer.
83	Command byte written Global data init done. About to check for lock-key.
84	Lock-key checking over. About to check for memory size mismatch with CMOS.
85	Memory size check done. About to display soft error; check for password or bypass setup.
86	Password checked. About to do programming before setup.
87	Programming before setup complete. Going to CMOS setup program.
88	Returned from CMOS setup and screen cleared. About to do programming after setup.
89	Programming after setup complete. Going to display power on screen message.
8A	First screen message displayed. About to display WAIT. . . message.
8B	WAIT. . . message displayed. About to do Main and Video BIOS shadow.
8C	Main/Video BIOS shadow successful. Setup options programming after CMOS setup about to start.
8D	Setup options are programmed, mouse check and init to be done next
8E	Mouse check and initialisation complete. Going for hard disk floppy reset.
8F	Floppy check returns that floppy is to be initialized. Floppy setup to follow.
90	Floppy setup is over. Test for hard disk presence to be done.
91	Hard disk presence test over. Hard disk setup to follow.
92	Hard disk setup complete. About to go for BIOS ROM data area check.

Code	Meaning
93	BIOS ROM data area check halfway. BIOS ROM data area check to be complete.
94	BIOS ROM data area check over. Going to set base and extended memory size.
95	Memory size adjusted due to mouse support hdisk type 47. Going to verify from display memory.
96	Returned after verifying from display memory. Going to do any init before C800 optional ROM control.
97	Any init before C800 optional ROM control is over. Optional ROM check and control next.
98	Optional ROM control is done. About to give control to do any required processing after optional ROM returns control.
99	Any initialization required after optional ROM test over. Going to setup timer data area and printer base address.
9A	Return after setting timer and printer base address. Going to set the RS-232 base address.
9B	Returned after RS-232 base address. Going to do any initialization before Copro test.
9C	Required initialization before coprocessor is over. Going to initialize the coprocessor next.
9D	Coprocessor initialized. Going to do any initialization after Coprocessor test.
9E	Initialization after co-pro test complete. Going to check extd keyboard; ID and num-lock.
9F	Extd keyboard check done ID flag set. num-lock on/off. Keyboard ID command to be issued.
A0	Keyboard ID command issued. Keyboard ID flag to be reset.
A1	Keyboard ID flag reset. Cache memory test to follow.
A2	Cache memory test over. Going to display any soft errors.
A3	Soft error display complete. Going to set the keyboard typematic rate.
A4	Keyboard typematic rate set. Going to program memory wait states.
A5	Memory wait states programming over. Screen to be cleared next.
A6	Screen cleared. Going to enable parity and NMI.
A7	NMI and parity enabled. Going to do any initialization required before giving control to optional ROM at E000.
A8	Initialization before E000 ROM control over. E000 ROM to get control next.
A9	Returned from E000 ROM control. Going to do any initialization required after E000 optional ROM control.
AA	Initialization after E000 optional ROM control is over. Going to display system configuration.
00	System configuration is displayed. Going to give control to INT 19h boot loader.

AMI New BIOS; 06/06/92-08/08/93

Code	Meaning
01	Processor register test about to start and NMI to be disabled.
02	NMI is Disabled. Power on delay starting.
03	Power on delay complete. Any initialization before keyboard BAT is in progress next.
04	Any init before keyboard BAT is complete. Reading keyboard SYS bit, to check soft reset/power on.
05	Soft reset/ power-on determined. Going to enable ROM; i.e. disable shadow RAM/Cache if any.
06	ROM is enabled. Calculating ROM BIOS checksum and waiting for 8042 keyboard controller input buffer to be free.
07	ROM BIOS checksum passed; KB controller input buffer free. Going to issue BAT command to the keyboard controller.
08	BAT command to keyboard controller is issued. Going to verify the BAT command.
09	Keyboard controller BAT result verified. Keyboard command byte to be written next.
0A	Keyboard command byte code is issued. Going to write command byte data.
0B	Keyboard controller command byte written. Going to issue Pin 23/24 block/unblock command.
0C	Pin-23 & 24 of keyboard controller is blocked/ unblocked. NOP command of keyboard controller to be issued next.
0D	NOP command processing is done. CMOS shutdown register test to be done next.
0E	CMOS shutdown register R/W test passed. Calculating CMOS checksum and update DIAG byte.
0F	CMOS checksum calculation is done; DIAG byte written. CMOS init to begin (If INIT CMOS IN EVERY BOOT is set).
10	CMOS initialization done (if any). CMOS status register about to init for Date and Time.
11	CMOS Status register initialised. Going to disable DMA and Interrupt controllers.
12	DMA controller #1 & #2, interrupt controller #1 & #2 disabled. About to disable Video display and init port-B.
13	Disable Video display and initialise port B. Chipset init/auto memory detection about to begin.
14	Chipset initialization/auto memory detection over. 8254 timer test about to start.
15	CH-2 timer test halfway. 8254 CH-2 timer test to be complete.

Code	Meaning
16	Ch-2 timer test over. 8254 CH-1 timer test to be complete.
17	CH-1 timer test over. 8254 CH-0 timer test to be complete.
18	CH-0 timer test over. About to start memory refresh.
19	Memory Refresh started. Memory Refresh test to be done next.
1A	Memory Refresh line is toggling. Going to check 15 microsecond ON/OFF time.
1B	Memory Refresh period 30 microsecond test complete. Base 64K memory test about to start.
20	Base 64k memory test started. Address line test to be done next.
21	Address line test passed. Going to do toggle parity.
22	Toggle parity over. Going for sequential data R/W test.
23	Base 64k sequential data R/W test passed. Any setup before Interrupt vector init about to start.
24	Setup required before vector initialization complete. Interrupt vector initialization about to begin.
25	Interrupt vector initialization done. Going to read I/O port of 8042 for turbo switch (if any).
26	I/O port of 8042 is read. Going to initialize global data for turbo switch.
27	Global data initialization is over. Any initialization after interrupt vector to be done next.
28	Initialization after interrupt vector is complete. Going for monochrome mode setting.
29	Monochrome mode setting is done. Going for Colour mode setting.
2A	Colour mode setting is done. About to go for toggle parity before optional ROM test.
2B	Toggle parity over. About to give control for any setup required before optional video ROM check.
2C	Processing before video ROM control done. Looking for optional video ROM and give control.
2D	Optional video ROM control done. Giving control for processing after video ROM returns control.
2E	Return from processing after video ROM control. If EGA/VGA not found test display mem R/W.
2F	EGA/VGA not found. Display memory R/W test about to begin.
30	Display memory R/W test passed. About to look for the retrace checking.
31	Display mem R/W test or retrace checking failed. About to do alternate Display memory R/W test.
32	Alternate Display memory R/W test passed. Looking for the alternate display retrace checking.
33	Video checking over. Verification of display type with switch setting and actual card to begin.
34	Verification of display adapter done. Display mode to be set next.
35	Display mode set complete. BIOS ROM data area about to be checked.
36	BIOS ROM data area check over. Going to set cursor for power on message.
37	Cursor setting for power on message complete. Going to display power on message.
38	Power on message display complete. Going to read new cursor position.
39	New cursor position read and saved. Going to display the reference string.
3A	Reference string display over. Going to display the Hit <ESC> message.
3B	Hit <ESC> message displayed. Virtual mode memory test about to start.
40	Preparation for virtual mode test started. Going to verify from video memory.
41	Returned after verifying from display memory. Going to prepare descriptor tables.
42	Descriptor tables prepared. Going to enter in virtual mode for memory test.
43	Entered in virtual mode. Going to enable interrupts for diagnostics mode.
44	Interrupts enabled (if diags switch on). Going to initialize data to check mem wrap around at 0:0.
45	Data initialized. Going to check for memory wrap around at 0:0 and finding total memory size.
46	Mem wrap around test done. Size calculation over. Going for writing patterns to test memory.
47	Pattern to be tested written in extended memory. Going to write patterns in base 640k memory.
48	Patterns written in base memory. Going to find out amount of memory below 1M b.
49	Amount of memory below 1Mb found and verified. Going to find amount of memory above 1Mb.
4A	Amount of memory above 1Mb found and verified. Going for BIOS ROM data area check.
4B	BIOS ROM data area check over. Going to check <Esc>, clear mem below 1 Mb for soft reset.
4C	Memory below 1Mb cleared. (SOFT RESET). Going to clear memory above 1 Mb.
4D	Memory above 1Mb cleared. (SOFT RESET). Going to save memory size.
4E	Memory test started. (NO SOFT RESET). About to display first 64K memory test.
4F	Memory size display started, will be updated during memory test. Going for sequential and random memory test.

Code	Meaning
50	Memory test below 1Mb complete. Going to adjust memory size for relocation/shadow.
51	Memory size adjusted due to relocation/shadow. Memory test above 1Mb to follow.
52	Memory test above 1Mb complete. Preparing to go back to real mode.
53	CPU registers saved including memory size. Going to enter real mode.
54	Shutdown successful; CPU in real mode. Restore registers saved during shutdown prep.
55	Registers restored. Going to disable gate A20 address line.
56	A20 address line disable successful. BIOS ROM data area about to be checked.
57	BIOS ROM data area check halfway. BIOS ROM data area check to be complete.
58	BIOS ROM data area check over. Going to clear Hit <ESC> message.
59	Hit <ESC> message cleared. <WAIT...> message displayed. About to start DMA and PIC test.
60	DMA page register test passed. About to verify from display memory.
61	Display memory verification over. About to go for DMA #1 base register test.
62	DMA #1 base register test passed. About to go for DMA #2 base register test.
63	DMA #2 base register test passed. About to go for BIOS ROM data area check.
64	BIOS ROM data area check halfway. BIOS ROM data area check to be complete.
65	BIOS ROM data area check over. About to program DMA unit 1 and 2.
66	DMA unit 1 and 2 programming over. About to initialize 8259 interrupt controller.
67	8259 initialization over. About to start keyboard test.
80	Keyboard test started. Clearing output buffer, checking for stuck key. Issue keyboard reset.
81	Keyboard reset error/stuck key found. About to issue keyboard controller interface command.
82	Keyboard controller interface test over. About to write command byte and init circular buffer.
83	Command byte written, Global data init done. About to check for lock-key.
84	Lock-key checking over. About to check for memory size mismatch with CMOS.
85	Memory size check done. About to display soft error and check for password or bypass setup.
86	Password checked. About to do programming before setup.
87	Programming before setup complete. Going to CMOS setup program.
88	Returned from CMOS setup program, screen is cleared. About to do programming after setup.
89	Programming after setup complete. Going to display power on screen message.
8A	First screen message displayed. About to display <WAIT...> message.
8B	<WAIT...> message displayed. About to do Main and Video BIOS shadow.
8C	Main/Video BIOS shadow successful. Setup options programming after CMOS setup about to start.
8D	Setup options programmed; mouse check and initialisation to be done next.
8E	Mouse check and initialisation complete. Going for hard disk and floppy reset.
8F	Floppy check returns that floppy is to be initialized. Floppy setup to follow.
90	Floppy setup is over. Test for hard disk presence to be done.
91	Hard disk presence test over. Hard disk setup to follow.
92	Hard disk setup complete. About to go for BIOS ROM data area check.
93	BIOS ROM data area check halfway. BIOS ROM data area check to be complete.
94	BIOS ROM data area check over. Going to set base and extended memory size.
95	Mem size adjusted due to mouse support, hard disk type 47. Going to verify from display memory.
96	Returned after verifying display memory. Doing any init before C800 optional ROM control
97	Any init before C800 option ROM control over. ROM check and control will be done next.
98	Optional ROM control is done. About to give control to do any required processing after optional ROM returns control.
99	Init required after optional ROM test over. Going to setup timer data area and printer base address.
9A	Return after setting timer and printer base address. Going to set the RS-232 base address.
9B	Returned after RS-232 base address. Going to do any initialization before coprocessor test
9C	Required initialization before co-processor over. Going to initialize the coprocessor next.
9D	Coprocessor initialized. Going to do any initialization after coprocessor test.
9E	Initialization after copro test complete. Check extd keyboard, keyboard ID and num lock.
9F	Extd keyboard check is done, ID flag set. num lock on/off. Keyboard ID command to be issued.

Code	Meaning
A0	Keyboard ID command issued. Keyboard ID flag to be reset.
A1	Keyboard ID flag reset. Cache memory test to follow.
A2	Cache memory test over. Going to display soft errors.
A3	Soft error display complete. Going to set keyboard typematic rate.
A4	Keyboard typematic rate set. Going to program memory wait states.
A5	Memory wait states programming over. Screen to be cleared next.
A6	Screen cleared. Going to enable parity and NMI.
A7	NMI and parity enabled. Going to do any init before giving control to optional ROM at E000.
A8	Initialization before E000 ROM control over. E000 ROM to get control next.
A9	Returned from E000 ROM control. Do any initialisation after E000 optional ROM control.
AA	Initialization after E000 optional ROM control is over. Going to display the system configuration.
00	System configuration is displayed. Going to give control to INT 19h boot loader.

AMI WinBIOS; 12/15/93 Onwards

Code	Meaning
01	Processor register test about to start; disable NMI next.
02	NMI is Disabled. Power on delay starting.
03	Power on delay complete (to check soft reset/power-on).
05	Soft reset/power-on determined, enable ROM (i.e. disable shadow RAM cache, if any).
06	ROM is enabled. Calculating ROM BIOS checksum.
07	ROM BIOS checksum passed. CMOS shutdown register test to be done next.
08	CMOS shutdown register test done. CMOS checksum calculation next.
09	CMOS checksum calculation done; CMOS diag byte written; CMOS initialisation to begin.
0A	CMOS initialization done (if any). CMOS status register about to init for Date and Time.
0B	CMOS status register init done. Any initialization before keyboard BAT to be done next.
0C	KB controller I/B free. Going to issue the BAT command to keyboard controller.
0D	BAT command to keyboard controller is issued. Going to verify the BAT command.
0E	Keyboard controller BAT result verified. Any initialization after KB controller BAT next.
0F	Initialisation after KB controller BAT done. Keyboard command byte to be written next.
10	Keyboard controller command byte written. Going to issue Pin 23 & 24 block/unblock command.
11	Keyboard controller Pin 23/24 blocked/unblocked; check press of <INS> key during power-on .
12	Checking for pressing of <Ins> key during power-on done. Disabling DMA/Interrupt controllers.
13	DMA controller #1 and #2 and Interrupt controller #1 and #2 disabled; video display disabled and port B initialised; chipset init/auto memory detection next.
14	Chipset init/auto memory detection over. To uncompress the POST code if compressed BIOS.
15	POST code is uncompressed. 8254 timer test about to start.
19	8254 timer test over. About to start memory refresh test.
1A	Memory Refresh line is toggling. Going to check 15 micro second ON/OFF time.
20	Memory Refresh 30 microsecond test complete. Base 64K memory/address line test about to start.
21	Address line test passed. Going to do toggle parity.
22	Toggle parity over. Going for sequential data R/W test on base 64k memory.
23	Base 64k sequential data R/W test passed. Setting BIOS stack and any setup before Interrupt
24	Setup required before vector initialization complete. Interrupt vector initialization about to begin.
25	Interrupt vector initialization done. Going to read Input port of 9042 for turbo switch (if any) and clear password if POST diag switch is ON next.
26	Input port of 8042 is read. Going to initialize global data for turbo switch.
27	Global data init for turbo switch over. Any initialization before setting video mode next.
28	Initialization before setting video mode complete. Going for mono mode and colour mode setting.
2A	Mono and colour mode setting is done. About to go for toggle parity before optional ROM test.

Code	Meaning
2B	Toggle parity over. About to give control for setup before optional video ROM check next.
2C	Processing before video ROM control done. About to look for video ROM and give control.
2D	Video ROM control done. About to give control for processing after video ROM returns control.
2E	Return from processing after video ROM control. If EGA/VGA not found do display mem R/W test.
2F	EGA/VGA not found. Display memory R/W test about to begin.
30	Display memory R/W test passed. About to look for the retrace checking.
31	Display mem R/W test or retrace checking failed. About to do alternate Display memory R/W test.
32	Alternate Display memory R/W test passed. Looking for the alternate display retrace checking.
34	Video display checking over. Display mode to be set next.
37	Display mode set. Going to display the power on message.
39	New cursor position read and saved. Going to display the Hit <DEL> message.
3B	Hit <DEL> message displayed. Virtual mode memory test about to start.
40	Going to prepare the descriptor tables.
42	Descriptor tables prepared. Going to enter in virtual mode for memory test.
43	Entered in virtual mode. Going to enable interrupts for diagnostics mode.
44	Interrupts enabled (if diags switch on). Going to initialize data to check mem wrap around at 0:0.
45	Data initialized. Going to check for memory wrap around at 0:0 and find total system memory.
46	Memory wrap around test done. Memory size calculation over. About to go for writing patterns to test memory.
47	Pattern to be tested written in extended memory. Going to write patterns in base 640k memory.
48	Patterns written in base memory. Going to find amount of memory below 1Mb.
49	Amount of memory below 1Mb found and verified. Going to find out amount of memory above 1Mb memory.
4B	Amount of memory above 1Mb found and verified. Check for soft reset and going to clear memory below 1Mb for soft reset next (if power on go to POST # 4Eh).
4C	Memory below 1Mb cleared.(SOFT RESET)
4D	Memory above 1Mb cleared.(SOFT RESET); save memory size next (go to POST # 52h).
4E	Memory test started. (NOT SOFT RESET); display first 64K memory size next.
4F	Memory size display started. This will be updated during memory test; sequential and random memory test next.
50	Memory testing/initialisation below 1Mb complete. Going to adjust displayed memory size for relocation/ shadow.
51	Memory size display adjusted due to relocation/ shadow. Memory test above 1Mb to follow.
52	Memory testing/initialisation above 1Mb complete. Going to save memory size information.
53	Memory size information is saved. CPU registers are saved. Going to enter real mode.
54	Shutdown successful, CPU in real mode, disable gate A20 line next.
57	A20 address line disable successful. Going to adjust memory size depending on relocation/shadow.
58	Memory size adjusted for relocation/shadow. Going to clear Hit <DEL> message.
59	Hit <DEL> message cleared. <WAIT...> message displayed. About to start DMA and interrupt controller test.
60	DMA page register test passed. About to go for DMA #1 base register test.
62	DMA #1 base register test passed. About to go for DMA #2 base register test.
65	DMA #2 base register test passed. About to program DMA unit 1 and 2.
66	DMA unit 1 and 2 programming over. About to initialize 8259 interrupt controller.
67	8259 initialization over. About to start keyboard test.
F4	Extended NMI sources enabling is in progress (EISA).
80	Keyboard test. Clear output buffer; check for stuck key; issue reset keyboard command next.
81	Keyboard reset error/stuck key found. About to issue keyboard controller interface test command.
82	Keyboard controller interface test over. About to write command byte and init circular buffer.
83	Command byte written; global data init done; check for lock-key next.
84	Lock-key checking over. About to check for memory size mismatch with CMOS.
85	Memory size check done. About to display soft error and check for password or bypass setup.
86	Password checked. About to do programming before setup.
87	Programming before setup complete. Uncompress SETUP code and execute CMOS setup.
88	Returned from CMOS setup and screen is cleared. About to do programming after setup.

Code	Meaning
89	Programming after setup complete. Going to display power on screen message.
8B	First screen msg displayed. <Wait...> message displayed. About to do Main/Video BIOS shadow.
8C	Main/Video BIOS shadow successful. Setup options programming after CMOS setup about to start.
8D	Setup options are programmed; mouse check and init next.
8E	Mouse check and initialisation complete. Going for hard disk controller reset.
8F	Hard disk controller reset done. Floppy setup to be done next.
91	Floppy setup complete. Hard disk setup to be done next.
94	Hard disk setup complete. Going to set base and extended memory size.
96	Memory size adjusted due to mouse support, hard disk type 47; any init before C800, optional ROM control next.
97	Init before C800 optional ROM control is over. Optional ROM check and control next.
98	Optional ROM control done. About to give control for any required processing after optional ROM returns control next.
99	Any initialization required after optional ROM test over. Going to setup timer data area and printer base address.
9A	Return after setting timer and printer base address. Going to set the RS-232 base address.
9B	Returned after RS-232 base address. Going to do any initialization before coprocessor test.
9C	Required initialization before co-processor is over. Going to initialize the coprocessor next.
9D	Coprocessor initialized. Going to do any initialization after coprocessor test.
9E	Init after coprocessor test complete. Going to check extd keyboard; keyboard ID and NumLock.
9F	Extd keyboard check is done; ID flag set; NumLock on/off, issue keyboard ID command next.
A0	Keyboard ID command issued. Keyboard ID flag to be reset.
A1	Keyboard ID flag reset. Cache memory test to follow.
A2	Cache memory test over. Going to display any soft errors.
A3	Soft error display complete. Going to set the keyboard typematic rate.
A4	Keyboard typematic rate set. Going to program memory wait states.
A5	Memory wait states programming over. Going to clear the screen and enable parity/NMI.
A7	NMI and parity enabled. Going to do any initialization required before giving control to optional ROM at E000 next.
A8	Initialization before E000 ROM control over. E000 ROM to get control next.
A9	Returned from E000 ROM control. Going to do init required.
AA	Init after E000 optional ROM control is over. Going to display the system configuration.
B0	System configuration is displayed. Going to uncompress SETUP code for hot-key setup.
B1	Uncompressing of SETUP code is complete. Going to copy any code to specific area.
00	Copying of code to specific area done. Going to give control to INT 19h boot loader.

EISA

Code	Meaning
F0	Initialisation of I/O cards in slots is in progress (EISA).
F1	Extended NMI sources enabling is in progress (EISA).
F2	Extended NMI test is in progress (EISA).
F3	Display any slot initialisation messages.
F4	Extended NMI sources enabling in progress.

Arche Technologies

Legacy BIOS

Derives from AMI (9 April 90), using port 80; certain codes come up if a copy is made without AMI's copyright notice. The major differences are at the end.

Code	Explanation
01	Disable NMI and test CPU registers

Code	Explanation
02	Verify ROM BIOS checksum (32K at F800:0)
03	Initial keyboard controller and CMOS RAM communication
04	Disable DMA and interrupt controllers; test CMOS RAM interrupt
05	Reset Video
06	Test 8254 timer
07	Test delta count for timer channel 2 (speaker)
08	Test delta count for timer channel 1 (memory refresh)
09	Test delta count for timer channel 0 (system timer)
0A	Test parity circuit and turn on refresh
0B	Enable parity check circuit and test system timer
0C	Test refresh trace link toggle
0D	Test refresh timing synchronization of high and low period
10	Disable cache and shadow BIOS; test 64K base memory address lines
11	Test base 64K memory for random addresses and data read/write
12	Initialize interrupt vectors in lower 1K of RAM
14	Test CMOS RAM shutdown register read/write; disable DMA and interrupt controllers
15	Test CMOS RAM battery and checksum, and different options such as diagnostic byte
16	Test floppy information in CMOS RAM; initialize monochrome video
17	Initialise colour video
18	Clear parity status if any
19	Test for EGA/VGA video ROM BIOS at C000:0 and pass control to it if there
1A	Returned from video ROM. Clear parity status if any; update system parameters for any video ROM found; test display memory read/write
1B	Primary video adapter: check vertical and horizontal retrace; write/read test video memory
1C	Secondary video adapter: check vertical and horizontal retrace; write/read test video memory
1D	Compare and verify CMOS RAM video type with switches and actual video adapter; set equipment byte if correct
1E	Call BIOS to set mono/colour video mode according to CMOS RAM
20	Display CMOS RAM write/read errors and halt if any
21	Set cursor to next line and call INT 10 to display
22	Display Power on 386 BIOS message and check CPU speed is 25 or 33 MHz
23	Read new cursor position and call INT 10 to display
24	Skip 2 rows of text and display (C)AMI at bottom of screen
25	Refresh is off, so call shadow RAM test
F0	Failure inside shadow RAM test
30	Verify (C)AMI... and overwrite with blanks before entering protected mode
31	Enter protected mode and enable timer interrupt (IRQ0). Errors indicate gate A20 circuit failed
32	Size memory above 1Mb
33	Size memory below 640K
34	Test memory above 1Mb
35	Test memory below 1Mb
36	Unknown AMI function
37	Clear memory below 1Mb
38	Clear memory above 1Mb
39	Set CMOS shutdown byte to 3 and go back to real mode
3A	Test sequential and random data write/read of base 64K RAM
3B	Test RAM below 1Mb and display area being tested
3C	Test RAM above 1Mb and display area being tested
3D	RAM test OK
3E	Shutdown for return to real mode
3F	Back in real mode; restore all variables

Code	Explanation
40	Disable gate A20 since now in real mode
41	Check for (C)AMI in ROM
42	Display (C)AMI message
43	Clear <Esc> message; test cache
4E	Process shutdown 1; go back to real mode
4F	Restore interrupt vectors and global data in BIOS RAM area
50	Test 8237 DMA controller and verify (c)AMI in ROM
51	Initialize DMA controller
52	Test various patterns to DMA controller
53	Verify (C)AMI in ROM
54	Test DMA control flip-flop
55	Initialize and enable DMA controllers 1 and 2
56	Initialize 8259 interrupt controllers—clear write request and mask registers
57	Test 8259 controllers and setup interrupt mask registers
61	Check DDNIL status bit and display message if clear
70	Perform keyboard BAT (Basic Assurance Test)
71	Program keyboard to AT type
72	Disable keyboard and initialize keyboard circular buffer
73	Display DEL message for setup prompt and initialize floppy controller/drive
74	Attempt to access floppy drive
75	If CMOS RAM is good, check and initialize hard disk type identified in CMOS RAM
76	Attempt to access hard disk and set up hard disk
77	Shuffle any internal error codes
78	Verify (C)AMI is in ROM
79	Check CMOS RAM battery and checksum; clear parity status
7A	Compare size of base/extended memory to CMOS RAM info
7B	Unknown AMI function
7C	Display (C)AMI
7D	Set/reset AT compatible memory expansion bit
7E	Verify (C)AMI is in ROM
7F	Clear <DEL> message from screen and check if DEL pressed
80	Find option ROM in C800 to DE00 and pass control to any found
81	Return from adapter ROM; initialize timer and data area
82	Setup parallel and serial port base info in global data area
83	Test for presence of 80387 numeric coprocessor and initialize
84	Check lock key for keyboard
85	Display soft error messages if CMOS RAM data error was detected such as battery or checksum
86	Test for option ROM in E000:0 and pass control to any found
A0	Error in 256 Kbit or 1Mbit RAM chip in lower 640K memory
A1	Base 64K random address/data pattern test (only in 386APR and Presto 386SX BIOS)
A9	Initialize on-board VGA (Presto 386SX)
B0	Error in 256 Kbit RAM chip in lower 640K memory
B1	Base 64K random address/data pattern test (only in Presto 386SX BIOS)
E0	Returned to real mode; initialise base 64K RAM (Presto)
E1	initialize base 640K RAM (Presto)
EF	Configuration memory error in Presto -can't find memory
F0	Test shadow RAM from 0:4000 RAM area
00	Call INT 19 boot loader

AST

See also *Phoenix* or (mostly) *Award*. AST introduced an enhanced BIOS in 1992 with 3 beeps before all early POST failure messages, for Field Replaceable Unit identification. Otherwise, the most significant (left) digit of the POST code indicates the number of Iong beeps, and the least significant (right) digit indicates the short beeps. 17 therefore means 1 long beep and 7 short. Doesn't work after 20. Errors below 20 are generally fatal.

Early POST Codes

These are usually fatal and accompanied by a beep code:

Code	Meaning
1	System Board
2	SIMM Memory; System Board
3	SIMM Memory; System Board
4	SIMM Memory; System Board
5	Processor; System Board
6	Keyboard Controller; System Board
7	Processor; System Board
8	Video Adapter; Video RAM; System Board
9	BIOS; System Board
10	System Board
11	External cache; System Board

Code	Meaning
00	Reserved
	Beep and Halt if Error occurs
01	Test CPU registers and functionality
02	Test empty 8042 keyboard controller buffer
03	Test 8042 keyboard controller reset
04	Verify keyboard ID and low-level keyboard communication
05	Read keyboard input port (WS386SX16 only)
06	Initialise system board support chipset
09	Test BIOS ROM checksum; flush external cache
0D	Test 8254 timer registers (13 short beeps)
0E	Test ASIC registers (CLEM only, 14 short beeps)
0F	Test CMOS RAM shutdown byte (15 short beeps)
10	Test DMA controller 0 registers
11	Test DMA controller 1 registers
12	Test DMA page registers (see code 17)
13	see code 17
14	Test memory refresh toggle (see code I7)
15	Test base 64K memory
16	Set interrupt vectors in base memory
17	Initialize video; if EGA/VGA, issue code 12-13 if error, but only use this POST code beep pattern
12	EGA/VGA vertical retrace failed (different from normal beep)
13	EGA/VGA RAM test failed (different than normal beep tone)
14	EGA/VGA CRT registers failed (different than normal beep)
18	Test display memory
	Don't beep and don't halt if error occurs
20	EISA bus board power up (EISA Systems only)

Code	Meaning
30	Test interrupt controller #1 mask register
31	Test interrupt controller #2 mask register
32	Test interrupt controllers for stuck interrupt
33	Test for stuck NMI (P386 25/33, P486, CLEM and EISA)
34	Test for stuck DDNIL status bit (CLEM only)
40	Test CMOS RAM backup battery
41	Calculate and verify CMOS RAM checksum
42	Setup CMOS RAM options (except WS386SX16)
50	Test protected mode
51	Test protected mode exceptions
60	Calculate RAM size
61	Test RAM
62	Test shadow RAM (WS386SXI6, P386 25/33, P486, CLEM, EISA), or test cache (P386/I6)
63	Test cache (P38625/33, P486, CLEM, EISA), or copy system BIOS to shadow RAM (P386C, P386/I6, WS386SX16)
64	Copy system BIOS to shadow RAM (P386 25/33, P486, CLEM, EISA), or copy video BIOS to shadow RAM (P38616, SW386SX16)
65	Copy video BIOS to shadow RAM (P386 25/33, P486, CLEM, EISA), or test cache (WS386SX16)
66	Test 8254 timer channel 2 (P386 25/33, P486, EISA)
67	Initialize memory (Eagle only)

AT&T

Either Phoenix or Olivetti BIOS. See Olivetti M24 for early 6300 series, and Phoenix for later ones with Intel motherboards. After 1991 see NCR.

Code	Meaning
01	CPU Test
02	System I/O Port
03	ROM Checksum
05	DMA Page Register
06	Timer 1
07	Timer 2
08	RAM Refresh
09	8/19-Bit Bus Conversion
0A	Interrupt Controller 1
0B	Interrupt Controller 2
0C	Keyboard Controller
0D	CMOS RAM/RTC
0E	Battery Power Lost
0F	CMOS RAM Checksum
10	CPU Protected Mode
11	Display Configuration
12	Display Controller
13	Primary Display Error
14	Extended DMOS Test
15	AT-Bus Reset
16	Initialize Tiger-Register
17	Exists Extension ROM
18	Internal Memory Address Test
19	Remap Memory

Code	Meaning
1A	Interleave Mode
1B	Remap Shadow Memory
1C	Setup MRAM
1D	Expanded Memory
1E	AT Memory Error
1F	Internal Memory Error
20	Minimum Complete
21	DMA Controller 1
22	DMA Controller 2
23	Timer 0
24	Initialize Internal Controllers
25	Unexpected Interrupt
26	Expected Interrupt
30	Switch to Protected Mode for AT-Bus Memory or Size of Conventional Memory
31	Size of AT-Bus Memory or Size of External Memory
32	Address Lines A16..A23
33	Internal Memory Test or Conventional Memory Test
34	AT-Bus Memory Test or External Memory Test
38	Shadow ROM BIOS
39	Shadow Extension BIOS
40	Enable/Disable Keyboard
41	Keyboard Clock and Data
42	Keyboard Reset
43	Keyboard Controller
44	A20 Gate
50	Initialize Interrupt Table
51	Enable Timer Interrupt
60	Flexible (Floppy) Controller/Drive
61	Fixed (Hard) Disk Controller
62	Initialize Flexible (Floppy) Drives
63	Initialize Fixed (Hard) Drives
70	Real Time Clock (RTC)
71	Set Real Time Clock
72	Parallel Interfaces
73	Serial Interfaces
74	External ROMs
75	Numeric Coprocessor
76	Enable Keyboard and RTC Interrupts (IRQ9)
F0	Display System Message
F1	ROM at E000H
F2	Boot from Flexible (Floppy) or Fixed (Hrad) Disk
F3	Setup Program
F4	Password Program
FC	DRAM Type Detection
FD	CPU Register Test

Award

The general procedures below are valid for greater than XT v3.0 and AT v3.02-4.2.The sequence may vary slightly between versions. If a failure occurs between 6- FF (unless it causes the computer to hang in the test), the system will keep outputting the POST sequence to the defined POST port. A normal error message will then be displayed on the screen when video is available.

Award Test Sequence—up to v4.2

Procedure	Meaning
CPU	BIOS sets verifies and resets the error flags in the CPU (i.e. carry; sign; zero; stack overflow). Failure here is normally due to the CPU or system clock.
POST Determination	BIOS determines whether motherboard is set for normal operation or a continuous loop of POST (for testing). If the POST test is cycled 1-5 times over and over either the jumper for this function is set to burn-in or the circuitry involved has failed.
Keyboard Controller	BIOS tests the internal operations of the keyboard controller chip (8042). Failure here is normally due to the keyboard chip.
Burn In Status	1-5 will repeat if the motherboard is set to burn in (you will see the reset light on all the time). If you haven't set the board for burn-in mode, there is a short in the circuitry.
Initialise Chipset	BIOS clears all DMA registers and CMOS status bytes 0E & 0F. BIOS then initialises 8254 (timer). Failure of this test is probably due to the timer chip.
CPU	A bit-pattern is used to verify the functioning of the CPU registers. Failure here is normally down to the CPU or clock chip.
RTC	BIOS verifies that that the real time clock is updating CMOS at normal intervals. Failure is normally the CMOS/RTC or the battery.
ROM BIOS Checksum	BIOS performs a checksum of itself against a predetermined value that will equal 00. Failure is down to the ROM BIOS.
Initialise Video	BIOS tests and initialises the video controller. Failure is normally the video controller (6845) or an improper setting of the motherboard or CMOS.
PIT	BIOS tests the functionality of channels 0 1 2 in sequence. Failure is normally the PIT chip (8254/53).
CMOS Status	Walking-bit pattern tests CMOS shutdown status byte 0F. Failure normally in CMOS.
Extended CMOS	BIOS checks for any extended information of the chipset and stores it in the extended RAM area. Failure is normally due to invalid information and can be corrected by setting CMOS defaults. Further failure indicates either the chipset or the CMOS RAM.
DMA	Channels 0 and 1 are tested together with the page registers of the DMA controller chip(s)—8237. Failure is normally due to the DMA chips.
Keyboard	The 8042 keyboard controller is tested for functionality and for proper interfacing functions. Failure is normally due to the 8042 chip.
Refresh	Memory refresh is tested; the standard refresh period is 120-140 ns. Failure is normally the PIT chip in ATs or the DMA chip in XTs.
Memory	The first 64K of memory is tested with walking-bit patterns. Failure is normally due to the first bank of RAM or a data line.
Interrupt Vectors	BIOS interrupt vector table loaded to first bank of RAM. Failure here is not likely since memory in this area has been tested. If a failure does occur suspect the BIOS or the PIC.
Video ROM	Video ROM is initialised which performs an internal diagnostic before returning control to the System BIOS. Failure is normally the video adapter or the BIOS.
Video Memory	This is tested with a bit-pattern. This is bypassed if there is a ROM on the video adapter. Failure is normally down to the memory on the adapter.
PIC	The functionality of the interrupt controller chip(s) is tested (8259). Failure is normally down to the 8259 chips but may be the clock.
CMOS Battery	BIOS verifies that CMOS byte 0D is set which indicates the CMOS battery power. Suspect the battery first and the CMOS second.
CMOS Checksum	A checksum is performed on the CMOS. Failure is either incorrect setup or CMOS chip or battery. If the test is passed the information is used to configure the system.
Determine System Memory	Memory up to 640K is addressed in 64K blocks. Failure is normally due to an address line or DMA chip. If all of the memory is not found there is a bad RAM chip or address line in the 64K block

Procedure	Meaning
	above the amount found.
Memory Test	Tests are performed on any memory found and there will normally be a message with the hex address of any failing bit displayed at the end of boot.
PIC	Further testing is done on the 8259 chips.
CPU protected mode	Processor is placed into protected mode and back into real mode; the 8042 is used for this. In case of failure suspect the 8042; CPU; CMOS; or BIOS in that order.
Determine Extended Memory	Memory above 1 Mb is addressed in 64K blocks. The entire block will be inactive if there is a bad RAM chip on a block.
Test Extended Memory	Extended memory is tested with a series of patterns. Failure is normally down to a RAM chip, and the hex address of the failed bit should be displayed.
Unexpected Exceptions	BIOS checks for unexpected exceptions in protected mode. Failure is likely to be a TSR or intermittent RAM failure.
Shadow/Cache	Shadow RAM and cache is activated; failure may be due to the cache controller or chips. Check the CMOS first for invalid information.
8242 Detection	BIOS checks for an Intel 8242 keyboard controller and initialises it if found. Failure may be due to an improper jumper setting or the 8242.
Initialise Keyboard	Failure could be the keyboard or the controller.
Initialise Floppy	All those set in the CMOS. Failure could be incorrect CMOS setup or floppy controller or the drive.
Detect Serial Ports	BIOS searches for and initialises up to four serial ports at 3F8/2F8/3E8 and 2E8. Detection failure is normally due to an incorrect jumper setting somewhere or an adapter failure.
Detect Parallel Ports	BIOS searches for and initialises up to four parallel ports at 378/3BC and 278. Detection failure is normally due to an incorrect jumper setting somewhere or an adapter failure.
Initialise Hard Drive	BIOS initialises any hard drive set in CMOS. Failure could be due to invalid CMOS setup, hard drive or controller.
Detect NPU Coprocessor	Initialisation of any NPU Coprocessor found. Failure is due to either an invalid CMOS setup or the NPU is failing.
Initialise Adapter ROM	Any adapter ROMs between C800 and EFFF are initialised. The ROM will do an internal test before giving back control to the System ROM. Failure is normally due to the adapter ROM or the attached hardware.
Initialise External Cache	Any cache external to the 486 is enabled. Failure would indicate invalid CMOS setup, cache controller or chips.
NMI Unexpected Exceptions	A final check for unexpected exceptions before giving control to the Int 19 boot loader. Failure is normally due to a memory parity error or an adapter.
Boot Errors	Failure when the BIOS attempts to boot off the default drive set in CMOS is normally due to an invalid CMOS drive setup or as given by an error message. If the system hangs there is an error in the Master Boot Record or the Volume Boot Record.

Award Test Sequence—after v4.2 (386/486)

Procedure	Meaning
CPU	BIOS sets verifies and resets the error flags in the CPU then performs a register test by writing and reading bit patterns. Failure is normally due to the CPU or clock chip.
Initialise Support Chips	Video is disabled as is parity/DMA and NMI. Then the PIT/PIC and DMA chips are initialised. Failure is normally down to the PIT or DMA chips.
Init Keyboard	Keyboard and Controller are initialised.
ROM BIOS Test	A checksum is performed by the ROM BIOS on the data within itself and is compared to a preset value of 00. Failure is normally due to the ROM BIOS.
CMOS Test	A test of the CMOS chip which should also detect a bad battery. Failure is due to either the CMOS chip or the battery.
Memory Test	First 356K of memory tested with any routines in the chipsets. Failure normally due to defective memory.
Cache	Any cache external to the chipset is activated. Failure is normally due to the cache controller or

Procedure	Meaning
Initialisation	chips.
Initialise Vector Table	Interrupt vectors are initialised and the interrupt table is installed into low memory. Failure is normally down to the BIOS or low memory.
CMOS RAM	CMOS RAM checksum tested, BIOS defaults loaded if invalid. Check CMOS RAM.
Keyboard Init	Keyboard initialised and Num Lock set On. Check the keyboard or controller.
Video Test	Video adapter tested and initialised.
Video Memory	Tested on Mono and CGA adapters. Check the adapter card.
DMA Test	DMA controllers and page registers are tested. Check the DMA chips.
PIC Tests	8259 PIC chips are tested.
EISA Mode Test	A checksum is performed on the extended data area of CMOS where EISA information is stored. If passed the EISA adapter is initialised.
Enable Slots	Slots 0-15 for EISA adapters are enabled if the above test is passed.
Memory Size	Memory addresses above 265K written to in 64K blocks and addresses found are initialised. If a bit is bad, entire block containing it and those above will not be seen
Memory Test	Read/Write tests performed to memory over 256K; failure due to bad bit in RAM.
EISA Memory	Memory tests on any adapters initialised previously. Check the memory chips.
Mouse Initialisation	Checks for a mouse and installs the appropriate interrupt vectors if one is found. Check the mouse adapter if you get a problem.
Cache Init	The cache controller is initialised if present.
Shadow RAM Setup	Any Shadow RAM present according to the CMOS Setup is enabled.
Floppy Test	Test and initialise floppy controller and drive.
Hard Drive Test	Test and initialise hard disk controller and drive. You may have an improper setup or a bad controller or hard drive.
Serial/Parallel	Any serial/parallel ports found at the proper locations are initialised.
Maths Copro	Initialised if found. Check the CMOS Setup or the chip.
Boot Speed	Set the default speed at which the computer boots.
POST Loop	Reboot occurs if the loop pin is set; for manufacturing purposes.
Security	Ask for password if one has been installed. If not check the CMOS data or the chip.
Write CMOS	The BIOS is waiting to write the CMOS values from Setup to CMOS RAM. Failure is normally due to an invalid CMOS configuration.
Pre-Boot	BIOS is waiting to write the CMOS values from Setup to CMOS RAM.
Adapter ROM Initialise	Adapter ROMs between C800 and EFFF are initialised. The ROM will do an internal test before giving back control to the System ROM. Failure is normally due to the adapter ROM or the attached hardware.
Set Up Time	Set CMOS time to the value located at 40h of the BIOS data area.
Boot System	Control is given to the Int 19 boot loader.

3.Ox

Uses IBM beep patterns. Version 3.xx sends codes 1-24 to port 80 and 300 and the system hangs up. Afterwards, codes are sent to the POST port and screen without hanging up.

Code	Meaning
01	CPU test 1: verify CPU status bits
02	Powerup check—Wait for chips to come up; initialize motherboard and chipset (if present) with defaults. Read 8042 status and fail if its input buffer contains data but output buffer does not.
03	Clear 8042 Keyboard interface—send self-test command AA, fail if status not 2 output buffer full.
04	Reset 8042 Keyboard controller—fail if no data input (status not equal 1) within a million tries, or if input data is not 55 in response to POST 03.
05	Get 8042 manufacturing status—read video type and POST type bits from 8042 discrete input port; test for POST type = manufacturing test or normal; fail if no response from 8042.

Code	Meaning
06	Initialize on-board chips—disable colour & mono video, parity, and 8237 DMA; reset 80x87 math chip, initialize 8255 timer 1, clear DMA chip and page registers and CMOS RAM shutdown byte: initialize motherboard chipset if present.
07	CPU test 2: read/write/verify registers except SS, SP, BP with FF and 00 data
08	Initialize CMOS RAM/RTC chip—update timer cycle normally; disable PIE, AIE, UIE and square wave. Set BCD date and 24-hour mode.
09	Checksum 32K of BIOS ROM; fail if not 0
0A	Initialize video interface—read video type from 8042 discrete input port. Fail if can't read it. Initialize 6845 controller register at either colour or mono adapter port to 80 columns, 25 rows, 8/14 scan lines per row, cursor lines at 6/11 (first) & 7/12 (last), offset to 0.
0B	Test 8254 timer channel 0- this test is skipped; already initialized for mode 3.
0C	Test 8254 timer channel 1—this test is skipped; already initialized for mode 0.
0D	Test 8254 timer channel 2—write/read/verify FF, then 00 to timer registers; initialize with 500h for normal operation.
0E	Test CMOS RAM shutdown byte (3.03: CMOS date and timer—this test is skipped and its functions performed
0F	Test extended CMOS RAM if present (3.03: test CMOS shutdown byte—write/read/verify a walk-to-left I pattern at CMOS RAM address 8F)
10	Test 8237 DMA controller ch 0—write/read/verify pattern AA, 55, FF and 00.
11	Test 8237 DMA controller ch 1—write/read/verify pattern AA, 55, FF and 00.
12	Test 8237 DMA controller page registers—write/read/verify pattern AA, 55, FF and 00: use port addresses to check out address circuitry to select page registers. At this point, POST enables user reboot.
13	Test 8741 keyboard controller interface—read 8042 status, verify buffers are empty, send AA self-test command, verify 55 response, send 8741 write command to 8042, wait for 8042 acknowledgement, send 44 data for 8741 (keyboard enabled, system flag, AT interface), wait for ack, send keyboard disable command, wait for ack. Fail if no ack or improper responses.
14	Test memory refresh toggle circuits—fail if not toggling high and low.
15	Test first 64K of base system memory—disable parity checking, zero all of memory, 64K at a time, to clear parity errors, enable parity checking, write/read/verify 00, 5A, FF and A5 at each address.
16	Set up interrupt vector tables in low memory.
17	Set up video I/O operations—read 8042 (motherboard switch or jumper) to find whether colour or mono adapter installed; validate by writing a pattern to mono memory B0000 and select mono I/O port if OK or colour if not, and initialize it via setting up the hardware byte and issuing INT 10. Then search for special video adapter BIOS ROM at C0000 (EGA/VGA), and call it to initialize if found. Fail if no 8042 response.
18, 1 beep	Test MDA/CGA video memory unless EGA/VGA adapter is found—disable video, detect mono video RAM at B0000 or colour at B8000, write/read/verify test it with pattern A5A5, fill it with normal attribute, enable the video card. No error halt unless enabled by CMOS. Beep once to let user know first phase of testing is complete. From now on, POST will display test and error messages on the screen.
19	Test 8259 PIC mask bits, channel 1—write/read/verify 00 to mask register.
1A	Test 8259 PIC mask bits, channel 2—write/read/verify 00 to mask register.
1B	Test CMOS RAM battery level—poll CMOS RTC/RAM chip for battery level status. Display error if level is low, but do not halt.
1C	Test CMOS RAM checksum—check CMOS RAM battery level again, calculate checksum of normal and extended CMOS RAM. Halt if low battery or checksum not 0; otherwise reinitialize motherboard chipset if necessary.
1D	Set system memory size parameters from CMOS RAM data, Cannot fail.
1E	Size base memory 64K at a time, and save in CMOS RAM. Cannot fail, but saves diagnostic byte in CMOS RAM if different from size in CMOS.
1F	Test base memory found from 64K to 640K—write/read/verify FFAA and 5500 patterns by byte. Display shows failing address and data.
20	Test stuck bits in 8259 PICs
21	Test for stuck NMI bits (parity /I0 check)

Code	Meaning
22	Test 8259 PIC interrupt functionality—set up counter timer 0 to count down and issue an interrupt on IRQ8. Fail if interrupt does not occur.
23	Test protected mode, A20 gate. and (386 only) virtual 86 & 8086 page mode.
24	Size extended memory above 1Mb; save size into CMOS RAM. Cannot fail, but saves diagnostic byte in CMOS RAM if different from size in CMOS.
25	Test all base and extended memory found (except the first 64K) up to 16 Mb. Disable parity check but monitor for parity errors. Write/read/verify AA55 then 55AA pattern 64K at a time. On 386 systems use virtual 8086 mode paging system. Displays actual and expected data and failing address.
26	Test protected mode exceptions—creates the circumstances to cause exceptions and verifies they happen; out-of-bounds instruction, invalid opcode, invalid TSS (JMP, CALL, IRET, INT), segment not present on segment register instruction, generate memory reference fault by writing to a read-only segment.
27	Initialise shadow RAM and move system BIOS and/or video BIOS into it if enabled by CMOS RAM setup. Also (386 only) initialise the cache controller if present in system. This is not implemented in some versions of 3.03
28	Detect and initialise Intel 8242/8248 chip (not implemented in 3.03)
29	Reserved
2A	Initialise keyboard
2B	Detect and initialise floppy drive
2C	Detect and initialise serial ports
2D	Detect and initialise parallel ports
2E	Detect and initialise hard drive
2F	Detect and initialise math coprocessor
30	Reserved
31	Detect and initialise adapter ROMs
BD	Initialize Orvonton cache controller if present
CA	Initialize 386 Micronics cache if present
CC	Shutdown NMI handler
EE	Test for unexpected processor exception
FF	INT 19 boot

3.00—3.03 8/26/87

Code	Meaning
01	Processor test part 1; Processor status verification. Tests following CPU status flags: set/clear carry zero sign and overflow (fatal). Output: infinite loop if failed; continue test if OK. Registers: AX/BP.
02	Determine type of POST test. Manufacturing (e.g. 01-05 in loop) or normal (boot when POST finished). Fails if keyboard interface buffer filled with data. Output: infinite loop if failed; continue test if OK. Registers: AX/BX/BP.
03	Clear 8042 keyboard interface. Send verify TEST_KBRD command (AAh). Output: infinite loop if failed; continue test if OK. Registers: AX/BX/BP.
04	Reset 8042 keyboard controller. Verify AAh return from 03. Infinite loop if test fails.
05	Get 8042 keyboard controller manufacturing status. Read input port via keyboard controller to determine manufacturing or normal mode operation. Reset system if manufacturing status from 02. Output: infinite loop if failed; continue test if OK. Registers: AX/BX/BP.
06	Init chips on board LSI chips. Disable colour/mono video; parity and DMA (8237A). Reset coprocessor; initialise (8254) timer 1; clear DMA page registers and CMOS shutdown byte.
07	Processor test #2. read/write verify SS/SP/BP registers with FFh and 00h data pattern.
08	Initialize CMOS chip
09	EPROM checksum for 32 Kbytes
0A	Initialize video interface
0B	Test 8254 channel 0
0C	Test 8254 channel 1
0D	Test 8254 channel 2

Code	Meaning
0E	Test CMOS date and timer
0F	Test CMOS shutdown byte
10	Test DMA channel 0
11	Test DMA channel 1
12	Test DMA page registers
13	Test 8741 keyboard controller
14	Test memory refresh toggle circuits
15	Test 1st 64k bytes of system memory
16	Setup interrupt vector table
17	Setup video I/O operations
18	Test video memory
19	Test 8259 channel 1 mask bits
1A	Test 8259 channel 2 mask bits
1B	Test CMOS battery level
1C	Test CMOS checksum
1D	Setup configuration byte from CMOS
1E	Sizing system memory & compare w/CMOS
1F	Test found system memory
20	Test stuck 8259'S interrupt bits
21	Test stuck NMI (parity/IO chk) bits
22	Test 8259 interrupt functionality
23	Test protected mode and A20 gate
24	Sizing extended memory above 1MB
25	Test found system/extended memory
26	Test exceptions in protected mode
27	Reserved

286 N3.03 Extensions

Code	Meaning
2A	POST_KEYBOARD present during reset keyboard before boot has no relationship to POST 19.
2B	POST_FLOPPY present during init of floppy controller and drive(s)
2C	POST_COMM present during init of serial cards.
2D	POST_PRN present during init of parallel cards
2E	POST_DISK present during init of hard disk controller and drive(s)
2F	POST_MATH present during init of math coprocessor. Result remains after DOS boot; left on the port 80 display
30	POST_EXCEPTION present during protected mode access or when processor exceptions occur. A failure indicates that protected mode return was not possible
CC	POST_NMI present when selecting the F2 system halt option

XT 8088/86 BIOS v3.1

Code	Meaning
01	Processor test 1; processor status verification. Tests the following processor status flags, carry, zero, sign, overflow. The BIOS will set each flags, verify they are set, then turn each flag off and verify it is off. Failure of any flag will cause a fatal error.
02	Determine type of POST test, manufacturing or normal, which can be set by a jumper on some motherboards. If the status is normal, POST continues through and, assuming no errors, boot is attempted. If manufacturing, POST will run in continuous loop and boot will not be attempted.Failed if keyboard interface buffer filled with data.

Code	Meaning
03	Clear 8042 Keyboard Controller - Test by sending TEST_KBRD command (AAh) and verifying controller reads command. Reset Keyboard Controller then verifiy controller returns Aah.
04	Get Manufacturing Status
05	The last test in the manufacturing cycle. If test 2 found the status to be manufacturing, this POST will trigger a reset and POSTs 1-5 will be repeated continuously.
06	Init 8259 PIC and 8237 DMA controller chips. Disable colour and mono video, parity circuits and DMA chips. Reset math coprocessor. Initialise 8253 Timer channel 1. Clear DMA chip and page registers.
07	Processor test #2. Write, read and verify all registers except SS, SP and BP with data patterns 00 and FF.
08	Initialize CMOS Timer. Update timer cycle normally
09	EPROM checksum for 32 Kbytes. Test failed if sum not equal to zero (0). Also checksums the sign-on message.
0A	Initialize video controller 6845 registers as follows: 25 lines x 80 columns, first cursor scan line at 6/11 and last at 7/12, reset display offset to 0.
0B	Test Timer (8254) Channel 0. These three timer tests verify that the 8254 timer chip is functioning properly.
0C	Test Timer (8254) Channel 1
0D	Test Timer (8254) Channel 2
0E	Test CMOS Shutdown Byte. Use walking bit (1) algorithm to check interface to CMOS circuit.
0F	Test Extended CMOS and Initialize CHIPSET. On motherboards with chip sets that support extended CMOS configurations, such as Chips and Technologies, the BIOS tables of CMOS information configure the chip set. These chip sets have an extended storage mechanism that allows you to save a system configuration after power is turned off. A checksum verifies the validity of the extended storage and, if valid, permits the information to be loaded into extended CMOS RAM.
10	Test DMA Channel 0. These three functions initialize the DMA (Direct Memory Access) chip and then test the chip using an AA, 55, FF, 00 pattern. Port addresses are used to check the address circuit to DMA page registers.
11	Test DMA Channel 1. Test DMA Page Registers.
12	Test DMA Page Registers.
13	Test Keyboard Controller. Test keyboard controller interface.
14	Test Memory Refresh.
15	Test 1st 64K of system memory. An extensive parity test is performed on the first 64K of system memory. This memory is used by the BIOS
16	Setup interrupt vector table in 1st 64K
17	Setup video I/O operations. If a CGA or MDA adapter is installed, the video is initialized by the system BIOS. If the system BIOS detects an EGA or VGA adapter, the option ROM BIOS installed on the video adapter is used to initialize and set up the video.
18	Test video memory for CGA and MDA video boards. This is not performed by the system BIOS on EGA or VGA video adapters - the board's own EGA or VGA BIOS will ensure that it is functioning properly.
19	Test 8259 channel 1 mask bits. These two tests verify 8259 masked interrupts by alternately turning off and on the interrupt lines. Unsuccessful completion will generate a fatal error.
1A	Test 8259 channel 2 mask bits.
1B	Test CMOS Battery Level. Verifies that the battery status bit is set to ``1''. A ``0'' can indicate a bad battery or some other problem, such as bad CMOS.
1C	Set Configuration from CMOS. If the CMOS checksum is good, the values are used to configure the system.
1D	Test CMOS Checksum. This function tests the CMOS checksum data (located at 2Eh and 2Fh), and Extended CMOS checksum, if present, to be sure they are valid.
1E	Size System Memory. The system memory size is determined by writing to addresses from 0K to 640K, starting at 0 and continuing until an address does not respond. This tells the BIOS that this is the end of the memory. This value is then compared to the CMOS value to ensure they are the same. If they are different a flag is set and at the end of POST an error message is displayed.
1F	Test found system memory. Tests memory from 64K to the top of the memory found by writing the pattern FFAA and 5500 then reading the pattern back, byte by byte, and verifying that it is correct
20	Test stuck 8259's interrupt bits

Code	Meaning
21	Test stuck NMI (parity/IO chk) bits
22	Test 8259 interrupt functionality
23	Test Protected Mode. Verifies protected mode, 8086 virtual mode as well as 8086 page mode. Protected mode ensures that any data about to be written to extended memory (above 1MB) is checked to ensure that it is suitable for storage there.
24	Size Extended Memory. This function sizes memory above 1MB by writing to addresses starting at 1MB and continuing to 16MB on 286 and 386SX systems and 64MB on 386 systems until there is no response. This determines the total extended memory, which is compared with CMOS to ensure the values are the same. If they are different a flag is set and at the end of POST an error message is displayed.
25	Test Found Extended Memory using virtual 8086 paging mode and writing an FFFF, AA55, 0000 pattern.
26	Test Protected Mode Exceptions.
27	Setup Cache Control or Shadow RAM. Tests for Shadow RAM (286, 386SX, 386, and 486) and cache controller (386 and 486 only) functionality. Systems with CGA and MDA adapters will indicate that Video Shadow RAM is enabled, even though there is no BIOS ROM to shadow. This is normal.
28	Setup 8242. Optional Intel 8242/8248 Keyboard Controller detection and support.
29	Reserved.
2A	Initialise keyboard
2B	Initialise floppy controller and drive
2C	Initialise COM ports
2D	Initialised LPT ports
2E	Initialize Hard Drive & Controller.
2F	Initialise maths coprocessor
30	Reserved.
31	Initialise option ROMs
3B	Initialize Secondary Cache w/ OPTi chip set
FF	Int 19 Boot attempt

Modular (386) BIOS v3.1

Also for PC/XT v3.0+ and AT v3.02+. Tests do not necessarily execute in numerical order.

Code	Meaning
01	Processor test part 1. Processor status verification. Tests the following processor-status flags: set/clear carry; zero; sign and overflow (fatal). BIOS sets each flag; verifies they are set and turns each flag off verifying its state. Failure of a flag means a fatal error. Output: infinite loop if failed; continue test if OK. Registers: AX/BP.
02	Determine POST type; whether normal (boot when POST finished) or manufacturing (run 01-05 in loop) which is often set by a jumper on some motherboards. Fails if keyboard interface buffer filled with data. Output: infinite loop if failed; continue test if OK. Registers: AX/BX/BP.
03	Clear 8042 keyboard interface. Send verify TEST_KBRD command (AAh). Output: infinite loop if failed; continue test if OK. Registers: AX/BX/BP.
04	Reset 8042 keyboard controller. Verify AAh return from 03. Infinite loop if test fails. Registers: AX/BX/BP.
05	Get 8042 keyboard controller manufacturing status; read input port via keyboard controller to determine manufacturing or normal mode operation. Reset system if manufacturing; i.e. if 02 found the status to be Manufacturing triggers a reset and 01-05 are repeated continuously. Output: infinite loop if failed; continue test if OK. Registers: AX/BX/BP.
06	Initialise chips on board LSI chips. Disables colour and mono video/parity circuits/DMA (8237) chips; resets maths coprocessor; initialises timer 1 (8255); clears DMA chip and all page registers and the CMOS shutdown byte.
07	Processor Test 2. Reads writes and verifies all CPU registers except SS/SP/BP with data pattern FF and 00.
08	Initialises CMOS timer/RTC and updates timer cycle; normally CMOS (8254) timer; (8237A) DMA; (8259) interrupt and EPROM.
09	EPROM Checksum; test fails if not equal to 0. Also checksums sign-on message.
0A	Initialise Video Interface; specifically register 6845 to 80 characters per row and 25 rows per screen and 8/14

Code	Meaning
	scan lines per row for mono/colour; first scan line of cursor 6/11; last scan line of cursor 7/12; reset display offset to 0.
0B	Test Timer (8254) Channel 0. See also below.
0C	Test Timer (8254) Channel 1.
0D	Test Timer (8254) Channel 2.
0E	Test CMOS Shutdown Byte using a walking-bit algorithm.
0F	Test Extended CMOS. On motherboards supporting extended CMOS configuration such as C & T the BIOS tables of CMOS information configure the chipset which has an extended storage facility enabling you to keep the configuration with the power off. A checksum is used for verification.
10	Test DMA Channel 0. This and next two tests initialise the DMA chip and test it with an AA/55/FF/00 pattern. Port addresses used to check address circuit to DMA page circuit registers.
11	DMA Channel 1
12	DMA Page Registers
13	Test keyboard controller interface.
14	Test memory refresh toggle circuits.
15	First 64K of system memory which is used by the BIOS; an extensive parity test.
16	Interrupt Vector Table. Sets up and loads interrupt vector tables in memory for the 8259 PIC.
17	Video I/O operations. Initialises the video; EGA and VGA ROMs are used if present.
18	Video memory test for CGA and mono cards (EGA and VGA have their own procedures).
19	Test 8259 mask bits—Channel 1.Interrupt lines turned alternately off and on. Failure is fatal.
1A	8259 Mask Bits—Channel 2
1B	CMOS battery level; verifies battery status bit set to 1. 0 could indicate bad battery at CMOS.
1C	Tests the CMOS checksum data at 2E and 2Fh and extended CMOS checksum if present.
1D	Configuration of the system from CMOS values if the checksum is good.
1E	System memory size is determined by writing to addresses from 0-640K continuing till there is no response. The size is then compared to the CMOS and a flag set if they do not compare. An error message will then be displayed.
1F	Tests memory from the top of 64K to the top of memory found by writing patterns FFAA and 5500 and reading them back byte by byte for verification
20	Stuck 8259 Interrupt Bits.
21	Stuck NMI bits (parity or I/O channel check).
22	8259 function.
23	Verifies protected mode; 8086 virtual and page mode.
24	As for 1E but for extended memory from 1-16Mb on 286/386SX systems and 64 Mb on 386s and above. The value found is compared to the CMOS settings.
25	Tests extended memory found above using virtual 8086 paging mode and writing an FFFF/AA55/0000 pattern.
26	Protected Mode Exceptions; tests other aspects of protected mode operations.
27	Tests cache control (386/486) or Shadow RAM. Systems with CGA and MDA indicate that video shadow RAM is enabled even though there is no BIOS ROM to shadow.
28	Set up cache controller or 8242 keyboard controller. Optional Intel 8242/8248 keyboard controller detection and support.
29	Reserved.
2A	Initialise keyboard and controller.
2B	Initialise floppy drive(s) and controller.
2C	Detect and initialise serial ports.
2D	Detect and initialise parallel ports.
2E	Initialise hard drive and controller.
2F	Detect and initialise maths coprocessor.
30	Reserved.
31	Detect and initialise option ROMs. Initialises any between C800-EFFF.
3B	Initialise secondary cache with OPTi chipset (486 only).

Code	Meaning
CC	NMI Handler Shutdown. Detects untrapped NMIs during boot.
EE	Unexpected Processor Exception.
FF	Boot Attempt; if POST is complete and all components are initialised with no errors.

ISA/EISA BIOS v4.0

EISA codes may be sent to 300h.

Code	Meaning
01	Processor test 1: Verify CPU status flags—set, test, clear, and test the carry, zero, sign, overflow flags (fatal)
02	Processor test 2: Write/read/verify all CPU registers, except SS, SP and BP with data patterns FF and 00.
03	Calculate BIOS EPROM and sign-on message checksum; fail if not 0
04	Test CMOS RAM interface and verify battery power Is available.
05	Initialize chips: Disable NMI, PIE, AIE, UEI, SQWV; disable video, parity checking, and DMA: reset math coprocessor, clear all page registers and CMOS RAM shutdown byte: Initialize timers 0, 1 and 2, and set EISA timer to a known state: initialize DMA controllers 0 and 1: initialize interrupt controllers 0 and 1; initialise EISA extended registers.
06	Test memory refresh toggle to ensure memory chips can retain data.
07	Set up low memory; Initialize chipset early; test presence of memory; run OEM chipset initialization routines, clear lower 256K of memory; enable parity checking and test parity in lower 256K; test lower 256K memory.
08	Setup interrupt vector table; initialize first 120 interrupt vectors with SPURIOUS_INT_HDLR and initialize INT 00-1F according to INT_TBL.
09	Test CMOS RAM checksum and load default; if checksum is bad.
0A	Initialize keyboard; detect type of keyboard controller (optional); set NumLock status.
0B	Initialize video interface; read CMOS RAM location 14 to find out type of video in use; detect and initialise the video adapter.
0C	Test video memory; write signon message to screen.
0D	OEM specific—initialise motherboard special chips as required by OEM; initialise cache controller early, when cache is separate from chipset.
0E	Reserved.
0F	Test DMA controller 0 with AA, 55, FF, 00 pattern.
10	Test DMA controller 1 with AA, 55, FF, 00 pattern.
11	DMA page registers—use 1/O ports to test address circuits.
12-13	Reserved
14	Test 3254 timer 0 counter 2.
15	Verify 8259 interrupt controller channel 1 by toggling interrupt lines off/on.
16	Verify 8259 interrupt controller channel 2 by toggling interrupt lines off/on.
17	Test stuck 8259 interrupt bits: turn interrupt bits off and verify no interrupt mask register is on.
18	Test 8259 functionality: force an interrupt and verify the interrupt occurred.
19	Test stuck NMI bits (parity I/O check): verify NMI can be cleared.
1A-1E	Reserved.
1F	Set EISA mode: If EISA non-volatile memory checksum is good, execute EISA init. If not, execute ISA tests and clear EISA mode flat. Test EISA config mem checksum and communication ability.
20	Initialize and enable EISA slot 0 (system board).
21-2F	Initialize and enable EISA slots 1-15.
30	Size base memory from 256-640K and test with various patterns.
31	Test extended memory above 1Mb using various patterns. Press Esc to skip.
32	If EISA mode flag set, test EISA memory found during slot initialization. Skip this by pressing Esc.
33-3B	Reserved.
3C	Verify CPU can switch in/out of protected, virtual 86 and 8086 page modes.
3D	Detect if mouse is present, initialize it, and install interrupt vectors.
3E	Initialize cache controller according to CMOS RAM setup

Code	Meaning
3F	Enable shadow RAM according to CMOS RAM setup or if MEM TYPE is SYS in the EISA configuration information.
40	Reserved
41	Initialise floppy disk drive controller and any drives.
42	Initialise hard disk drive controller and any drives.
43	Detect and initialise serial ports.
44	Detect and initialize parallel ports.
45	Detect and initialise math coprocessor
46	Print Setup message (press Ctrl-Alt-Esc to enter Setup at bottom of the screen, and enable setup.
47	Set speed for boot.
48-4D	Reserved.
4E	Reboot if manufacturing POST loop pin is set. Otherwise, display any messages for non-fatal POST errors; enter setup if user pressed Ctrl-Alt-Esc.
4F	Security check (optional): Ask for password.
50	Write all CMOS RAM values back to CMOS RAM, and clear the screen.
51	Preboot enable: Enable parity, NMI, cache before boot.
52	Initialize ROMs between C80000-EFFFF. When FSCAN enabled, init from C80000 to F7FFF.
53	Initialize time value at address 40 of BIOS RAM area.
55	Initialize DDNIL counter to NULLs.
63	Boot attempt: Set low stack and boot by calling INT 19.
88	CPU failed to initialise
B0	Spurious interrupt occurred in protected mode.
B1	Unclaimed NMI. If unmasked NMI occurs, display Press F1 to disable NMI, F2 to boot.
BF	Program chipset: Called by POST 7 to program chipset from CT table.
C0	OEM specific—Turn on/off cache.
C1	OEM specific—Test for memory presence and size on-board memory.
C2	OEM specific—Initialize board and turn on shadow and cache for fast boot.
C3	OEM specific—Turn on extended memory DRAM select and initialize RAM.
C4	OEM specific—Handle display/video switch to prevent display switch errors.
C5	OEM specific—Fast Gate A20 handling.
C6	OEM specific—Cache routine for setting regions that are cacheable.
C7	OEM specific—Shadow video/system BIOS after memory proven good.
C8	OEM specific—Handle special speed switching.
C9	OEM specific—Handle normal shadow RAM operations.
D0-DF	Debug: available POST codes for use during development.
EO	Reserved.
E1-EF	Setup pages: E1 = page 1, E2 = page 2, etc.
FF	If no error flags such as memory size are set, boot via INT 19—load system from drive A, then C; display error message if boot device not found.

EISA BIOS

Code	Meanings
1	CPU flags
2	CPU registers
3	Initialise DMA
4	Memory refresh
5	Keyboard initialisation
06	ROM checksum
07	CMOS
08	256K memory

Code	Meanings
09	Cache
0A	Set interrupt table
0B	CMOS checksum
0C	Keyboard initialisation
0D	Video adapter
0E	Video memory
0F	DMA channel 0
10	DMA channel 1
11	DMA page register
14	Timer chip
15	PIC controller 1
16	PIC controller 2
17	PIC stuck bits
18	PIC maskable IRQs
19	NMI bit check
1F	CMOS XRAM
20	Slot 0
21	Slot 1
22	Slot 2
23	Slot 3
24	Slot 4
25	Slot 5
26	Slot 6
27	Slot 7
28	Slot 8
29	Slot 9
2A	Slot 10
2B	Slot 11
2C	Slot 12
2D	Slot 13
Code	Meanings
2E	Slot 14
2F	Slot 15
30	Memory size 256K
31	Memory test over 256K
32	EISA memory
3C	CMOS setup on
3D	Mouse
3E	Cache RAM
3F	Shadow RAM
40	N/A
41	Floppy drive
42	Hard drive
43	RS232/parallel
45	NPU
47	Speed
4E	Manufacturing loop
4F	Security
50	CMOS update
51	Enable NMI

Code	Meanings
52	Adapter ROMs
53	Set time
63	Boot
B0	NMI in protected
B1	Disable NMI
BF	Chipset program
C0	Cache on/off
C1	Memory size
C2	Base 256K test
C3	DRAM page select
C4	Video switch
C5	Shadow RAM
C6	Cache program
C8	Speed switch
C9	Shadow RAM
CA	OEM chipset
FF	Boot

Late Award BIOS (4.5x-non PnP)

Code	Meaning
C0	Turn Off Chipset Cache; OEM specific cache control
01	Processor Test 1; Processor Status (1Flags) Verification. Tests carry/zero/sign/overflow processor status flags.
02	Processor Test 2; Read/Write/Verify CPU registers except SS/SP and BP with pattern FF and 00.
03	Initialise Chips; Disable NMI/PIE/UEL/SQWV; video; parity checking; DMA; reset maths coprocessor. Clear all page registers and CMOS shutdown byte. Initialise timer 0 1 and 2 including set EISA timer to a known state. Initialise DMA controllers 0 and 1; interrupt controllers 0 and 1 and EISA extended registers.
04	Test Memory Refresh Toggle
05	Blank video; initialise keyboard
06	Reserved
07	Test CMOS Interface and battery status. Detects bad battery. BE and Chipset Default Initialisation. Program chipset registers with power-on BIOS defaults.
C1	Memory Presence Test; OEM specific test to size on-board memory
C5	Early Shadow; OEM specific—enable for fast boot
C6	Cache Presence Test; External cache size detection
08	Setup Low Memory; Early chipset initialisation. Memory presence test. OEM chipset routines. Clear low 64K of memory. Test first 64K memory
09	Early Cache Initialisation. Cyrix CPU Initialisation. Cache Initialisation
0A	Setup Interrupt Vector Table; Initialise first 120 interrupt vectors with SPURIOUS_INT_HDLR and initialise INT 00-FF according to INT_TBL.
0B	Test CMOS RAM Checksum if bad or Insert key depressed; load defaults.
0C	Initialise keyboard; Set NUM LOCK status.
0D	Initialise video interface; Detect CPU Clock. Read CMOS location 14h to find out type of video. Detect and initialise video adapter.
0E	Test Video Memory. Write signon message to screen. Set up Shadow RAM and enable according to Setup.
0F	Test DMA Controller 0. BIOS Checksum Test. keyboard detect and initialisation.
10	Test DMA Controller 1
11	Test DMA Page Registers
12-13	Reserved
14	Test Timer Counter 2. Test 8254 Timer 0 Counter 2

Code	Meaning
15	Test 8259-1 Mask Bits. Alternately turns on and off interrupt lines.
16	Test 8259-2 Mask Bits. Alternately turns on and off interrupt lines.
17	Test Stuck 8259 interrupt bits. Turn off interrupts then verify no interrupt mask register is on.
18	Test 8259 Interrupt Functionality. Force an interrupt and verify that it occurred.
19	Test Stuck NMI Bits (Parity/I/O check). Verify NMI can be cleared.
1A	Display CPU Clock
1B-1E	Reserved
1F	Set EISA Mode. If EISA NVR checksum is good execute EISA initialisation. If not execute ISA tests and clear EISA mode flag. Test EISA configuration memory integrity (checksum and communication interface).
20	Enable Slot 0. Motherboard
21-2F	Enable Slots 1-15
30	Size Base and Extended Memory. From 256-640K and that above 1 Mb.
31	Test Base and Extended Memory. Various patterns are used on that described above. This will be skipped in EISA mode and can be skipped in ISA mode with Esc.
32	Test EISA Extended Memory. If EISA Mode flag is set then test EISA memory found in slots initialisation. This will be skipped in ISA mode and can be skipped in EISA mode with Esc.
33-3B	Reserved
3C	Setup Enabled
3D	Initialise and Install Mouse
3E	Setup Cache Controller
3F	Reserved
BF	Chipset Initialisation. Program registers with Setup values.
40	Display virus protect enable or disable.
41	Initialise floppy drive(s) and controller
42	Initialise hard drive(s) and controller
43	Detect and initialise Serial/Parallel Ports and game port.
44	Reserved
45	Detect and Initialise Maths Coprocessor
46	Reserved
47	Reserved
48-4D	Reserved
4E	Manufacturing POST Loop or Display Messages. Reboot if manufacturing POST Loop Pin is set. Otherwise display any messages (i.e. non-fatal errors detected during POST) and enter Setup.
4F	Security Check. Ask password (optional)
50	Write CMOS. Write all CMOS values back to RAM and clear screen.
51	Pre-boot Enable. Enable Parity Checker; NMI and cache before boot.
52	Initialise Option ROMs. Between C800-EFFF. When FSCAN option is enabled will initialise between C800-F7FF
53	Initialise Time Value In 40h BIOS area.
60	Setup Virus Protect. According to Setup
61	Set Boot Speed
62	Setup NumLock. According to Setup
63	Boot attempt. Set Low Stack. Boot via INT 19
88	CPU failed to initialise
B0	Spurious. If interrupt occurs in protected mode
B1	Unclaimed NMI. If unmasked NMI occurs display Press F1 to disable NMI; F2 reboot
E1-EF	Setup Pages. E1=Page 1; E2=Page 2 etc
FF	Boot

Late Award BIOS (4-5x PnP)

Code	Meaning
C0	1.Turn off OEM specific cache, shadow 2.Initialize standard devices with default values: DMA controller (8237) Programmable Interrupt Controller (8259) Programmable Interval Timer (8254) RTC chip
C1	Auto detection of onboard DRAM & Cache
C3	1. Test the first 256K DRAM 2. Expand the compressed codes into temporary DRAM area including the compressed system BIOS & Option ROMs
C5	Copy the BIOS from ROM into E000FFFF shadow RAM so that POST will go faster
01-02	Reserved
03	Initialize EISA registers (EISA BIOS only)
04	Reserved
05	1. Keyboard Controller Self Test 2. Enable Keyboard Interface
06	Reserved
07	Verifies CMOS's basic R/W functionality
BE	Program defaults values into chipset according to the MODBINable Chipset Default Table
09	1.Program configuration register of Cyrix CPU according to the MODBINable Cyrix Register Table 2.OEM specific cache initialization
0A	1.Initialize the first 32 interrupt vectors with corresponding interrupt handlers Initialize INT No from 33120 with Dummy (Spurious) interrupt handler 2.Issue CPUID instruction to identify CPU type 3.Early Power Management initialization (OEM specific)
0B	1.Verify the RTC time is valid or not 2.Detect bad battery 3.Read CMOS data into BIOS stack area 4.PnP initializations including (PnP BIOS only) Assign CSN to PnP ISA card Create resource map from ESCD 5.Assign IO & Memory for PCI devices (PCI BIOS only)
0C	Initialization of the BIOS data area (40:040:FF)
0D	1.Program some of the chipset's value according to setup.(Early setup value program) 2.Measure CPU speed for display & decide the system clock speed 3.Video initialization including Monochrome, CGA, EGA/VGA If no display device found, the speaker will beep.
0E	1.Initialize the APIC (MultiProcessor BIOS only) 2.Test video RAM (If Monochrome display device found) 3.Show message including: Award logo Copyright string BIOS date code & Part No OEM specific sign on messages Energy Star logo (Green BIOS only) CPU brand, type & speed
0F	DMA channel 0 test
10	DMA channel 1 test
11	DMA page registers test
12-13	Reserved

Code	Meaning
14	Test 8254 timer 0 counter 2
15	Test 8259 interrupt mask bits for channel 1
16	Test 8259 interrupt mask bits for channel 2
17	Reserved
19	Test 8259 functionality
1A-1D	Reserved
1E	If EISA NVM checksum is good, execute EISA initialization (EISA BIOS only)
1F-29	Reserved
30	Get base memory & extended memory size
31	1.Test base memory from 256K to 640K 2.Test extended memory from 1M to the top of memory
32	1.Display the Award Plug & Play BIOS extension message(PnP BIOS only) 2.Program all onboard super I/O chips(if any) including COM ports, LPT ports, FDD port according to setup value
33-3B	Reserved
3C	Set flag to allow users to enter CMOS setup utility
3D	1.Initialise keyboard 2.Install PS2 mouse
3E	Try to turn on level 2 cache Note: Some chipset may need to turn on the L2 cache in this stage. But usually, the cache is turn on later in Post 61h
3F-40	Reserved
BF	1.Program the rest of the chipset's value according to setup (later setup value program) 2.If auto configuration is enabled, programmed the chipset with predefined values in the MODBINable AutoTable
41	Initialize floppy disk drive controller
42	Initialize hard drive controller
43	If it is a PnP BIOS, initialize serial & parallel ports
44	Reserved
45	Initialize math coprocessor
46-4D	Reserved
4E	If there is any error detected (such as video, KB....), show all the error messages on the screen & wait for user to press <F1> key
4F	1.If password is needed, ask for password 2.Clear the Energy Star logo (Green BIOS only)
50	Write all the CMOS values currently in the BIOS stack are back into the CMOS
51	Reserved
52	1.Initialize all ISA ROMs 2.Later PCI initializations(PCI BIOS only) assign IRQ to PCI devices initialize all PCI ROMs 3.PnP initializations (PnP BIOS only) assign IO, Memory, IRQ & DMA to PnP ISA devices initialize all PnP ISA ROMs 4.Program shadow RAM according to setup settings 5.Program parity according to setup setting 6.Power Management initialization Enable/Disable global PM APM interface initialization
53	1.If it is not a PnP BIOS, initialize serial & parallel ports 2.Initialize time value in BIOS data area by translate the RTC time value into a timer tick value
54-5F	Reserved
60	Setup virus protection (boot sector protection) functionality according to setup setting

Code	Meaning
61	1.Try to turn on level 2 cache (if L2 cache already turned on in post 3D, this part will be skipped) 2.Set the boot up speed according to setup setting 3.Last chance for chipset initialization 4.Last chance for Power Management initialization (Green BIOS only) 5.Show the system configuration table
62	1.Setup daylight saving according to setup values 2.Program the NUM lock, typematic rate & typematic speed according to setup setting
63	1.If there is any changes in the hardware configuration, update the ESCD information (PnP BIOS only) 2.Clear memory that have been used 3.Boot system via INT 19h
88	CPU failed to initialise-
FF	Boot

Unexpected Errors

Code	Meaning
B0	If interrupt occurs in protected mode
B1	Unclaimed NMI occurs

v3.3

Code	Meaning
1-5	Keyboard controller
06	On board LSI
07	CPU
8-0E	CMOS; 8254; 8237; 8259; EPROM
0F	Extended CMOS
10-14	Refresh
15	First 64K RAM
16	Interrupt vector tables
17	Video initialisation
18	Video memory
19-1A	Interrupt line mask
1B	Battery good
1C	CMOS checksum
1D	CMOS chip
1E	Memory size
1F	Memory verifier
20-23	CPU support chips
24	Extended memory size
25	Extended memory size
26	Protected mode
27-28	Shadow RAM
29	Reserved
2A	Initialise keyboard
2B	Floppy drive initialisation
2C	Serial port initialisation
2D	Parallel port initialisation
2E	Hard disk initialisation
2F	Maths coprocessor
30	Reserved

Code	Meaning
31	Optional ROMs
FF	Boot

Chips and Technologies

Some are sent to the display in decimal as well as port 80 in hex. Micro Channel BIOSes use ports 680 and 3BC.

POST Procedures

Procedure	Meaning
Power On Tests	CPU synchronises with clock. Check the CPU or clock.
System ROM Check	The BIOS runs a checksum on itself. Check the BIOS chips.
DMA Controller Fail	DMA Controllers are initialised and tested. Check the DMA chips.
System Timer Failed	Channels 0/1/2 are tested in sequence. Check the PIT chips.
Base 64K Memory Testing	Walking-bit test performed on 1st 64K of RAM which is critical for the BIOS vector area to be initialised. Check for bad RAM chips or a data or address line.
Interrupt Contr Failed	Test the 8259 chip.
CPU Still In Protected Mode	Attempts are made to read the configuration of the system through the 8042 keyboard controller.
Refresh Not Occurring	Memory refresh is tested; standard refresh is 120-140 ns. Check the PIT chip.
Keyboard Controller Not Responding	Tests are run on the keyboard controller. Check the 8042 chip.
Could Not Enter Protected Mode	BIOS attempts to enter protected mode to test extended memory. Check the 8042 chip or the A20 address line.
Initialise Timer	Attempts are made to initialise the PIT.
Init DMA Controller	Attempts are made to initialise the DMA Controller.
Entering/Exiting Protected Mode	The transition is handled by the keyboard controller and the A20 line. Check the 8042 or the A20.
Relocate Shadow RAM	BIOS attempts to shadow itself into extended memory. Check for memory problems.
Test For EMS	Check the EMS adapter or an improper CMOS/Jumper setting.
Test Video Capabilities	Normally includes a memory test on the adapter memory up to 256K.
Test Memory	Extensive testing of Base, Extended, Expanded memory. Check for defective memory modules; 8042 chip; A20 line or an improper CMOS/Jumper setting.
Check System Options	The hardware in the system is compared with the values stored in CMOS. The PIT/PIC/8042/RTC and other system board chips are tested again.
Peripheral Check/Test	Checks are made for peripherals at standard I/O ports including serial and parallel ports keyboards and maths coprocessors. You should see an error message on screen at this point.
Floppy Test	Floppy devices set in CMOS are checked and initialised. If a bootable floppy is found the fixed disks are tested and the BIOS will boot to the floppy disk. Check for defective controllers or an improper CMOS Setup.
Fixed Disk Test	Checks for fixed disks in CMOS. If no bootable floppy in A: drive, the BIOS loads the first sector off the first fixed disk and jumps to the area of memory where the sector was loaded. You may just see a flashing cursor or an error message from the potential operating system. Check for improper CMOS setup/defective controller/fixed disk or corruption of bootloader software on the fixed disk.
Advanced Options	These include mouse/cache etc. You should see an error message on the screen at this point, except that a defective cache may hang the system; in most cases, the cache will be disabled by the BIOS.

POST Codes

NEAT, PEAK/DM, OC8291, ELEAT BIOS

Hex	Dec	Code
00	00	Error in POS register.
01	01	Flag register failed.
02	02	CPU register failed.
03	03	System ROM did not checksum
04	04	DMA controller failed
05	05	System timer failed
06	06	Base 64K RAM failed address test: not installed, misconfigured, or bad addressing
07	07	Base 64K RAM failed data test
08	08	Interrupt controller failed
09	09	Hot (unexpected) interrupt occurred
0A	10	System timer does not interrupt
0B	11	CPU still in protected mode
0C	12	DMA page registers failed
0D	13	Refresh not occurring
0E	14	Keyboard controller not responding
0F	15	Could not enter protected mode
10	16	GDT or IDT failed
11	17	LDT register failed
12	18	Task register failed
13	19	LSL instruction failed
14	20	LAR instruction failed
15	21	VERR/VERW failed
16	22	Keyboard controller gate A20 failed
17	23	Exception failed/unexpected exception
18	24	Shutdown during memory test
19	25	Last used error code
1A	26	Copyright checksum error
1B	27	Shutdown during memory sizing
1C	28	CHIPSet initialization
50	80	Initialize hardware
51	81	Initialize timer
52	82	Initialize DMA controller
53	83	Initialize interrupt controller
54	84	Initialize CHIPSet
55	85	Setup EMS configuration
56	86	Entering protected mode for first time
57	87	Size memory chips
58	88	Configure memory chip interleave
59	89	Exiting protected mode for first time
5A	90	Determine system board memory size
5B	91	Relocate shadow RAM
5C	92	Configure EMS
5D	93	Set up wait state configuration
5E	94	Re-test 64K RAM
5F	95	Test shadow RAM
60	96	Test CMOS RAM
61	97	Test video

Hex	Dec	Code
62	98	Test and initialize DDNIL bits
63	99	Test protected mode interrupt
64	100	Test address line A20
65	101	Test memory address lines
66	102	Test memory
67	103	Test extended memory
68	104	Test timer interrupt
69	105	Test real time clock (RTC)
6A	106	Test keyboard
6B	107	Test 80x87 math chip
6C	108	Test RS232 serial ports
6D	109	Test parallel ports
6E	110	Test dual card
6F	111	Test floppy drive controller
70	112	Test hard drive controller
71	113	Test keylock
72	114	Test pointing device
90	144	Setup RAM
91	145	Calculate CPU speed
92	146	Check configuration
93	147	Initialize BIOS
94	148	POST Bootstrap
95	149	Reset ICs
96	150	PEAK: System board POS. NEAT/OC8291 ELEAT: Test/init cache RAM and controller.
97	151	VGA Power on Diagnostics and setup
98	152	Adapter POS
99	153	Re-initialize DDNIL bits
A0	160	Exception 0
A1	161	Exception 1
A2	162	Exception 2
A3	163	Exception 3
A4	164	Exception 4
A5	165	Exception 5
A6	166	Exception 6
A7	167	Exception 7
A8	168	Exception 8
A9	169	Exception 9
AA	170	Exception A
AB	171	Exception B
AC	172	Exception C
AD	173	Exception D
C0	224	System board memory failure
C1	225	I/O Channel Check activated
C2	226	Watchdog timer timeout
C3	227	Bus timer timeout

Compaq

Port 84 codes indicate errors while port 85 codes show the category:

00 System BIOS
01 Error after boot
05 Video POST

General

Code	Meaning
00	Initialise flags
01	Read manufacturing jumper
02	8042 Received Read command
03	No response from 8042
04	Look for ROM at E000
05	Look for ROM at C800
06	Normal CMOS reset code
08	Initialise 8259
09	Reset code in CMOS byte
0A	Vector Via 40:67 reset function
0B	Vector Via 40:67 with E01 function
0C	Boot reset function
0D	Test #2 8254 Counter 0

Code	Meaning
0E	Test #2 8254 Counter 2
0F	Warm Boot

Overall Power Up Sequence

Code	Meaning
10	PPI disabled
11	Initialise (blast) VDU controller
12	Clear Screen; turn on video
13	Test time 0
14	Disable RTC interrupts
15	Check battery power
16	Battery has lost power
17	Clear CMOS diags
18	Test base memory (first 128K)
19	Initialise base memory
1A	Initialise VDU adapters
1B	The system ROM
1C	CMOS checksum
1D	DMA controller/page registers
1E	Test keyboard controller
1F	Test 286 protected mode
20	Test real and extended memory
21	Initialise time-of-day

Code	Meaning
22	Initialise 287 coprocessor
23	Test the keyboard and 8042
24	Reset A20
25	Test diskette subsystem
26	Test fixed disk subsystem
27	Initialise parallel printer
28	Perform search for optional ROMs
29	Test valid system configuration
2A	Clear screen
2B	Check for invalid time and date
2C	Optional ROM search
2D	Test timer 2
2F	Write to diagnostic byte

Base RAM Initialisation

Code	Meaning
30	Clear first 128K bytes of RAM
31	Load interrupt vectors 70-77
32	Load interrupt vectors 00-1F
33	Initialise MEMSIZE and RESETWD
34	Verify CMOS checksum
35	CMOS checksum not valid
36	Check battery power
37	Check for game adapters
38	Check for serial ports
39	Check for parallel printer ports
3A	Initialise port and comm timeouts
3B	Flush keyboard buffer

Base RAM Test

Code	Meaning
40	Save RESETWD value
41	Check RAM refresh
42	Start write of 128K RAM test
43	Rest parity checks
44	Start verify of 128K RAM test
45	Check for parity errors
46	No RAM errors
47	RAM error detected

VDU Initialisation and Test

Code	Meaning
50	Check for dual frequency in CMOS
51	Check CMOS VDU configuration
52	Start VDU ROM search
53	Vector to VDU option ROMs
54	Initialise first display adapter
55	Initialise second display adapter

Code	Meaning
56	No display adapters installed
57	Initialise primary VDU mode
58	Start of VDU test (each adapter)
59	Check existence of adapter
5A	Check VDU registers
5B	Start screen memory test
5C	End test of adapter
5D	Error detected on an adapter
5E	Test the next adapter
5F	All adapters successfully tested

Memory Test

Code	Meaning
60	Start of memory tests
61	Enter protected mode
62	Start memory sizing
63	Get CMOS size
64	Start test of real memory
65	Start test of extended memory
66	Save size memory (base
67	128K option installed CMOS bit
68	Prepare to return to Real Mode
69	Back in Real Mode—successful
6A	Protected mode error during test
6B	Display error message
6C	End of memory test
6D	Initialise KB OK string
6E	Determine size to test
6F	Start MEMTEST
70	Display XXXXXKB OK
71	Test each RAM segment
72	High order address test
73	Exit MEMTEST
74	Parity error on bus

80286 Protected Mode

Code	Meaning
75	Start protected mode test
76	Prepare to enter protected mode
77	Test software exceptions
78	Prepare to return to Real Mode
79	Back in Real Mode—successful
7A	Back in Real Mode—error occurred
7B	Exit protected test
7C	High order address test failure
7D	Entered cache controller test
7E	Programming memory cache
7F	Copy system ROM to high RAM

8042 and Keyboard

Code	Meaning
80	Start of 8042 test
81	Do 8042 self test
82	Check result received
83	Error result
84	OK 8042
86	Start test
87	Got acknowledge
88	Got result
89	Test for stuck keys
8A	Key seems to be stuck
8B	Test keyboard interface
8C	Got result
8D	End of Test

System Board Test

Code	Meaning
90	Start of CMOS test
92	CMOS seems to be OK
92	Error on CMOS read/write test
93	Start of DMA controller test
94	Page registers seem OK
95	DMA controller is OK
96	8237 initialisation is complete
97	Start of NCA RAM test

Diskette Test

Code	Meaning
A0	Start of diskette tests
A1	FDC reset active (3F2h bit 2)
A2	FDC reset inactive (3F2h bit 2)
A3	FDC motor on
A4	FDC timeout error
A5	FDC failed reset
A6	FDC passed reset
A8	Start to determine drive type
A9	Seek operation initiated
AA	Waiting for FDC seek status
AF	Diskette tests completed
B0	Start of fixed disk drive tests
B1	Combo board not found—exit
B2	Combo controller failed—exit
B3	Testing drive 1
B4	Testing drive 2
B5	Drive error (error condition)
B6	Drive failed (failed to respond)
B7	No fixed drives—exit
B8	Fixed drive tests complete

Code	Meaning
B9	Attempt to boot diskette
BA	Attempt to boot fixed drive
BB	Boot attempt failed FD/HD
BC	Boot record read, jump to boot record
BD	Drive error, retry booting
BE	Weitek coprocessor test (386, 386/xxe, 386&486/33L, P486c)

EISA TESTS

Deskpro/M, /LT, /33L, P486c

Code	Meaning
C0	EISA non-volatile memory checksum
C1	EISA DDF map initialization
C2	EISA IRQ initialization
C3	EISA DMA initialization
C4	EISA slot initialization
C5	EISA display config error messages
C6	EISA PZ initialization begun
C7	EISA PZ initialization done
C8	System manager board self-test

LT, SLT, LTE

Code	Meaning
C0	Disable NMI
C1	Turn off hard disk subsystem
C2	Turn off video subsystem
C3	Turn off floppy disk subsystem
C4	Turn off hard disk/modem subsystems
C5	Go to standby
C6	Update BIOS time of day
C7	Turn on hard disk/modem subsystems
C8	Turn on floppy disk subsystem
C9	Turn on video subsystem
CB	Flush keyboard input buffer
CC	Re-enable MNI

Standard POST Functions

Code	Meanings
D0	Entry to clear memory routine
D1	Ready to go to protected mode
D2	Ready to clear extended memory
D3	Ready to reset back to real mode
D4	Back in real mode, ready to clear
D5	Clear base memory, CLIM register init failure (SLT/286)
D7	Scan and clear DDNIL bits
D9	Orvonton 4-way cache detect
DD	Built-in self-test failed

Option ROM Replacement

Code	Meaning
E0	Ready to replace E000 ROM
E1	Completed E000 ROM replacement
E2	Ready to replace EGA ROM
E3	Completed EGA ROM replacement
E8	Looking for serial external boot ID str (Deskpro 2/386N, 386s/20)
E9	Receiving for serial external boot sector (2/386N, 386s/20)
EA	Looking for parallel external boot ID str (2/386N, 386s/20)
EB	Receiving parallel external boot sector (2/386N, 386s/2O)
EC	Boot record read, jump to boot record (2/386N, 386s/20)

Port 85=05 (Video POST)

Code	Meaning
00	Entry into video option ROM
01	Alternate adapter tests
02	Vertical sync tests
03	Horizontal sync tests
04	Static tests
05	Bus tests
06	Configuration tests
07	Alternate ROM tests
08	Colour gun off tests
09	Colour gun on tests
0A	Video memory tests
0B	Board present tests
10	Illegal configuration error
20	No vertical sync present
21	Vertical sync out of range
30	No horizontal sync present
40	Colour register failure
50	Slot type conflict error
51	Video memory conflict error
52	ROM conflict error
60	Red DAC stuck low error
61	Green DAC stuck low error
62	Blue DAC stuck low error
63	DAC stuck high error
64	Red DAC fault error
65	Green DAC fault error
66	Blue DAC fault error
70	Bad alternate ROM version
80	Colour gun stuck ON base code
90	Colour gun stuck OFF base code
A0	Video memory failure base code

Code	Meaning
F0	Equipment failure base code
00	Video POST over (also send 00 to 85)

After the POST, the BIOS boots the OS. If it detects a run-time error, it sends category code 01 to port 85, and the error code to port 84 in the same way it sends POST codes before booting. These are the run-time codes:

Code	Meaning
10	Entered dummy end-of-interrupt routine
11	Entered int 2 module (parity error)
12	Emulating lock instruction
13	Emulating loadall' instruction
14	Illegal opcode instruction encountered
15	Entered dum iret module
16	Entered irg9 module
17	Entered 287err module

286 DeskPro

Code	Meaning
01	CPU
02	Coprocessor
03	DMA
04	Interrupt Controller
05	Port 61
06	Keyboard Controller
07	CMOS
08	CMOS
09	CMOS
10	Programmable Timer
11	Refresh Detect Test
12	Speed Test
14	Speaker Test
21	Memory Read/Write
24	Memory Address
25	Walking I/O
31	Keyboard Short Test
32	Keyboard Long Test
33	Keyboard LED Test
35	Security Lock Test
41	Printer Failed
42	Printer Date
43	Printer Pattern Test
48	Printer Failed
51	VDU Controller Test
52	VDU Controller Test
53	VDU Attribute Test

Code	Meaning
54	VDU Character Set Test
55	VDU 80x25 Mode
56	VDU 80x25 Mode
57	VDU 40x25 Mode
60	Diskette Drive ID Test
61	Format
62	Read Test
63	Write/Read Compare Test
64	Random Seek
65	ID Media Test
66	Speed Test
67	Wrap Test
68	Write Protect Test
69	Reset Controller Test

386 DeskPro

Code	Meaning
01	I/O ROM Error
02	System Memory Board Failure
12	System Option Error
13	Time and Date not set
14	Memory Size Error
21	Memory Error
23	Memory Address Error
25	Memory Error
26	Keyboard Error
33	Keyboard Controller Error
34	Keyboard or System Unit Error
41	Printer Error
42	Mono Adapter Failure
51	Display Adapter Failure
61	Diskette Controller Error
62	Diskette Boot Recorder Error
65	Diskette Drive Error
67	Ext FDC Failed—Go To Internal F
6A	Floppy Port Address Conflict
6B	Floppy Port Address Conflict
72	Coprocessor Detection

486 DeskPro

Code	Meaning
01	CPU Test Failed
02	Coprocessor or Weitek Error
03	DMA Page Registers
04	Interrupt Controller Master
05	Port 61 Error
06	Keyboard Controller Self Test
07	CMOS RAM Test Failed
08	CMOS Interrupt Test Failed

Code	Meaning
09	CMOS Clock Load Data Test
10	Programmable Timer
11	Refresh Detect Test Failed
12	Speed Test Slow Mode out of range
13	Protected Mode Test Failed
14	Speaker Test Failed
16	Cache Memory Configuration
19	Installed Devices Test
21	Memory Machine ID Test Failed
22	Memory System ROM Checksum
23	Memory Write/Read Test Failed
24	Memory Address Test Failed
25	Walking I/O Test Failed
26	Increment Pattern Test Failed
31	Keyboard Short Test, 8042
32	Keyboard Long Test Failed
33	Keyboard LED Test, 8042
34	Keyboard Typematic Test Failed
41	Printer Failed or Not Connected
42	Printer Data Register Failed
43	Printer Pattern Test
48	Printer Not Connected
51	Video Controller Test Failed
52	Video Memory Test Failed
53	Video Attribute Test Failed

Code	Meaning
54	Video Character Set Test Failed
55	Video 80x25 Mode
56	Video 80x25 Mode
57	Video 40x25 Mode Test Failed
58	Video 320x200 Mode Colour Set 1
59	Video 320x200 Mode Colour Set 1
60	Diskette ID Drive Types Test
61	Diskette Format Failed
62	Diskette Read Test Failed
63	Diskette Write
65	Diskette ID Media Failed
66	Diskette Speed Test Failed
67	Diskette Wrap Test Failed
68	Diskette Write Protect Test
69	Diskette Reset Controller Test
82	Video Memory Test Failed
84	Video Adapter Test Failed

Dell

OEM version of Phoenix, Port 80. Also uses Smartvu display on front of machine.

Code	Beeps	SmartVu	Meaning
01	1-1-2	Regs xREG xCPU(2)	CPU register test in progress
02	1-1-3	CMOS xCMS	CMOS write/read test failed
03	1-1-4	BIOS xROM	ROM BIOS checksum bad
04	1-2-1	Timr xTMR	Programmable interval timer failed
05	1-2-2	DMA xDMA	DMA initialization failed
06	1-2-3	Dpge xDPG	DMA page register write/read bad
08	1-3-1	Rfsh xRFH	RAM refresh verification failed
09	1-3-2	Ramp RAM?	First 64K RAM test in progress
0A	1-3-3	xRAM	First 64K RAM chip or data line bad, multi-bit
0B	1-3-4	xRAM	First 64K RAM odd/even logic bad
0C	1-4-1	xRAM	Address line bad first 64K RAM
0D	1-4-2	64K? x64K	Parity error detected in first 64K RAM
10	2-1-1		Bit 0 first 64K RAM bad
11	2-1-2		Bit 1 first 64K RAM bad
12	2-1-3		Bit 2 first 64K RAM bad
13	2-1-4		Bit 3 first 64K RAM bad
14	2-2-1		Bit 4 first 64K RAM bad
15	2-2-2		Bit 5 first 64K RAM bad
16	2-2-3		Bit 6 first 64K RAM bad

Code	Beeps	SmartVu	Meaning
17	2-2-4		Bit 7 first 64K RAM bad
18	2-3-1		Bit 8 first 64K RAM bad
19	2-3-2		Bit 9 first 64K RAM bad
1A	2-3-3		Bit 10 first 64K RAM bad
1B	2-3-4		Bit 11 first 64K RAM bad
1C	2-4-l		Bit 12 first 64K RAM bad
1D	2-4-2		Bit 13 first 64K RAM bad
1E	2-4-3		Bit 14 first 64K RAM bad
1F	2-4-4		Bit 15 first 64K RAM bad
20	3-1-1	SDMA xDMS	Slave DMA register bad
21	3-1-2	MDMA xDMM	Master DMA register bad
22	3-1-3	PICO xICO	Master interrupt mask register bad
23	3-1-4	PIC1 xIC1	Slave interrupt mask register bad
25	3-2-2	Intv	Interrupt vector loading in progress
27	3-2-4	Kybd xKYB	Keyboard controller test failed
28	3-3-1	CmCk	CMOS RAM power bad; calculating checksum
29	3-3-2	Cnfg	CMOS configuration validation in progress
2B	3-3-4		Video memory test failed
2C	3-4-1	CRTI	Video initialization failed
2D	3-4-2		Video retrace failure
2E	3-4-3	CRT?	Search for video ROM in progress
30	none		Screen operable, running with video ROM
31	none		Monochrome monitor operable
32	none		Colour monitor (40 column) operable
33	none		Colour monitor (80 column) operable

Non-Fatal Error Meanings tor ATs

Only if Manufacturing Jumper is on POST

Code	Beeps	Smartvu	Meaning
34	4-2-1	Tick	Timer tick interrupt test in progress or bad
35	4-2-2	Shut	Shutdown test in progress or bad
36	4-2-3	A20	Gate A20 bad
37	4-2-4		Unexpected interrupt in protected mode
38	4-3-1	Emem	RAM test in progress or high address line bad > FFFF
3A	4-3-3	Tmr2	Interval timer channel 2 test or bad
3B	4-3-4	Time	Time-of-Day clock test or bad
3C	4-4-1	Asyn	Serial port test or bad
3D	4-4-2	Prnt	Parallel port test or bad
3E	4-4-3		Math coprocessor test or bad
3F	4-4-4	XCsh	Cache test failure

DTK

Evolved from ERSO (Taiwan).

Post Procedures—Symphony 486 BIOS

Procedure	Meaning
Init Interrupt Controller	Check the PIC chips.

Procedure	Meaning
Initialise Video Card	
Initialise DMA Controller	
Initialise Page Register	Check the 74612 chips.
Test Keyboard Controller	Internal operations of the keyboard controller are tested (8042).
Initialise DMA Contr/Timer	All DMA registers and CMOS status bytes 0E/0F are cleared. The BIOS then initialises the 8254 chip. Check the DMS or PIT chips.
DRAM Refresh Testing	
Base 64K Memory Testing	A walking-bit test of the first 64K of RAM address which is critical for the BIOS vector area to be initialised. Check for bad RAM chips or a data or address line.
Set System Stack	An area of memory is set aside by BIOS as a stack. Check bad DMA/memory.
Read System Configuration via 8042	e.g. the keyboard controller. Check for incorrect setup or bad keyboard controller or CMOS chip.
Test Keyboard Clock and Data Line	The keyboard's ability to handle the A20 line is tested as well as its internal clock. Check the keyboard controller or a bad address line.
Determine Video Type	
Check RS232/Printer	Test serial/parallel ports. Check I/O cards.
FDC Check	Test floppy controller. Check the drive as well.
Count Shadow RAM	Run memory tests. Check for bad memory chips address lines or data lines.
Display Total Mem/Return to Real Mode	Total memory detected is displayed and the machine is returned to real mode. Check the keyboard controller or A20 line.
Back to Real Mode	Transition is attempted through the A20 line and the keyboard controller.
Check HDC	The hard drive controller is tested.
Check FDD	Attempts are made to initialise the floppy drives.
Turn off Gate A20 and Test CoProcessor	Attempts are made to transition back to real mode by disabling the A20 line then the coprocessor is tested if present. Check the keyboard controller coprocessor or improper setup in CMOS.
Set Time and Date	Time and date will be read from the RTC.

POST Codes

Code	Meaning
01	Power on start
03	Initialise interrupt controller—8259
05	Initialise video card—MCA and CGA
0D	Initialise DMA controller—8237
0E	Initialise page register—74612
12	Test keyboard controller—8042
16	Initialise DMA controller and timer
22	DRAM refresh testing
25	Base 64K memory testing
30	Set system stack
33	Read system configuration through 8042
37	Test keyboard clock and data line
40	Determine video type
44	Testing MGA and CGA if existing
48	Video 80 x 25 mode initialisation
4D	Display DTK BIOS title
4F	Check RS232 and printer
50	FDC check
55	Count shadow RAM
58	Display total memory and return to real mode
5A	Back to real mode

Code	Meaning
60	Check HDC
62	Check FDD
65	Check HDC
67	Initialise FDC and HDC
6A	Turn off gate A20 and test coprocessor
70	Set time and date according to RTC
77	Boot

Eurosoft

See *Mylex/Eurosoft*.

Faraday A-Tease

Owned by Western Digital.

Code	Meaning
01	CPU test failed
02	BIOS ROM checksum test
03	Shutdown
04	DMA page register test
05	8254 timer test
06	Start refresh
07	8042 keyboard controller test
08	Test lower 128K RAM
09	Setup video
0A	Test 128K-640K
0B	Test DMA controller #1
0C	Test DMA controller #2
0D	Test interrupt controller #1
0E	Test interrupt controller #2
0F	Test control port
10	Test parity
11	Test CMOS RAM
12	Test for manufacturing mode
13	Set up interrupt vectors
14	Test keyboard
15	Configure parallel port
16	Configure serial ports
17	Configure lower 640K RAM
18	Configure RAM above 1 Mb
19	Configure keyboard
1A	Configure floppy drive
1B	Configure hard drive
1C	Configure game card
1D	Configure 80287 math chip
1E	Check CMOS real time clock
1F	Generate and verify CMOS RAM checksum
21	Initialize PROM drivers
22	Test parallel port loopback

Code	Meaning
23	Test serial port loopback
24	Test CMOS real time clock
25	Test shutdown
26	Test memory over 1mb; output codes for errors 80-FF
80	Divide overflow
81	Single step
82	NMI
83	Breakpoint
84	Int 0 detect
85	Bound error
86	Invalid opcode
87	Processor extension not available
88	Double exception
89	Processor extended segment error
8A	Invalid task state segment
8B	Segment not present
8C	Stack segment not present
8D	General protection error
8E	General protection error
8F	General protection error
90	Processor extension error
91-FF	Spurious interrupts (except F3 and F0)
F3	CPU virtual (protected mode) test error
F0	Virtual block move error

Headstart

See *Philips*.

HP

Derived from Phoenix, all POST information is sent to the screen.

Vectra

A failure during POST will emit four beeps, and a 4-digit hex code to the monitor. Failures that occur before EGA/VGA monitors are initialised will not be displayed, so use a mono instead. BIOSes prior to March 1989 initialised the video before getting on with the POST.

POST Procedures

Code	Meaning
CPU	Registers in CPU tested with data patterns; error flags are set, verified and reset.
BIOS Checksum	Checksums are performed on High and low BIOS Chips.
PIC Test	Test Timer Channels 0-2 then the memory refresh signal. Initialise timer if tests are passed. Check the 8254 chip.
64K Test	Walking-bit and address collision tests are performed on the first 64K of memory. Check for a bad memory chip or address line.
Cache Controller	Test the CPU cache controller and memory.
Video Adapter	Initialise the video adapter. If EGA/VGA is present wait for adapter to finish internal diagnostics. check the adapter or for improper setup.

Code	Meaning
DMA Test	Bit-patterns written to all DMA controller registers (inc page registers) and verifies the patterns written. If the tests pass the registers are reset and the controller initialised.
PIC Test	Test mask register of master and slave interrupt controllers. Generate interrupt and monitor CPU to test success. Failure is normally down to the PIC but the interrupt test uses the BIOS clock (interrupt) and the RTC so check those.
Keyboard Controller	Perform several tests on the 8042 keyboard controller then send a series of interrupt request commands via the 8259 PIC.
HP-HIL Test	Test HP-HIL (Hardware Interrupt Level) controller with data patterns and verify it.
CMOS Test	Perform a checksum on the standard and extended CMOS RAM areas; perform a register test and check Byte 0D to determine power status. Check the CMOS extended CMOS RAM or battery respectively.
Manufacturing Test	Search for diagnostic tool used in manufacturing and run predetermined tests if found. Otherwise continue POST.
Base Memory Test	Test RAM between 64-640K with several pattern tests; the bit failure and bank can be determined by the displayed hex code.
Ext Memory Test	Test extended memory found. Bank and failing bit displayed by the hex code.
RTC Test	Test the RTC portion of the CMOS chip.
Keybrd Controller	Test keyboard controller; initialise k/b if no errors.
Floppy Disk	Test and initialise floppy controllers and drives found; check specific errors with the displayed hex code. Check for correct setup or defective CMOS chip or battery.
Maths Copro	Test NPU registers and interrupt request functions.
CPU Clock Test	Test interface between CPU and system at different speeds. Check for incorrect clock setting for system peripherals or a bad CPU or clock generator chip.
Serial/Parallel Test	Test and initialise serial/parallel ports. Failure here will not halt the POST. The Vectra RS BIOS does not test the parallel port.
Boot	Initialise the BIOS vector table; standard and extended CMOS data areas and any adapter ROMs present. Then call Int 19 and give control to the boot loader. Failures past this point are usually down to the hard drive or corrupt OS code.

POST Codes

Code	Meaning
01	LED test
02	Processor test
03	System (BIOS) ROM test
04	RAM refresh timer test
05	Interrupt RAM test
06	Shadow the System ROM BIOS
07	CMOS RAM test
08	Internal cache memory test
09	Initialize the Video Card
10	Test external cache
11	Shadow option ROMs
12	Memory Subsystem test
13	Initialize EISA/ISA hardware
14	8042 self-test
15	Timer 0/Timer 2 test
16	DMA Subsystem test
17	Interrupt controller test
18	RAM address line independence test
19	Size extended memory
20	Real-Mode memory test (first 640K)
21	Shadow RAM test

Code	Meaning
22	Protect Mode RAM test (extended RAM)
23	Real Time clock test
24	Keyboard test
25	Mouse test
26	Hard disk test
27	LAN test
28	Flexible disk controller subsystem test
29	Internal numeric coprocessor test
30	Weitek coprocessor test
31	Clock speed switching test
32	Serial Port test
33	Parallel Port test

IBM

Tests are performed by PC/XT/AT and PS/2 machines. There will be POST Codes (below), beep codes and screen displays if possible, but the XT does not give POST codes. ATs emit codes to 80h, while PS/2 models 25 and 30 emit to 90h, and 35 and above to 680. The BIOS will test main system components first, then non-critical ones. If there is an error, the BIOS will look for a reference diskette in drive A: so diagnostics can be performed.

IBM POST I/O Ports

Architecture	Typical Computer	Port
PC	PC	none
ISA	XT	60
	AT	80
	PS/2 25,30	90, 190
MCA	PS/2 50 up	680, 3BC
EISA	none	none

POST Procedures

Procedure	Meaning
CPU	Perform register test on the CPU by writing data patterns to the registers and reading the results of the write.
ROM BIOS Checksum	The value of the bits inside the BIOS chip(s) is added to a preset value that should create a total of 00.
CMOS RAM	RAM within the CMOS chip is tested by writing data patterns to the area and verifying that the data was stored correctly.
DMA	Test DMA chips by forcing control inputs to the CPU to an active state and verifying that the proper reactions occur.
8042/8742 Keyboard Controller	Test including Gate A20 and the reset command. The buffer space is prepared and data is sent to the determined area via the keyboard controller to see if commands are received and executed correctly.
Base 64K System RAM.	Perform a walking-bit test of the first 64K of RAM so the BIOS vector area can be initialised. Check for bad RAM chips or a data/address line.
8259A PIC	Determine if commands to interrupt CPU processes are carried out correctly. Check the PIC/PIT/RTC/CMOS or Clock chip(s).
8254 PIT	Check that proper setup and hold times are given to the PIC for interrupts of the CPU processes. Check the PIT or Clock chip.
82385 Cache Controller	This is normally responsible for cache and shadow memory.
CMOS RAM Configuration	Check information in CMOS RAM before further testing so any failures after this could also be down to

Procedure	Meaning
Data	the CMOS chip.
CRT controllers	Test any video adapters listed in the CMOS.
RAM above 64K	Perform a walking-bit test on memory above 64K listed in the CMOS.
Keyboard	Test interface to the keyboard including scan code stuck keys etc.
Pointing Device (mouse etc)	Test and init vector for pointing devices. Failure to see a device may be the device itself but there may be a problem with the CMOS or 8042/8742.
Diskette Drive A:	Test and initialise the A: drive.
Serial Interface Circuitry	Test any RS232 devices found at the proper I/O address.
Diskette Controllers	If an A: drive has been found further testing is performed before proceeding to the bootloader. This test includes reading the first sector of any diskette in the drive to see if a valid boot code is there.
Fixed Disk Controllers	Test and initialise any hard drives set in the CMOS including reading the first sector of the hard drive to see if a valid boot code exists.

XT (Port 60)

The PC uses an irregular way of sending codes to ports 10 and 11, which makes it impractical to monitor them on a POST card. The XT, on the other hand, uses three methods; before initializing the display, it issues a few codes to port 60 (the 8255 controller for the keyboard) for critical system board errors. It beeps to indicate successful or unsuccessful POST, and displays error messages. After initializing the display, it writes error codes to memory address 15, which are sent to the screen to make up part of other error messages.

Code	Meaning
00 or FF	CPU register test failed
01	BIOS ROM (ROS) checksum failed
02	Timer I failed
03	8237 DMA register write/read failed or unexpected timer 1 request for DMA ch 1
04	After enabling port 213 expansion box, base 32K memory write/read of AA, 55, FF, 01 and 00 test failed; POST output alternates between POST code and failing bit pattern.
	Size memory, initialize the 8259 PIC, setup BIOS interrupt vectors in RAM, read the configuration switches, poll the manufacturing jumper. If installed, load the manufacturing test via the keyboard port and run it. If not, initialize the rest of the system.

AT POST Codes

Code	Meaning
00	Main board damaged
01	80286 test in real mode; verify read/write registers, flags and conditional jumps.
02	ROM checksum test—test 32K ROMs; POST BASIC and BIOS.
03	Test CMOS shutdown byte—rolling bit pattern and verified at shutdown address.
04	8254 timer 1; all bits on; set timer count; check all bits on.
05	8254 timer 1; all bits off; set timer count; check all bits off.
06	8237 DMA 0 init channel register test. Disable DMA controller; r/w current address to all channels
07	8237 DMA 1 init channel register test. Disable DMA controller; r/w current address to all channels
08	DMA page register test—r/w all page registers. Check 74LS612.
09	Storage refresh test. 8042 i/face test I/O issue self test; check 55H received
0A	Keyboard controller test 1; Soft reset
0B	Keyboard controller test 2; Reset 8042
0C	Keyboard controller test 3; Test switch settings
0D	Keyboard controller test 4: Write byte 0 of 8042 mem; issue comd to 8042, await response.
0E	Base 64K r/w memory test—r/w data patterns AAh, 55h.
0F	Get I/P buffer switch setting. Also Base 64K r/w memory test #2—r/w data patterns AAh, 55h.

Code	Meaning
10	Roll error code to MFG Port
11	Initialise display row count. Verify 286 LGDT.SGDT LIDT/SIDT instruction
12	Protected mode register test failure
13	Initialise 8259
14	Setup interrupt vector to temp interrupt
15	Establish BIOS interrupt call subroutine vectors. Verify CMOS checksum/battery OK
16	Set data segment or Check CMOS battery condition.
17	Set defective battery flag or CMOS checksum error.
18	Ensure CMOS dividers set or enable protected mode.
19	Set return address byte in CMOS.
1A	Set temporary stack or protected mode test. Determine memory size; verify parity.
1B	Segment address 01-0000 (second 64K memory test)
1C	Set or reset; check 512—640 memory installed
1E	Set (expanded?) memory size determined in CMOS; or determine memory size above 1024K.
1F	Test address lines 19-23
20	Fatal addressing error; Shutdown.
21	Return 1 from shutdown. Initialise and start CRT controller (6845); test video r/w; test video enable; select alpha mode; w/r patterns; or check CMOS config data.
22	Enable video signal and set mode; CRT interface test; verify video enable and horizontal sync. Video card initialisation failure or invalid switch setting.
23	Check for advanced video card; Video card initialisation failure or invalid switch setting.
24	8259 PIC test -r/w interrupt mask register with 1s and 0s; mask device interrupts off.
25	Check for hot interrupts; test interrupt mask registers.
26	Display 101 error; Check for unexpected interrupts.
27	Check the converting logic (106 error)
28	Check hot NMI interrupts (error 107)
29	Test data bus to timer 2 (error 108). 8253 timer register failure.
2A	8253 Timer speed failure (error 102)
2B	Too fast; or 8253 Timer interrupt initialisation.
2C	Too slow; or Timer 0 interrupt failure (error 103)
2D	Check 8042 (k/b controller) for last command excepted (error 105)
2F	Check for warm boot
30	Set shutdown return 2; Protected mode r/w memory test step 1.
31	Enable protected mode; Protected mode r/w memory test step 2.
32	Address lines 0-15
33	Next block of 64K; Protected mode r/w memory test step 3.
34	Restore checkpoint; Protected mode r/w memory test step 4.
35	Keyboard test; Check for manufacturing burn in test.
36	Check <AA> scan code; keyboard clock error.
38	Error—check 8042 working; also 37 and 39
3A	Initialise 8042; keyboard locked
3B	Check for ROM in 2K blocks
3C	Check for floppy diskette drive
3D	Initialise floppy for drive type
3E	Initialise hard drive
3F	Initialise printer; non-fatal error; press F1 to continue.

Additional Protected Mode Tests

Code	Meaning
40	Enable hardware interrupt if 80287; initialisation
41	System code @ segment code E000.0
42	Exit to system code
43	Go to boot loader diskette attachment test
44	Boot from fixed disk
45	Unable to boot; go to BASIC
81	Build descriptor table
82	Switch to virtual mode
90-B6	EXEC_00 to EXEC_31 & SYS_32 to SYS_38 tests; memory test; boot loader.
DD	Transmit error code to MFG_PORT
F0	Set data segment
F1	Interrupt test (programming interrupt 32)
F2	Exception interrupt test
F3	Verify 286 LDT/SDT and LTR/STR instructions.
F4	Verify 286 bound instruction
F5	Verify push and pop all instruction; stack/register test.
F6	Verify access rights function correctly.
F7	Verify Adjust RPL field of selector instructions (ARPL) functions
F8	Verify LAR function
F9	Verify LSL i(Load Segment Limits) instruction
FA	Low meg chip select test

PS/2 (Micro Channel) POST Codes

Code	Meaning
00	CPU test; FFAA0055 pattern
01	32 bit CPU register test; setup system timer
02	System ROM checksum
03	Test system enable/system port 94 enable/check
04	Test system POS register; port 102 enable/check
05	Test adapter setup port; POS port 96 enable/check
06	Test RTC/CMOS shutdown byte; Byte 0F CMOS (NMI disable)
07	Test extended CMOS location; ports 74-76 test
08	Test DMA & page register 8 channels; ports 2
09	Initialise DMA command & mode registers
0A	Test refresh (port 61)
0B	Test keyboard controller buffers (8042—port 61
0C	Keyboard controller self test (8042—port 60)
0D	Keyboard controller test continuation (8042)
0E	Keyboard self test error indicated (port 64)
0F	Setup system memory configuration
10	Test first 512K RAM in real mode
11	Half system if memory test error
12	Verify LGDT/SGDR LIDT/SIDT (keyboard commands)
13	Initialise PIC #1 (Master)
14	Initialise PIC #2 (Slave)
15	Initialise A20 interrupt vectors
16	Setup extended vector table
17	Check power RTC/CMOS power good signal (byte 0D)

Code	Meaning
18	Check RTC/CMOS checksum
19	RTC/CMOS lost power (0D 80h)
1A	Skip memory test in protected mode if warm reset
1B	Prepare for shutdown; protected mode initialisation
1C	Setup stack pointer point to the end of first 64K
1D	Decide low memory size in protected mode; Size base memory
1E	Save memory size detected
1F	Setup system memory split address
20	Check for extended memory beyond 64 Mb
21	Test memory address bus lines
22	Clear parity error and channel check; Disable NMI
23	Initialise interrupt 00; system timer
24	Determine CMOS validity
25	Write keyboard controller (8042) command byte
40	Check valid CMOS and video
41	Display error code 160. Check CMOS, AC ripple.
42	Test PIC #1 & PIC #2 registers; Master/Slave test
43	Test PIC #1 & PIC #2 registers with another pattern
44	Check for interrupt with interrupt masked; check for NMI when disabled.
45	Test NMI
46	NMI error detected
47	Test system timer 0
48	Check stuck speaker clock; speaker bitstuck test
49	Test timer 0 count
4A	Test timer 2 output
4B	Check if timer interrupt occurred
4C	Test timer 0 for count too fast or slow
4D	Verify timer 0 interrupt
4E	Check 8042 ready for command; buffer free
4F	Check for soft reset
50	Prepare for shutdown/protected mode
51	Start protected mode test
52	Test memory in 64K increments
53	Check if memory test done
54	Shutdown system and return to real mode
55	Test for manufacture or regular test; test for loop. Check jumper.
56	Disable keyboard
57	Check for keyboard self test
58	Keyboard test passed; check for errors
59	Test keyboard interface
5A	Initialise mouse
5B	Disable mouse
5C	Initialise interrupt vectors
5D	Initialise interrupt vectors
5E	Initialise interrupt vectors
5F	BIOS data area
60	Determine diskette rate
61	Reset floppy controller/drive
62	Floppy drive test
63	Turn floppy motor off

Code	Meaning
64	Serial port setup
65	Enable/test RTC interrupt
66	Configure floppy drives
67	Configure hard drive
68	Enable system CPU arbitration; wait states
69	Scan for optional ROMs
6A	Verify serial and parallel ports
6B	Setup equipment byte
6C	Setup configuration errors reported
6D	Set keyboard typematic rate
6E	Reset page register; boot up system (Int 19 bootloader)
70	Reset disk
71	Read bootcode for E6/E9
72	Control to bootcode
73	Bootcode/ROM Basic

Landmark

Comes with POST card and replaces that in motherboard being tested; same as BIOSYS BIOS. Beeps as for IBM AT. Codes sent to ports 280 and 80.

XT Jumpstart

Code	Meaning
01	Jump to reset area in ROM BIOS
02	Initialize DMA page register
03	Initialize DMA refresh register
04	Clear all RAM
05	Perform RAM test on 1st 64k
06	Clear 1st 64k
07	Initialize BIOS stack to 0:FC0
08	Set the equipment flag based on switches
09	Initialize default interrupt vectors
0A	Initialize 8255 if it exists and enable parity
0B	Initialize 8259 and enable interrupts
0C	Setup adapters and peripherals
0D	Setup video
0E	Initialize video
0F	Initialize equipment
10	Initialize memory configuration in RAM (currently = 64K)
11	Setup timer function
12	Initialize timer function
13	Setup time of day function
14	Initialize time of day function
15	Setup and init print screen function
16	Setup and init cassette function
17	Setup and init bootstrap function
18	Setup and init keyboard function
19	Enable speaker
1A	Setup timer 0 for the real time clock

Code	Meaning
1B	Enable RTC
1C	Setup timer 2 for the beeper
1D	Size memory: write 55AA/AA55 to 1st/last word in segment
1E	Read 1st and last word of segment
1F	Compare 1st and last words
20	Report determined memory size to screen
21	Perform checksum on ROM BIOS
22	If cold boot perform complete RAM testing
23	Move system stack to bottom of memory and save pointer at 40:0E
24	Reset parity after RAM sizing
25	Enable timer and keyboard interrupts
26	Setup the serial and parallel ports
27	Setup the game port
28	Setup the floppy disk controller
29	Scan for optional ROM in 2K chunk from C8000 to start of BIOS
2A	Boot System

AT Jumpstart

Code	Meaning
03	1 short beep when first awake
04	Initialize bell tone
05	Enable CMOS RAM
06	Reset video controller
07	Disable I/O parity
08	Start memory refresh
09	Clear reset flag in RAM
0A	Test DMA page registers
10	Use CMOS to determine if soft reset
11	Perform ROM checksum
12	Test timer A
13	Test DMA channel A
14	Test DMA channel B
15	Test refresh
16	Flush 8042 input buffer
17	Reset 8042
18	Get keyboard switch
19	Initialise keyboard
1A	Clear any existing parity
1B	Enable on-board parity
1C	Test base 64K memory
1D	Test base 64k parity
1E	Initialize POST stack
20	Put keyboard # in RAM
65	Set video speed
21	Test protected mode registers
22	Initialize 8259 interrupts
23	Zero all 256 interrupts
24	Initialize interrupts 0-1fh
25	Perform DRAM checksum

Code	Meaning
26	Adjust configuration based on hardware found
27	Check manufacturing switch (may exit POST)
28	Initialize video controller
2A	Test video memory
2B	Test video sync
2C	Look for external video
2D	Change video configuration if external video
2E	Unused
2F	Initialize video controller
30	Change video interrupt
31	Print any POST messages
32	Size memory by testing it
33	Adjust memory configuration
33	Verify CMOS RAM size
34	Enable I/O parity
35	Test 8259
36	Bytes swap test
37	Test NMI
38	Timer test
39	Initialize timer A
3A	Protected mode memory test
3B	Test keyboard
3C	Test keyboard interrupt
3D	Enable A20
3E	Reset hard disk controller
3F	Setup floppy controller
40	Test floppies
41	Setup keyboard (NumLock)
42	Enable timer interrupt
43	Check for dual floppy/hard disk controller
44	Find floppy drive A type
45	Find floppy drive B type
46	Reset hard disk
47	Enable slave DMA
63	Set video interrupt vector
48	Call any external ROMs
49	Initialize printer
4A	Initialize serial
4B	Initialize 80287
4C	Read CMOS RAM status
4D	Check CMOS configuration against hardware found
70	Check CMOS configuration against memory found
4E	Initialize timer ticks
4F	Enable IRQ9
50	Enable on-board parity
51	Call add-on card ROM
52	Enable keyboard interrupt
53	Reset printer
60	Check for any errors
61	One short beep

Code	Meaning
62	Print sign-on message
64	Perform boot

Magnavox

See *Philips*.

MR BIOS

The last code emitted is the one that failed. There may also be a message on screen. Beep codes are in a binary format and are preceded by a high and low tone (described elsewhere). Check also *Nasty Noises* for more codes.

POST Procedures

Procedure	Meaning
Reset	See if a warm boot (Ctrl+Alt+Del) or a cold boot (Reset) is needed.
Chipset Initialisation	Reset the support chips (8259) DMAs and timers to defaults before proceeding.
Disable Chips	Disable NMI/DMA and Video (6845) to get accurate results later. Failure here is normally a NMI generated by one of the disabled chips.
ROM BIOS Checksum	Perform checksum test, add a preset value stored in BIOS to create value of 00.
DMA Test	Perform a test of the page registers in the DMA controller.
Keyboard Controller Test	Send a command to the 8042 keyboard controller to perform a selftest. The keyboard controller will return a buffer and error buffer address.
Chipset Initialisation	Initialise the DMA (8237)/PIC (8259)/PIT (8254) and RTC chips.
DMA Test	Test the registers of the master 16-bit and slave 8-bit DMA controllers by writing bit patterns and reading the results.
Cache/Shadow Disable	Disable cache and shadow RAM before processing with POST.
Refresh	Test interval in which PIT (8254) chip sends a refresh signal to the DMA chips.
Base 64K Memory	Test the first 64K of system memory with a walking-bit pattern.
PIC Test	Test the mask registers of the master and slave interrupt controllers by setting the mask-bit in the registers and generating an interrupt to see if the interrupt is trapped. Then test the additional registers in the PICs with a walking-bit pattern.
PIT Test	Test the interrupt timer channels 0-2 and initialise if no failures occur.
RTC	Perform read/write test of RTC portion of CMOS and initialise if no failures occur.
Video	Test and initialise the video adapter, which will perform an internal diagnostic and sign on before returning an OK status.
CMOS Checksum	Perform a checksum on the system RAM.
Keybd Initialisation	Initialise the keyboard and read the buffer address for errors.

OEM Specific

Procedure	Meaning
Base Memory Test	Test memory addresses between 64-640K with a walking-bit pattern. There may be a hex display of the failing it.
Keyboard 2nd Init	Tries again if the first failed.
Protected Mode Test	Test the ability of the keyboard controller address line 20 to respond to commands that switch the CPU in and out of protected mode.
Extended Memory Test	Test addresses above 1 Mb in 64K blocks and perform pattern tests.
OEM Memory	Normally test the cache controller and shadow RAM.

Procedure	Meaning
RTC Time Test	Test the write active line of the RTC/CMOS chip. Check bad CMOS/battery
Serial Port	Generate an interrupt of the CPU through I/O ports reserved for RS232 devices. Failure to see a device could be the device itself or more than one set to the same port. Checks are only made for two devices.
Parallel	Check for parallel devices. Failure to see a device could be the device itself or more than one using the same port. Checks are only made for three.
NPU Test	Perform a register test on the NPU then initialise if passed.
Floppy Test	Test floppy controller and drive.
Fixed Disk	Test fixed disk controller and drive and compare the results against the CMOS setting. This is skipped if no drive is installed.
CMOS Update	Update information in CMOS RAM based on the previous results.

Non-Fatal Errors

Procedure	Meaning
Lock Check	Check if a system lock-byte is set and wait for user response if an error is generated. Check the panel lock or circuitry.
NumLock/Pwd/Setup	Set NumLock on (if set) and ask for password (if set) and display setup message.
Typematic Rate	Set the typematic rate.
Floppy Disk	Perform any further initialisation needed.
Hard Disk	Perform any further initialisation needed.
Video Mode	Set primary video mode and display any errors found during initialisation routines.
Shadow/Cache Enable	
Adapter ROM	Initialise adapters with a ROM signature of 55AA. Self tests will be performed by the equipment concerned before handing back control to the POST.
Video Monitor Mode	Set the video mode based on the information in the CMOS and update the time variables from the RTC.
Parity/NMI Enable	Enable NMI by setting bit 7 of CMOS address 41 and enable parity.
Set Stack	Set the last significant byte of the stack pointer and install the shadow RAM at E000 if set by CMOS.
Acknowledge	Acknowledge errors and set primary video mode before calling Int 19 boot loader. Errors reported will await a keyboard response before proceeding. Errors beyond this point are normally software related.

POST Codes (inc 3.4x)

Code	Meaning
00	Cold-Boot commences (Not seen with warm-boot). Output EDX register to I/O ports 85h, 86h, 8Dh, 8Eh for later use
01	HOOK 00 OEM specific typically resets chipset to default. Initialize any Custom KBD controller, disable CPU cache, cold initialize onboard I/O chipset, size & test RAM, size cache
02	Disable critical I/O: 6845s CRT; 8237s DMA; 7675 floppy and parity latches (monitor, DMA, FDC, I/O ports, Speaker, NMI).
03	BIOS checksum test
04	DMA Page register test (Ports 81-8F)
05	8042 (Keyboard Controller) Self test. Enable A20 Gate.
06	Init ISA I/O: Game Port: 8237 master/slave; 8254 ch2/1; RTC Reg3 F/A; 8259 master/slave
07	HOOK 01. OEM specific; typically disables cache/shadow/ or memory refresh circuit test, or warm initialize custom KBD controller, warm initialize onboard I/O chipset.
08 (09?)	Refresh toggle test (PORTB)
09 (08?)	Pattern test master/slave 8237s; eight 16-bit regs each
0A	Base 64K memory test—check beep code.
0B	Pattern test master/slave 8259 mask regs
0C	8259/IRQ tests purge powerup ints—check beep code. Test 8259 Slave, test 8259 slave's interrupt range, initialize interrupt vectors 00-77h, init KBD buffer variables.
0D	8254 channel-0 test and initialization

Code	Meaning
0E	8254 channel-2 toggle test speaker circuitry
0F	RTC tests/inits: Init REG-B; write/readback NVRAM. PIE test
10	Video Initialization; display cold boot sign-on message or possible error messages.
11	CMOS Checksum test
12	Sign-on msg. Accept KB BAT; perform 1st try KB unit; cold boot delay
13	HOOK 02. OEM specific; select 8MHz bus
14	Size/Test base memory (low 64K already done)
15	Perform 2nd try KB init if necessary
16	HOOK 03. OEM specific. Size/Test cache
17	Test A20 gate off; then on; stuck in asserted state.
18	Size/Test extended memory
19	HOOK 04 and Size/Test system memory (special OEM memory)
1A	Test RTC Update-In-Progress and validate time; RTC settings invalid.
1B	Serial port determination off-board/on-board
1C	Parallel port determination off-board/on-board
1D	Copro determination/initialization
1E	Floppy controller test/determination CMOS validation
1F	Fixed Disk controller test/determination CMOS validation
20	Rigorous CMOS parameter validation display other config changes
21	Front-Panel lock check; wait for user to acknowledge errors
22	Set NumLock; Password-Security Trap; despatch to setup utility
23	HOOK 05. OEM specific. Final determination of onboard Serial/Parallel ports.
24	Set typematic rate
25	Floppy subsystem initialization
26	Fixed subsystem initialization
27	ACK errors; set primary adapter video mode
28	HOOK 06. OEM specific; typically enables shadow, cache, turbo. Cyrix WB-CPU support, Green PC: purge 8259 slave, relieve any trapped IRRs before enabling PwrMgmt, set 8042 pins, Ctrl-Alt-Del possible now, Enable CPU Features.
29	Disable A20-gate; set low stack, install C800, E000 ROMs.
2A	ACK errors; set video mode, set DOS time variables from RTC.
2B	Enable parity checking and NMI
2C	Set low stack, Install E000 ROM
2D	ACK errors, set primary video mode.
2E	HOOK 07. OEM specific. Log-in EMS (if built-in). Fast A20: Fix A20.
2F	Purge 8259 slave; relieve any trapped IRRs before enabling Green-PC. Pass control to INT 19.
32	Test CPU Burst
33	Reserved
34	Determine 8042, Set 8042 Warm-Boot flag STS.2
35	Test HMA Wrap, Verify A20 enabled via F000:10 HMA
36	Reserved
37	Validate CPU: CPU Step NZ, CPUID Check. Disable CPU features
38	Set 8042 pins (Hi-Speed, Cache-off)
39	PCI Bus: Load PCI; Processor Vector init'd, BIOS Vector init'd, OEM Vector init'd
3A	Scan PCI Bus
3B	Initialize PCI Bus with intermediate defaults
3C	Initialize PCI OEM with intermediate defaults, OEM bridge
3D	PCI Bus or PLUGnPLAY: Initialize AT Slotmap from AT-Bus CDE usage
3E	Find phantom CDE ROM PCI-cards
3F	PCI Bus: final Fast-Back-to-Back state
40	OEM POST Initialization, Hook Audio

Code	Meaning
41	Allocate I/O on PCI-Bus, logs-in PCI-IDE
42	Hook PCI-ATA chips
43	Allocate IRQs on the PCI Bus
44	Allocate/enable PCI Memory/ROM space
45	Determine PS/2 Mouse
46	Map IRQs to PCI Bus per user CMOS, Enable ATA IRQs.
47	PCI-ROM install, note user CMOS
48	If Setup conditions: execute setup utility
49	Test F000 Shadow integrity, Transfer EPROM to Shadow-RAM
4A	Hook VL ATA Chip
4B	Identify and spin-up all drives
4C	Detect Sec IRQ, if VL/AT-Bus IDE exists but its IRQ not known yet, then autodetect it
4D	Detect/log 32-bit I/O ATA devices
4E	ATAPI drive M/S bitmap to Shadow-RAM, Set INT13 Vector
4F	Finalize Shadow-RAM variables
50	Chain INT 13
51	Load PnP, Processor Vector init'd, BIOS Vector init'd, OEM Vector init'd
52	Scan PLUGnPLAY, update PnP Device Count
53	Supplement IRQ usage—AT IRQs
54	Conditionally assign everything PnP wants
58	Perform OEM Custom boot sequence just prior to INT 19 boot
59	Return from OEM custom boot sequence. Pass control to 1NT 19 boot
5A	Display MR BIOS logo
88	Dead motherboard and/or CPU and/or BIOS ROM.
FF	BIOS POST Finished.

Msg	Low-High	Problem
03	LH-LLL	ROM-BIOS Checksum Failure
04	LH-HLL	DMA Page Register Failure
05	LH-LHL	Keyboard Controller Selftest Failure
08	LH-HHL	Memory Refresh Circuitry Failure
09	LH-LLH	Master (16 bit) DMA Controller Failure
09	LH-HLH	Slave (8 bit) DMA Controller Failure
0A	LH-LLLL	Base 64K Pattern Test Failure
0A	LH-HLLL	Base 64K Parity Circuitry Failure
0A	LH-LHLL	Base 64K Parity Error
0A	LH-HHLL	Base 64K Data Bus Failure
0A	LH-LLHL	Base 64K Address Bus Failure
0A	LH-HLHL	Base 64K Block Access Read Failure
0A	LH-LHHL	Base 64K Block Access Read/Write Failure
0B	LH-HHHL	Master 8259 (Port 21) Failure
0B	LH-LLLH	Slave 8259 (Port A1) Failure
0C	LH-HLLH	Master 8259 (Port 20) Interrupt Address Error
0C	LH-LHLH	Slave 8259 (Port A0) Interrupt Address Error
0C	LH-HHLH	8259 (Port 20/A0) Interrupt Address Error
0C	LH-LLHH	Master 8259 (Port 20) Stuck Interrupt Error
0C	LH-HLHH	Slave 8259 (Port A0) Stuck Interrupt Error
0C	LH-LHHH	System Timer 8254 CH0 / IRQ0 Interrupt Failure
0D	LH-HHHH	8254 Channel 0 (System Timer) Failure
0E	LH-LLLLH	8254 Channel 2 (Speaker) Failure

Msg	Low-High	Problem
0E	LH-HLLLH	8254 OUT2 (Speaker Detect) Failure
0F	LH-LHLLH	CMOS RAM Read/Write Test Failure
0F	LH-HHLLH	RTC Periodic Interrupt / IRQ8 Failure
10	LH-LLHLH	Video ROM Checksum Failure at Address XXXX Mono Card Memory Error at Address XXXX Mono Card Memory Address Line Error at XXXX CGA Card Memory Error at Address XXXX CGA Card Address Line Error at Address XXXX
11	(None)	Real Time Clock (RTC) Battery is Discharged
11	(None)	Battery Backed Memory (CMOS) is Corrupt
12	LH-HLHLH	Keyboard Controller Failure
14/18/19	LH-LHHLH	Memory Parity Error
14/18/19	LH-HHHLH	I/O Channel Error
14		
18		
19	(None)	RAM Pattern Test Failed at XXXX Parity Circuit Failure in Bank XXXX Data Bus Test Failed: Address XXXX Address Line Test Failed at XXXX Block Access Read Failure at Address XXXX Block Access Read/Write Failure: Address XXXX Banks Decode to Same Location: XXXX and YYYY
15	(None)	Keyboard Error—Stuck Key Keyboard Failure or no Keyboard Present
17	LH-LLLHH	A20 Test Failure Due to 8042 Timeout
17	LH-HLLHH	A20 Gate Stuck in Disabled State (A20=0)
17	(None)	A20 Gate Stuck in Asserted State (A20 Follows CPU)
1A	LH-LHLHH	Real Time Clock (RTC) is Not Updating
1A	(None)	Real Time Clock (RTC) Settings are Invalid
1E	(None)	Diskette CMOS Configuration is Invalid Diskette Controller Failure Diskette Drive A: Failure Diskette Drive B: Failure
1F	(None)	Fixed Disk CMOS Configuration is Invalid Fixed Disk C: (80) Failure Fixed Disk D: (81) Failure Please Wait for Fixed Disk to Spin Up
20	(None)	Fixed Disk Configuration Change Diskette Configuration Change Serial Port Configuration Change Parallel Port Configuration Change Video Configuration Change Memory Configuration Change Numeric Coprocessor Configuration Change
21	(None)	System Key is in Locked Position—Turn Key to Unlocked Position
29	(None)	Adapter ROM Checksum Failure at Address XXXX

Mylex/Eurosoft

Derived from Eurosoft BIOS, mainly for Mylex EISA boards.

4.71

Pass	Fail	Meaning
03	04	DMA page registers test
05	06	Keyboard reply test
07	08	Keyboard self-test
09	0A	8042 keyboard controller able to read links
0B		RATMOD/DIAG link
0C	0D	Keyboard acceptance of 60H
0E	0F	Keyboard acceptance of parameter
10	11	Read keyboard command byte
12	13	Keyboard command byte came back
14	15	RAM refresh toggle test
16	17	RAM bit test
18	19	RAM parity test
1A	1B	CMOS RAM test
1C	1D	CMOS RAM battery test
1E	1F	CMOS RAM checksum test
	20	CMOS RAM battery fault bit set
21	22	Master DMA controller test
21	23	Slave DMA controller 2 test
24		Protected mode entered safely
25		RAM test completed
26	27	BIOS ROM checksum test
28		Protected mode exit
29	2A	Keyboard power-up reply received test
2B	2C	Keyboard disable command acceptance test
	2D	Video display presence check
	2E	POST Errors were reported
	2F	About to halt
30		Protected mode entered safely (2)
31		RAM test complete
33		Master interrupt controller test
34	35	Slave interrupt controller test
36	37	Chipset initialization
38	39	System BIOS shadowed
3A	3B	Video BIOS shadowed

EISA/ISA

Code	Meaning
01	Processor test
02	DMA Page Register
03	8042 keyboard controller
04	BIOS ROM Checksum error
05	Send keyboard command test bad
06	CMOS RAM Test
07	RAM Refresh Test
08	1st 64K memory test
09	8237 DMA controller test
0A	Initialise DMA controller
0B	Interrupt Test

Code	Meaning
0C	Determine RAM size
0D	Initialise video
0E	EGA/VGA ROM checksum test failed
10	Search for monochrome card
11	Search for colour card
12	Word splitter and byte shifter test failed
13	Keyboard Test
14	RAM Test failed
15	Timer test error
16	Initialise output port of keyboard controller
17	Keyboard interrupt test
18	Initialise keyboard
19	RTC clock test failure
1A	Maths copro test failure
1B	Reset hard/floppy controller
1C	Initialise floppy drive
1D	Initialise hard drive
1E	Initialise ROMs in C000-DFFF
1F	Initialise serial and parallel ports
20	Initialise time of day in RTC
21	Initialise ROMs in E000-EFFF
22	Look for boot device
23	Boot from floppy disk
24	Boot from hard disk
25	Gate A20 enable/disable failure
26	Parity error occurred
30	DDNIL bit scan failure
FF	Fatal error occurred and system halted

NCR

Purchased in 1991 by AT&T. 3 main types of motherboards: OEM from AMI, AT and Micro channel clones. See AMI pre-0490 for PC386, and below for others. All NCR-designed systems send POST codes to LPT1, but see table.

Architecture	Typical PC	BIOS	POST Code Port
XT	PC6	NCR	378 or 3BC (LPT 1)
AT (ISA)	3728, 3204, PC 916	NCR	80 and 378 or 3BC (LPT 1)
	PC386	AMI Pre-0490	80
Micro Channel	3421	Phoenix	680 and 3BC

PC6

Code	Meanings
AA	8088 CPU failure
B1	2764 EPROM checksum failure
B2	8237 DMA controller failure
B3	8253 timer failure
B4	RAM failure. Halts if error in first 64K, otherwise displays MEMORY ERROR.

Code	Meanings
B5	8259 interrupt controller failure. Displays INTERRUPT FAILURE
B6	RAM parity error. Displays ERROR IN BASE MEMORY or ERROR ON EXPANSION CARD.
BB	All tests passed

3302/3304/3728/PC916SX

Code	Meaning
01	Test CPU registers
02	Test system I/0 port—write and read port 61 to confirm it will handle RAM refresh.
03	Test ROM BIOS checksum
04	Test DMA page registers
05	Test timer channel 1 (refresh)
06	Test timer channel 2 (speaker)
07	Test RAM refresh logic. Also verifies timer is working.
08	Test base 64K RAM
09	Test 8/16 bit bus conversion
0A	Test interrupt controller 1
0B	Test interrupt controller 2
0C	Test I/O controller
0D	Test CMOS RAM read/write
0E	Test for battery power low or interrupted since last test
0F	Test CMOS RAM checksum
10	Test CPU protected mode
11	Test video configuration in CMOS RAM or display switch
12	Test primary video controller
13	Test secondary video controller
20	Display results of tests to this point
21	Test DMA controller 1
22	Test DMA controller 2
23	Test Timer channel 0 (system timer tick)
24	Initialize interrupt controllers
25	Test interrupts
26	Test interrupts
30	Check base 640K memory size
31	Check extended memory size
32	Test higher 8 address lines
33	Test base memory
34	Test extended memory
40	Test keyboard—enable/disable
41	Test keyboard—reset
42	Test keyboard—clock low
43	Test keyboard—for interrupt, enable keyboard, init pointers, write out subcommand
44	Test 8086 address overrun compatibility (gate A20)
50	Set up hardware interrupt vectors
51	Enable interrupt from timer channel 0
52	Security ROM
60	Test floppy disk controller and drive
61	Test hard disk controller
62	Initialize floppy drives
63	Initialize hard drives

Code	Meaning
70	Test real time clock
71	Set time of day in real time clock
72	Check parallel interfaces
73	Check serial interfaces
74	Check for and execute adapter option ROMs
75	Check if math coprocessor is installed and enable interrupt
76	Enable keyboard and real time clock interrupts
F0	System not configured correctly, or hardware defect
F1	Scan for and execute motherboard option ROMs
F2	INT 19 to boot operating system—No POST errors.

PC916 5/6

*halt on error if loop jumper installed in keyboard connector

Code	Meaning
01	Test CPU registers, reset video cards, display diagnostic messages
02	Verify port 61, disable non-maskable interrupt, start speaker timer channel 2
03	Test ROM BIOS checksum
04	Test DMA page registers
05	Test timer channel 1 (refresh)
06	Test timer channel 2 (speaker)
07	Test refresh logic by reading port 61 bit 4 every 15 microseconds
08	Test base 64K RAM
09	Test 8/16-bit bus converting logic, initialize both interrupt controllers
0A	Test interrupt mask register A
0B	Test interrupt mask register B, write temporary interrupt vector table for INT 00-77
0C	Test 8042/8742 keyboard controller
0D	Test CMOS RAM shutdown byte
0E*	Test CMOS RAM battery power low or interrupted since last test
0F*	Test CMOS RAM checksum; initialize periodic rate
10	Test CPU protected mode
11	Test video configuration in CMOS RAM or display switch, look for advanced video card ROM in segment C000, initialize interrupt vectors.
12	Initialize and test primary video controller
13	Primary video error, test secondary video controller
14	Test disabling Speed stretch enable/disable port 69 bit 0=1
15	Start refresh timer 1 counter 1, disable speed switch timer 2, counter 2
16	Enable then disable speed stretch enable/disable port 69 bit 0
17	Clear write protect bit
18	Write/verify global/local/interrupt descriptor table registers; copy ROM BIOS to shadow RAM F000
19	Verify RAM to ROM BIOS copy OK; reinitialize restart vector, check and execute for burn-in ROM D000. Disable real time clock in CMOS status reg B, reset and initialize video cards.
IA	Command 8042 to execute self-test and verify result
1B	Test 64K Shadow RAM in segment F000
20	Display results of tests to this point
21	Test DMA controller 1
22	Test DMA controller 2 and initialize all 8 channels
23	Test timer 1 counter 0 840 ns clock timer for IRQ0 (INT8)
24	Initialize both interrupt controllers
25	Check for unexpected (hot) interrupts

Code	Meaning
26	Wait for interrupt
27*	Test timer 2 counter 0 for NMI (INT02), failsafe
28*	Test timer 2 counter 1 (INT72-74)
30	Check base 640K memory size
31	Check extended memory size (max 256M RAM on 5.2, 6 BIOS)
32	Test higher 8 address lines for mirror addresses (5.x BIOS)
33*	Test base memory
34*	Test extended memory (up to 256M)
35*	Test RAM in E000 (v6 BIOS—also test keyboard shutdown command FE—shutdown path 0B)
40	Test keyboard—enable/disable
41	Test keyboard—reset command FF (halt on error if loop jumper not installed)
42	Test keyboard—clock low (halt on err if loop jumper not installed)
43	Test keyboard—check for interrupt, enable keyboard, initialize buffer pointers, verify keyboard unlocked, disable external interrupts mask A=F, turn on write protect for RAM E000-FFFF, write out subcommand (halt on error if loop jumper not installed).
44	Test address overrun compatibility (turn off gate A20, 8042 P2 bit 1 = 0)
45	v6 BIOS—Init mouse, en IRQ1 (INT09)keyboard (15 IRQs, 1 disabled), disp Press F1 for Setup.
50	Set up hardware interrupt vectors 0-15, 70-77
51	Enable IRQ0 interval interrupt 08 from timer channel 0; enable external interrupts (STI)
60	Test for floppy/hard disk controller and drive
61	Test cylinder register for disk controller
62	Initialize floppy drives
63	Initialize hard drives
70*	Test real time clock
71	Set interval timer RAM counts
72	Configure and test parallel interfaces
73	Configure and test serial interfaces
74	Check for and execute adapter option ROMs C8000-DFFFF
75*	Test math coprocessor if installed, and enable interrupt
76	Enable keyboard and real time clock IRQ8 (INT 70) interrupts; enable slave interrupt controller 2 via PlC 1 mask bit 2=0.
F0	Display logged errors. Halt if locked; loop if loop jumper installed
F1	Test system code at segment E000 (v5.x BIOS only); v6 BIOS—copy video ROM BIOS (if present) to shadow RAM if system ROM is absent and switch pack switch 1 is on
F2	INT 19 to boot operating system—No POST errors
F3	Go to setup if F1 key pressed. v6 BIOS: execute floppy diagnostic if Ctrl-D pressed, enable failsafe NMI port 61 bit 2=0, enable parity error port 61 bit 3=0, enable NMI.
F4	v5.x BIOS only—Display speed setting
F4	v6 BIOS—Display speed setting Auto, high, fixed
F5	v5.x BIOS only—initialize counter 2 for speed requested
F6	v5.x BIOS only—Test base memory (long test in 5.2 BIOS)
F6	v6 BIOS only—Test base memory (long test) if F2 pressed
F7	v5.x BIOS only—Test extended memory (long test in 5.2 BIOS)
F7	v6 BIOS only—Long test extended memory if F2 pressed

Olivetti

For EISA and PS/2, the code is issued after the test has passed, so a stuck code indicates the next test failed. Codes are sent to printer ports 3BC (the mono adapter's parallel port), 278, or 378; they will not be printed because no strobe data is sent. AT&Ts using the Olivetti motherboard and BIOS (e.g. the AT&T 6300) do the same.

1076/AT&T 6312/WGS 80286

The first checkpoint, 40, resets and initializes a test monitoring device on the parallel port. When an error occurs, the most recent checkpoint code sent to port 378 is exclusive-ored with 3F to complement the lower 6 bits, and then sent to 378, so if the refresh test fails (45), the POST card will show 7B because the most recent code sent before the failure was 44. If an error occurs, the POST tries to run through a sequence of activities that display a message on the monitor, showing tttt Error: xx, where *tttt* is the name of the failing routine, and *xx* is a suberror number. If the error is fatal, the display will show Unrecoverable power-up error, wait for you to press F1, and return to the failing test. If video has failed, the POST will output beep codes.

Pass	Fail	Meaning
40		Dummy check—reset black box
41	7F	80286 CPU flags and register test
42	7E	Check and verify shutdown code—read keyboard status from port 64. if shutdown bit is set, read the shutdown byte from CMOS RAM (and clear the location there), check it for an illegal shutdown condition, initialize the 8259s unless shutdown is 9 or A, and jump to the correct routine to handle the shutdown: 0= warm boot (go to next test), 1= return to advanced protected mode test, 2= return to memory test above 1 Mb, 3=return to protected mode test 2, 4=INT19, 5=send EOI to 8259 and return to user routine, 9=int15 block move, and A=return to user routine.
43	7D	Checksum test the BIOS ROMs—verify contents add up to 0.
44	7C	Test the 8253 timer—check all 3 timers for not counting, counting too slowly, or counting too fast. Suberror display is the bad timer number 0, 1, or 2.
45	7B	Start memory refresh and verify it occurs every 15.1 microseconds. Init the manufacturing test byte in RAM.
46	7A	Command the 8041 keyboard controller to do a self-test. Suberror display is 1 if error return, 2 if self-test times out.
47	79	Test the first 8K of RAM in 4 passes: 1) write into each word a data value corresponding to the address; 2) invert all bits written; 3) write an odd parity pattern; 4) write zeros. Only pass 4 is done on a warm boot. Beep once when this test passes. Install dummy interrupt vectors, set up the stack and other memory areas. display power-on banner on screen.
48	78	Test 80286 in protected mode 1—pattern test all IDT and GDT registers, verify LIDT, SIDT, LGDT, and SGDT instructions.
49	77	Test CMOS RAM shutdown byte with a pattern, then clear it.
4A	76	Test 80286 in protected mode 2—put CPU into protected mode, check it's there, then return to real mode
4B	75	Test RAM from 8K to 640K (cold boot only)—display progress for each 128K block; write, read, and compare the address and inverted address into each word.
4C	74	Test all RAM above IM—same as below 1 Mb test. Also verify CPU runs properly in protected mode.
4D	73	Test for NMI—installs NMI vector in interrupt table and small service routine. Disables I/O and memory parity errors, then checks for hot NMI.
4E	72	Test for RAM parity—turn NMI parity checking back on, and run a pattern test on the parity checking circuit, monitoring for a parity error.
50	71	Test 8259 interrupt controller 1—pattern test the mask register, install interrupt vectors for IRQs, mask them all off. look for hot interrupt coming through mask, set timer 0 to issue an interrupt, unmask it, count down, and expect the interrupt. Suberror display is l=no in, 2=timer doesn't count, 3=int occurred when masked, 4=bad mask register.
51	6F	Test 8259 interrupt controller 2—same as # 1, but no timer test is done. Suberror display is 5=int occurs wen masked, 6=bad mask register. When the test passes, install the interrupt service routine pointer in the vector table, mask off all interrupts. and display PASS message.
52	6E	Test DMA page register—marching bit test on all page registers.
53	6D	Test 8237 DMA controller 1—pattern test all read/write registers. Initialize each channel into the correct mode for BIOS. Suberror 1 display if failure.
54	6C	Test 8237 DMA controller 2—pattern test all read/write registers. Initialize each channel into the correct mode for BIOS. Suberror 3 display if failure.
55	6B	Test PIC port—write/read pattern test speaker port 61.
56	6A	Test keyboard controller—reset the keyboard and initiate self-test Suberror display is l=bad keyboard self-test

Pass	Fail	Meaning
		completion code. 2=stuck key. 3=no keyboard interrupt Otherwise, display pass message, and set up keyboard id flags and buffer in BIOS RAM area.
57	69	Test CMOS clock/calendar chip—verify accurate time keeping and display pass message.
59	68	Test 80286 advanced protected mode—tests LDT, SDT, LTR, STR, VERR, VERW, LAR, SLR, ARPL instructions; forces exception ints 13 and 5. Suberror display is 3=instruction error, 4=no exception or protection violation. Otherwise display prot mode pass message.
5A	66	Test CMOS RAM battery and display message if low.
5B	65	Test CMOS RAM non-destructively—copy contents to base memory, write/read pattern test CMOS RAM, restore contents. Suberror 2 if failure.
5C	64	Verify CMOS RAM checksum.
5D	63	Test parallel port by writing AA to 3BC, 278 and 378, and set config info in BIOS RAM.
5E	62	Test serial port configuration—read 3FA and 3FA and assume a UART is present if values not FF. Set up port addresses and timeout values in BIOS RAM area.
5F	61	Test configuration of memory below 640K—compare memory size stored in CMOS RAM with result of earlier test. Display message to run setup if different.
60	60	Test configuration of memory above 1M—compare memory size stored in CMOS RAM with result of earlier test. Display message to run setup if different.
61	5F	Test configuration of 80287 math coprocessor chip -verify math chip same as in CMOS RAM info. Display pass or run setup message.
62	5E	Test configuration of game port at 201 and set equipment bit in BIOS RAM data area.
62	5D	Test keylock switch and wait till unlocked.
63	5D	Test hard drive configuration—initialize controller and drive. Display whether drives are present, and message to run setup if not same as CMOS RAM info.
64	5C	Configure floppy drives A and B—initialize controller and drive. Display whether drives are present, and message to run setup if not same as CMOS RAM info.
66	5B	Test option ROMs—look for signature AA5 each 2K beginning at C8000, run checksum and display error if it occurs. Otherwise pass control to the ROM so it can initialize, and display pass message when done.
		INT 19—boot the system.

M20

Not a true IBM clone, as it had a Zilog Z8001 CPU. Also, a typical POST card will not fit in a slot, so you can only monitor codes from the parallel port. The POST shows a triangle, diamond, or 4 lines on the screen to indicate early POST failure, as shown in the table.

Code	Meaning
	Program video controller using load, output, and jump relative instructions (need video).
Triangle	Test Z8001 CPU registers and instructions; infinite loop if failure.
Triangle	Test RAM module; infinite loop if failure; also send msg to printer: E Mc bb ssss wwww. c = RAM configuration # (3 = 1 32K memory card); bb = hex 16K bank # (0,4,5,6,9,A=motherboard; 1,7,B=expansion board 1; 2=expansion board 2; 3,11,12=cxpansion board 3); ssss = what data should be; wwww = what data was (hx).
4 vertical lines	Test CPU call and trap instructions; infinite loop if failure.
Diamond	Initialize screen and printer drivers.
	Program UARTs (serial chips) and 8253 baud rate generator for keyboard at 1200 baud and RS232 at 9600. Now test remaining circuits and send codes to display and printer.
EC0	8255 parallel interface chip test failed
EC1	6845 CRT controller chip test failed
EC2	1797 floppy disk controller chip test failed
EC3	8253 timer chip test failed
EC4	8251 keyboard serial interface chip test failed
EC5	8251 RS232 serial interface chip test failed

Code	Meaning
EC6	8259 interrupt controller chip test failed
EK0	Keyboard did not respond
EK1	Keyboard responded, but self-test failed
ED1	Disk drive 1 test failed
ED0	Disk drive 0 test failed
E10	Non-vectored interrupt error
E11	Vectored interrupt error

M21/M24 (AT&T 6300)

The M24 went to the US as the AT&T 6300. It had an 8086, so was faster than the PC, albeit difficult to work on. POST codes are sent to 378 (LPT1). If a fatal error occurs, it performs more initialization of DMA and interrupt controller circuits, tries to display an error message, complements the lower 6 bits of the POST code, sends the result to port 378, and halts the CPU, so numbers will flicker on the POST display with bit 6 on and the lower bits running from 0 upward. The codes start at 40 because a black box was used to monitor POST status at the parallel port. Bit 6 was set true (to a 1) to alert the box that the POST was starting.

Code	Meaning
40	CPU flags and register test failed (fatal)
41	BIOS ROM checksum test failed (fatal)
42	Disable pdma controller comd and test 8253 timer channel 1, mode 2, refresh counter (fatal); display sub-error code of 1 if interval is below window, 2 if above, and 3 if timer does not reply.
43	8237 DMA controller test failed (fatal)—master clear the controller, set the mask register, read the control registers, test all 8 read/writeable channel registers. Test registers 0-3 DMA address and count with FFFF then 0000.Set up channel 0 for 64K RAM address refresh. Set up memory-to-I/O transfer, unmask the RAM refresh, and let refresh begin for the first time. Set up the 8253 for proper refresh count. Test for unexpected DMA request (suberror 3), and init DMA channel 1 (not used), 2 (floppy), 3 (display), and init nibble latches. Check for proper DMA transfer into lowest 64K bank of RAM (suberror 4 if parity error).
44	8259 PIC test failed (halt)—init stack to lower 64K RAM area just tested, init and disable 8259A, set up interrupt vectors in RAM, set up software then hardware diagnostic interrupt vectors, test software interrupts, then hardware interrupts. Disable interrupts via 8259 mask register, check for hot interrupts, convert hot mask to IRQ number, save any error code, install interrupt vectors, initialize video, and display error messages (H:#, where # is the hot IRQ#).
45	Install real interrupt vectors, determine system configuration from switches, and initialize video mono and colour. Set video mode 3, clear the screen, and display any passing error messages for CPU, ROM, DMA, or interrupt controller. Size and clear RAM at every 64K bank past the lowest 64K, displaying the tested RAM as test progresses. Display errors in form cc:y000:zzz:wwww:rrrr, where cc is the config number, y the failing segment, z the offset, w the written data and r the read data. Test MM58174 clock calendar, and display message if fails Test 8253 real time clock count capability, and tone generator. Display errors, halt if failure.
48	Send beep to display and initialize all basic hardware. Init 8041 keyboard controller, determine parallel port configurations and test their registers, determine serial 8250 and Z8530 configurations, check for game card, set up interrupt controller, set all 4 Z8530 serial controllers to 9600 baud, no parity, 1 stop and 8 data. Set up interrupt vectors, initialize RAM variables, clear the screen, initialize the hard disk controller, test for and initialize option ROMs, verify ROM checksums okay, initialize floppy disk controller, allow user to select alternate Z8000 processor if installed and perform INT 19 cold boot.

EISA 2.01

Port 278, 378, Or 3BC (i.e. printer ports).

Code	Meaning
01	Test CPU flags, registers. Initialize interrupt controller
02	Test memory refresh

Code	Meaning
03	Test CMOS RTC periodic interrupt
04	Test gate A20 line
05	Test mapping memory SRAM
06	Test first 128K RAM. Stack has now been established
07	Test for console presence and initialize
08	Verify system BIOS ROM checksum
09	Test 8042 keyboard controller Normal burn-in/manufacturing mode established
0A	Test timer ratio
0B	Test CMOS RAM battery
0C	Verify CMOS RAM checksum
0D	Test for unexpected NMI
0E	Test interrupt controller #1
0F	Test interrupt controller #2
10	Test timer 1 counter 0
11	Test system control port B
12	Test system control port A
13	Verify checksum of NVRAM configuration memory
14	Initialize system board
15	Initialize adapter
16	Initialize ESC SCSI adapter
17	Initialize system video
18	Test and copy shadow RAM. Video is initialized—display banner and non-fatal errors
19	Test DMA page registers
1A	Test DMA address registers
1B	Test DMA count registers
1C	Test DMA mask registers
1D	Test DMA stop registers. Initialize DMA controllers
1E	Test IDTR and GDTR
1F	Test CMOS shutdown byte
20	Test real/protected mode
21	Check system memory configuration
22	Size memory
23	Test 640K base memory
24	Verify base memory configuration
25	Test extended memory (above 1 Mb)
26	Verify extended memory configuration
27	Check for contiguous extended memory
28	Test cache memory. Extended BIOS data area created and POST errors logged
29	Test protected mode instructions
2A	Test CMOS RAM
2B	Test real time clock
2C	Check calendar values
2D	Test keyboard/AUX device fuse
2E	Test keyboard
2F	Initialize keyboard typematic rate and delay
30	Test auxiliary device
31	Test 80x87 math coprocessor
32	Test and initialize Weitek math coprocessor
33	Run 1860 CPU basic and advanced diagnostics
34	Test and configure serial ports

Code	Meaning
35	Test and configure parallel ports
36	Detect game port
37	Test and initialize hard drives
38	Test and initialize floppy drives
39	Scan for and pass control to adapter ROMs
3A	INT 19 boot—load operating system

PS/2 Compatible

Code	Meaning
01	Processor test
02	Shutdown
03	Interrupt controller initialisation
04	Refresh test
05	CMOS periodic interrupt test
06	Timer ratio
07	Test first 64k RAM
08	Test the KBC (8742)
09	NMI test
0A	8254 test
0B	Port 94h test
0C	Port 103h test
0D	Port 102h test
0E	Port 96h test
0F	Port 107h test
10	Blank the screen
11	KB/Aux device fuse check
12	CMOS battery test
13	CMOS RAM checksum test
14	Extended CMOS checksum 0-8K
15	System board and adapter initialisation
16	RAM test and initialisation
17	Protected mode register test
18	CMOS RAM shutdown byte test
19	80286 protected mode test
1A	Video option ROM scan
1B	EPROM checksum test
1C	Interrupt controller #1 test
1D	Interrupt controller #2 test
1E	Interrupt vector initialisation
1F	CMOS RAM test
20	Extended CMOS r/w test
21	CMOS clock test
22	Clock calendar test
23	Dummy checkpoint
24	Watchdog timer test
25	Test RAM from 64K to 640K
26	Configure memory 640K
27	Text expansion memory
28	Initialize extended BIOS data segment and log POST errors

Code	Meaning
29	Configure memory above 1 Mb
2A	Dummy checkpoint
2B	Test RAM parity
2C	Test DMA page registers
2D	Test DMA controller base/current address registers
2E	Test DMA transfer count register
2F	Initialize DMA controller
30	Test PIO 61
31	Test keyboard
32	Initialize keyboard typematic rate and delay
33	Test AUX device
34	Test advanced protected mode
35	Configure parallel ports
36	Configure 8250 serial ports
37	Configure coprocessor
38	Configure game card
39	Configure and initialize hard disk
3A	Floppy disk configuration
3B	Initialize ROM drivers
3C	Display total memory and hard drives
3D	Final initialization, Checkpoints complete
3E	Detect and initialize parallel ports
3F	Initialize hard drive and controller
40	Detect and initialize math coprocessor
41	Reserved
42	Initiate adapter ROM scan
CC	Unexpected processor exception occurred
DD	Save DDNIL status
EE	NMI handler shutdown
FF	INT 19 boot

Packard Bell

See *Phoenix*.

Philips/Magnavox/Headstart

Philips, Magnavox, and HeadStart use motherboards designed by Philips Home Electronics in Montreal. Most use a Philips-designed BIOS, although at least one of their portables uses one from Award Software. The beep pattern consists of a series of long and short beeps that correspond to the binary representation of the POST code where leading zeroes are omitted; a zero means a short and a one means a long beep. The various Philips platforms do not all execute the same POST tests.

Philips Platform Cross Reference

Platform	CPU	System Model/Name
Avenger	80286	Magnavox MaxStation 286, Magnum GL; Headstart Series 300
P3212	80286	Magnavox MaxStation 480, Headstart System 380

Platform	CPU	System Model/Name
P 3239	80286 80386SX	Magnavox Headstart/Maxstation/Magnum/Professional 1200, 48CD, 1600, 64CD, P160, SR16CD
P 3349	80386SX-20	Magnavox Headstart/Maxstation/Magnum/Professional SX20, 80CD
P3345	80386SX	Magnavox Maxstation 386SX, Magnum SX; Headstart Series 500
P33711	80386DX	Headstart/Maxstation/Magnum/Professional 3300

Code	Beeps 0=sh 1=lg	Meanings (Port 80)
0A	1010	DMA page register write/read bad
10	1 0000	CMOS RAM read/write error (only after hard reset)
11	1 0001	System ROM BIOS checksum error
12	1 0010	Timer A error
13	1 0011	DMA controller A error
14	1 0100	DMA controller B error
15	1 0101	Memory refresh error
16	1 0110	Keyboard controller error
17	1 0111	Keyboard controller error
19	1 1001	Keyboard controller error
1C	1 1100	Base 64K RAM error
1D	1 1101	Base 64K RAM parity error
1F	1 1111	Orvonton LSI sync missing
21	10 0001	PVAM register error
25	10 0101	System options error
2B	10 1011	Video sync error (incorrect switch setting or CMOS RAM—run SETUP)
2C	10 1100	Video BIOS ROM error
2D	10 1101	Monochrome/colour configuration error
2E	10 1110	No video memory
35	11 0101	Interrupt controller error
36	11 0110	Byte swapper error
37	11 0111	NMI error
38	11 1000	Timer interrupt
39	11 1001	LSI timer halted
3A	11 1010	Main memory test error
3B	11 1011	Keyboard error
3C	11 1100	Keyboard interrupt error (only after hard reset)
3D	11 1101	DDNIL scan halted, cache disabled
40	100 0000	Diskette error
48	100 1000	Adapter card error
4c	100 1100	CMOS battery/checksum error (run SETUP)
4D	100 1101	System options error (run Setup)
52	101 0010	Keyboard controller error
6A	110 1010	Failure shadowing BIOS ROM
70	111 0000	Memory size configuration error (run SETUP)

Phoenix

Created the first clone of IBM's BIOS. On 4.3 and above, the system will attempt to generate a code with four groups of beeps, with 1-4 per group. The micro channel version sends codes to port 680, with an execution sequence of: 01, 03, 41, 02, 42, 05, 06, 08, 04, 09—22, 23, 25, 27, 28, 29, 2E, 2B, 2C, 2D, 30, 31, 32, 61, 62, 34, 35, 3A, 38, 3B.

Architecture	Typical Computer	POST Port
ISA	XT	60
	AT	80
	PS/2 25/30	90
EISA	Intel chipset	80
MCA	PS/2 50 up	68O

POST Procedures

Procedure	Meaning
CPU	Check internal operations e.g. ALE/IRQ status; Request; ALU and Memory Read/Write.
CMOS RAM	Test with walking-bit pattern.
ROM BIOS	Perform checksum on ROM BIOS where all bits are added and compared to a factory-set total.
PIT	Check to ensure interrupt requests are properly executed.
DMA	Check DMA from CPU to memory without BIOS. Also check page registers.
Base 64K	Check first 64K block.
Serial and Parallel	I/O data areas for any devices found are assigned; they are not tested.
PIC	Check that proper interrupt request levels are addressed.
Keyboard Controller	Check 8240 for proper operationluding scan code response and Gate A20 which allows CPU operation in protected mode.
CMOS	Check data within CMOS and compare to BIOS information. Failure of the extended area is often due to wrong data setup. Constant failure after resetting CMOS is either battery CMOS chip or RTC.
Video Controller	Test and initialise controller and ROM on the video adapter.
RTC	Check to ensure proper frequencies are on proper lines for the Video Colour CPU and DMA Frequency. Check RTC/PIT or system crystal.
CPU	Return From Protected Mode. CPU is put into protected mode and returns to the POST at the point indicated by the CMOS ROM data area byte 0F. Failure here is normally due to the CPU/keyboard controller/CMOS chip or an address line.
PIC	Test Counter 2.
NMI	Check the Non-Maskable Interrupt request vector for active status. Failure is normally due to the CMOS but could also be the BIOS IRQ or CPU chips.
Keyboard	Check for NumLock/Caps and Shift Keys.
Mouse	Initialise through the keyboard controller; this is only done if a mouse is present and it is initialised in this way.
RAM above 64K	Test in 64K blocks with a walking-bit pattern and parity enabled.
Fixed/Floppy Controllers	Test for proper response to BIOS calls.
Shadow RAM Areas	Look in CMOS for settings on which adapter or system ROMs are to be shadowed.
Option ROM	Look for ROM signatures of 55AA in extended memory then initialise the ROM and halt testing while internal checks are carried out.
External Cache	Check controller chip for external cache.
CPU Internal Cache	
Hardware Adapters	Initialise and test video/floppy/hard I/O adapters/serial and parallel.
Cassette	Test internal or external cassette drives.
Boot Code Errors	Errors occurring after this point are normally a corrupt boot record.

2.52 BNP XT

Code	Meaning
01	Test 8253 timer
02	First 64K RAM failed
03	First 1K parity check failed

Code	Meaning
04	Initialize 8259 interrupt controller
05	Second 1K RAM test (BIOS data area) failed

BIOS Plus or v1.0 POST/Beep Codes

Only for BIOS PLUS or A286/A386/A486 Version 1.xx on an AT-class (80286 or higher) systems. Codes in the 50h range or beyond are chipset or custom platform specific, and will vary from system to system.

Code	Beeps	Meaning
01	none	CPU register test in progress.
02	1-1-3	CMOS write/read failure.
03	1-1-4	ROM BIOS Checksum Failure.
04	1-2-1	Programmable interval timer failure.
05	1-2-2	DMA Initialisation failure.
06	1-2-3	DMA page register write/read failure.
08	1-3-1	RAM refresh verification failure.
09	none	1st 64K RAM test in progress.
0A	1-3-3	1st 64K RAM chip or data line failure multi-bit.
0B	1-3-4	1st RAM odd/even logic failure.
0C	1-4-1	Address line failure 1st 64K RAM.
0D	1-4-2	Parity failure 1st 64K RAM.
10	2-1-1	Bit 0 1st 64K RAM failure.
11	2-1-2	Bit 1 1st 64K RAM failure.
12	2-1-3	Bit 2 1st 64K RAM failure.
13	2-1-4	Bit 3 1st 64K RAM failure.
14	2-2-1	Bit 4 1st 64K RAM failure.
15	2-2-2	Bit 5 1st 64K RAM failure.
16	2-2-3	Bit 6 1st 64K RAM failure.
17	2-2-4	Bit 7 1st 64K RAM failure.
18	2-3-1	Bit 8 1st 64K RAM failure.
19	2-3-2	Bit 9 1st 64K RAM failure.
1A	2-3-3	Bit A(10) 1st 64K RAM failure.
1B	2-3-2	Bit B(11) 1st 64K RAM failure.
1C	2-4-2	Bit C(12) 1st 64K RAM failure.
1D	2-4-2	Bit D(13) 1st 64K RAM failure.
1E	2-4-3	Bit E(14) 1st 64K RAM failure.
1F	2-4-4	Bit F(15) 1st 64K RAM failure.
20	3-1-1	Slave DMA register failure.
21	3-1-2	Master DMA register failure.
22	3-1-3	Master interrupt mask register failure.
23	3-1-4	Slave interrupt mask register failure.
25	none	Interrupt vector loading in progress.
27	3-2-4	8042 keyboard controller test failure.
28	none	CMOS power failure/checksum calculation in progress.
29	none	CMOS configuration validation in progress.
2B	3-3-4	Screen memory test failure.
2C	3-4-1	Screen initialisation failure.
2D	3-4-2	Screen retrace test failure.
2E	none	Search for video ROM in progress.

Code	Beeps	Meaning
30	none	Screen believed running with video ROM.
31	none	Mono monitor believed operable.
32	none	Colour monitor (40 col) believed operable.
33	none	Colour monitor (80 col) believed operable.
34	4-2-1	Timer tick interrupt test in progress or failed (non-fatal).
35	4-2-2	Shutdown failure (non-fatal).
36	4-2-3	Gate A20 failure (non-fatal).
37	4-2-4	Unexpected interrupt in protected mode (non-fatal).
38	4-3-1	Mem high address line fail at 01000-0A000 (non-fatal).
39	4-3-2	Mem high addr line fail at 100000-FFFFFF (non-fatal).
3A	4-3-3	Timer chip counter 2 failed (non-fatal).
3B	4-3-4	Time-of-day clock stopped
3C	4-4-1	Serial port test
3D	4-4-2	Parallel port test
3E	4-4-3	Maths coprocessor test
41	low 1-1-2	System board select bad
42	low 1-1-3	Extended CMOS RAM bad

UMC Chipset PCI

Code	Beep	Meaning
02	1-1-1-3	Verify Real Mode
04	1-1-2-1	Get CPU type
06	1-1-2-3	Initialise system hardware
08	1-1-3-1	Initialise chipset registers with initial POST values
09	1-1-3-2	Set in POST flag
0A	1-1-3-3	Initialise CPU registers
0C	1-1-4-1	Initialise cache to initial POST values
0E	1-1-4-3	Initialise I/O
10	1-2-1-1	Initialise power management
11	1-2-1-2	load alternate registers with initial POST values
12	1-2-1-3	Jump to User Patch 0
14	1-2-2-1	Initialise keyboard controller
16	1-2-2-3	BIOS ROM checksum
18	1-2-3-1	8254 timer initialisation
1A	1-2-3-3	8237 DMA controller initialisation
1C	1-2-4-1	Reset PIC
20	1-3-1-1	Test DRAM refresh
22	1-3-1-3	Test 8742 keyboard controller
24	1-3-2-1	Set ES segment register to 4 Gb
26	1-3-2-3	Enable Address Line A20
28	1-3-3-1	Autosize DRAM
2A	1-3-3-3	Clear 512K base RAM
2C	1-3-4-1	Test 512K base address lines
2E	1-3-4-3	Test 512K base memory
30	1-4-1-1	Test base address memory
32	1-4-1-3	Test CPU bus clock frequency
34	1-4-2-1	Test CMOS RAM
35	1-4-2-2	Test chipset register initialise
36	1-4-2-3	Test check resume

Code	Beep	Meaning
37	1-4-2-4	Reinitialise the chipset
38	1-4-3-1	Shadow System BIOS ROM
39	1-4-3-2	Reinitialise the cache
3A	1-4-3-3	Autosize the cache
3C	1-4-4-1	Configure advanced chipset registers
3D	1-4-4-2	Load alternate registers with CMOS values
3E	1-4-4-3	Read hardware configuration from keyboard controller
40	2-1-1-1	Set initial CPU speed
42	2-1-1-3	Initialise interrupt vectors
44	2-1-2-1	Initialise BIOS interrupts
46	2-1-2-3	Check ROM copyright notice
47	2-1-3-1	Initialise manager for PCI option ROMs
48	2-1-2-4	Check video configuration against CMOS
49	2-1-3-2	Initialise PCI bus and devices
4A	2-1-3-3	Initialise all video adapters
4C	2-1-4-1	Shadow video BIOS ROM
4E	2-1-4-3	Display copyright notice
50	2-2-1-1	Display CPU type and speed
52	2-2-1-3	Test keyboard
54	2-2-2-1	Set key click if enabled
56	2-2-2-3	Enable keyboard
58	2-2-3-1	Test for unexpected interrupts
5A	2-2-3-3	Display prompt Press F2 to Enter Setup
5C	2-2-4-1	Test RAM between 512 and 640K
5E	2-2-4-3	Test base memory
60	2-3-1-1	Test expanded memory
62	2-3-1-3	Test extended memory address lines
64	2-3-2-1	Jump to User Patch 1
66	2-3-2-3	Configure advanced cache registers
68	2-3-3-1	Enable external and CPU caches
69	2-3-3-2	Set up power management
6A	2-3-3-3	Display external cache size
6C	2-3-4-1	Display shadow message
6E	2-3-4-3	Display non-disposable segments
70	2-4-1-1	Display error messages
72	2-4-1-3	Check for configuration errors
74	2-4-2-1	Test RTC
76	2-4-2-3	Check for keyboard errors
7A	2-4-3-3	Enable keylock
7C	2-4-4-1	Set up hardware interrupt vectors
7E	2-4-4-3	Test coprocessor if present
80	3-1-1-1	Disable onboard I/O ports
82	3-1-1-3	Detect and install external RS232 ports
84	3-1-2-1	Detect and install external parallel ports
86	3-1-2-3	Reinitialise onboard I/O ports
88	3-1-3-1	Initialise BIOS data area
8A	3-1-3-3	Initialise extended BIOS data area
8C	3-1-4-1	Initialise floppy controller
8E	3-1-4-3	Hard disk autotype configuration
90	3-2-1-1	Initialise hard disk controller

Code	Beep	Meaning
91	3-2-1-2	Initialise local bus hard disk controller
92	3-2-1-3	Jump to User Patch 2
94	3-2-2-1	Disable A20 address line
96	3-2-2-3	Clear huge ES segment register
98	3-2-3-1	Search for option ROMs
9A	3-2-3-3	Shadow option ROMs
9C	3-2-4-1	Set up Power Management
9E	3-2-4-3	Enable hardware interrupts
A0	3-3-1-1	Set time of day
A2	3-3-1-3	Check key lock
A4	3-3-2-1	Initialise typematic rate
A8	3-3-3-1	Erase F2 prompt
AA	3-3-3-3	Scan for F2 key stroke
AC	3-3-4-1	Enter Setup
AE	3-3-4-3	Clear in-POST flag
B0	3-4-1-1	Check for errors
B2	3-4-1-3	POST done
B4	3-4-2-1	One beep
B6	3-4-2-3	Check password (optional)
B8	3-4-3-1	Clear global descriptor table
BC	3-4-4-1	Clear parity checkers
BE	3-4-4-3	Clear screen (optional)
BF	3-4-4-4	Check virus and backup reminders
C0	4-1-1-1	Try to boot with INT 19
D0	4-2-1-1	Interrupt handler error
D2	4-2-1-3	Unknown interrupt error
D4	4-2-2-1	Pending interrupt error
D6	4-2-2-3	Initialise option ROM error
D8	4-2-3-1	Shutdown error
DA	4-2-3-3	Extended Block Move
DC	4-2-4-1	Shutdown 10 error

These are for boot block in Flash ROM:

Flash BIOS Integrity Test

Code	Beep	Meaning
E2	4-3-1-3	Initialise the chipset
E3	4-3-1-4	Check for Forced Flash
E4	4-3-2-1	
E5	4-3-2-2	Check HW status of ROM
E6	4-3-2-3	BIOS ROM is OK
E7	4-3-2-4	Do a complete RAM test

Flash Recovery

Code	Beep	Meaning
E8	4-3-3-1	Do OEM initialisation
E9	4-3-3-2	Initialise interrupt controller
EA	4-3-3-3	Read in the bootstrap code
EB	4-3-3-4	Initialise all vectors

Code	Beep	Meaning
EC	4-3-4-1	Boot the flash program
ED	4-3-4-2	Initialise the boot device
EE	4-3-4-3	Boot code was read OK.

PCI

Code	Meaning
02	If the CPU is in protected mode turn on A20 and pulse the reset line; forcing a shutdown 0.
04	On a cold boot save the CPU type information value in the CMOS.
06	Reset DMA controllers. Disable videos. Clear pending interrupts from RTC. Setup port B register.
08	Initialise chipset control registers to power on defaults.
0A	Set a bit in the CMOS that indicates POST; used to determine if the current configuration causes the BIOS to hang. If so default values will be used on next POST.
0C	Initialise I/O module control registers.
0E	External CPU caches are initialised. Cache registers are set to default.
10/12/14	Verify response of 8742.
16	Verify BIOS ROM checksums to zero.
18	Initialise all three of 8254 timers.
1A	Initialise DMA command register. Initialise 8 DMA channels.
1C	Initialise 8259 interrupt controller to :ICW4 needed; Cascade and edge-triggered mode.
20	Test DRAM refresh by polling refresh bit in PORTB.
22	Test 8742 keyboard controller. Send self test command to 8742 and await results. Also read the switch inputs from the 8742 and write the keyboard controller command byte.
24	Set ES segment register to 4 Gb
26	Enable Address Line A20
28	Autosize DRAM
2A	Clear first 64K of RAM
2C	Test RAM address lines
2E	Test first 64K bank of memory consisting of a chip address line test and a RAM test.
30/32	Find true MHz value
34	Clear CMOS diagnostic byte (register E). Check RTC and verify battery has not lost power. Checksum the CMOS and verify it has not been corrupted.
36/38/3A	External cache is autosized and its configuration saved for enabling later in POST.
3C	Configure advanced cache features. Configure external cache's configurable parameters.
3E	Read hardware configuration from keyboard controller
40	Set system power-on speed to the rate determined by the CMOS. If the CMOS is invalid use a conservative speed.
42	Initialise interrupt vectors 0-77h to the BIOS general interrupt handler.
44	Initialise interrupt vectors 0-20h to proper values from the BIOS interrupt table.
46	Check copyright message checksum.
48	Check video configuration.
4A	Initialise both monochrome and colour graphics video adapters.
4C/4E	Display Copyright message.
50	Display CPU type and speed
52	Test for the self-test code if a cold start. When powered the keyboard performs a self-test and sends an AA if successful.
54	Initialise keystroke clicker during POST.
56	Enable keyboard
58	Test for unexpected interrupts. First do an STI for hot interrupts; secondly test NMI for unexpected interrupt. Thirdly enable parity checkers and read from memory checking for unexpected interrupt.
5A	Display prompt Press F2 to Enter Setup
5C	Determine and test the amount of memory available. Save the total memory size in the BIOS variable called bdaMemorySize.

Code	Meaning
5E	Perform address test on base memory. The following address lines are tested based on the memory size.
60	Determine and test the amount of extended memory available. Save the total extended memory size in the CMOS at CMOSExtended.
62	Perform an address line test on A0 to the amount of memory available. This test is dependent on the processor since the test will vary depending on the width of memory (16 or 32 bits). This test will also use A20 as the skew address to prevent corruption of the system memory.
68	External and CPU caches if present are enabled. Non-cacheable regions are configured if necessary.
6A	Display cache size on screen if non-zero.
6C	Display BIOS shadow status.
6E	Display the starting offset of the non-disposable section of the BIOS.
70	Check flags in CMOS and in the BIOS data area to see if any errors have been detected during POST. If so, display error messages on the screen.
72	Check status bits for configuration errors. If so display error messages on the screen.
74	Test RTC if the battery has not lost power. If the RTC is not running or the battery has lost powerset the incorrect time bit in register E of the CMOS.
76	Check status bits for keyboard errors. If so display error messages on the screen.
78	Check for stuck keys on the keyboard. If so display error messages on the screen.
7A	Enable keylock
7C	Set up hardware interrupt vectors
7E	Test coprocessor if present
80-82	Detect and install RS232 ports
84	Detect and install parallel ports
86-88	Initialise timeouts/key buffer/soft reset flag.
8A	Initialise extended BIOS data area and initialise the mouse.
8C	Initialise both floppy disks and display an error message if failure was detected. Both drives are checked so the appropriate diskette types are established in the BIOS data area.
8E	Hard disk autotype configuration
90	If the CMOS RAM is valid and intact and fixed disks are defined call the fixed disk init routine to initialise the fixed disk system and take over the appropriate interrupt vectors.
92-94	Disable A20 address line
96-98-	Scan for ROM BIOS extensions.
9E	Enable hardware interrupts
A0	Set time of day
A2	Set up NumLock indicator. Display a message if key switch is locked.
A4	Initialise typematic rate.
A6	Initialise hard disk autoparking.
A8	Erase F2 prompt.
AA	Scan for F2 key strokes.
AC	Check to see if SETUP should be executed.
AE	Clear ConfigFailedBit and InPostBit in CMOS.
B0	Check for POST errors
B2	Set/clear status bits to reflect POST complete.
B4	One beep.
B6	Check for password before boot.
B8	Clear global descriptor table (GDT).
BA	Initialise the screen saver.
BC	Clear parity error latch.
BE	Clear screen.
C0	Try to boot with INT 19
D0-D2	If an interrupt occurs before interrupt vectors have been initialised this interrupt handler will try to see if the interrupt caused was an 8259 interrupt and which one. If unknown, InterruptFlag will be FF. Otherwise it will contain the IRQ number that

Code	Meaning
	occurred
D4	Clear pending timer, kbd interrupts, transfer control to double word address at RomCheck.
D6-D8-DA	Return from extended block move.

Phoenix v3.07

see Quadtel.

ISA/EISA/MCA BIOS POST/Beep Codes (fatal)

Msg	Beeps	Meaning
01	none	CPU register test in progress.
02	1-1-3	CMOS write/read failure.
03	1-1-4	ROM BIOS Checksum Failure.
04	1-2-1	Programmable interval timer failure.
05	1-2-2	DMA Initialisation failure.
06	1-2-3	DMA page register write/read failure.
08	1-3-1	RAM refresh verification failure.
09	none	1st 64K RAM test in progress.
0A	1-3-3	1st 64K RAM chip or data line failure multi-bit.
0B	1-3-4	1st RAM odd/even logic failure.
0C	1-4-1	Address line failure 1st 64K RAM.
0D	1-4-2	Parity failure 1st 64K RAM.
0E	1-4-3	Fail-safe timer failure.
0F	1-4-4	Software NMI port failure.
10	2-1-1	Bit 0 1st 64K RAM failure.
11	2-1-2	Bit 1 1st 64K RAM failure.
12	2-1-3	Bit 2 1st 64K RAM failure.
13	2-1-4	Bit 3 1st 64K RAM failure.
14	2-2-1	Bit 4 1st 64K RAM failure.
15	2-2-2	Bit 5 1st 64K RAM failure.
16	2-2-3	Bit 6 1st 64K RAM failure.
17	2-2-4	Bit 7 1st 64K RAM failure.
18	2-3-1	Bit 8 1st 64K RAM failure.
19	2-3-2	Bit 9 1st 64K RAM failure.
1A	2-3-3	Bit A 1st 64K RAM failure.
1B	2-3-2	Bit B 1st 64K RAM failure.
1C	2-4-2	Bit C 1st 64K RAM failure.
1D	2-4-2	Bit D 1st 64K RAM failure.
1E	2-4-3	Bit E 1st 64K RAM failure.
1F	2-4-4	Bit F 1st 64K RAM failure.
20	3-1-1	Slave DMA register failure.
21	3-1-2	Master DMA register failure.
22	3-1-3	Master interrupt mask register failure.
23	3-1-4	Slave interrupt mask register failure.
25	none	Interrupt vector loading in progress.
27	3-2-4	Keyboard controller test failure.
28	none	CMOS pwr failure; checksum calculation in progress.
29	none	CMOS RAM configuration validation in progress.
2B	3-3-4	Screen memory test failure.
2C	3-4-1	Screen initialisation failure.

Msg	Beeps	Meaning
2D	3-4-2	Screen retrace test failure.
2E	none	Search for video ROM in progress.
30	none	Screen believed running with video ROM.
31	none	Mono monitor believed operable.
32	none	Colour monitor (40 col) believed operable.
33	none	Colour monitor (80 col) believed operable.

ISA/EISA/MCA BIOS POST/Beep Codes (non-fatal)

Non-fatal if manufacturing jumper is on.

Msg	Beeps	Meaning
34	4-2-1	No time tick.
35	4-2-2	Shutdown test in progress or failure.
36	4-2-3	Gate A20 failure.
37	4-2-4	Unexpected interrupt in protected mode.
38	4-3-1	Memory high address line failure at 01000-0A000. Also RAM test in progress or address failure >FFFH.
39	4-3-2	Memory high address line failure at 100000-FFFFFF.
3A	4-3-3	Interval Timer channel 2 test or failure.
3B	4-3-4	Time-of-day clock test or failure.
3C	4-4-1	Serial port test or failure.
3D	4-4-2	Parallel port test or failure.
3E	4-4-3	Maths coprocessor test
3F		Cache test (Dell)
41	low 1-1-2	System board select bad (Micro Channel only)
42	low 1-1-3	Extended CMOS RAM bad (Micro Channel only)

Phoenix v4.0

Beeps	Code	Meaning
1-1-1-3	02	Verify Real Mode
1-1-2-1	04	Get CPU type
1-1-2-3	06	Initialize system hardware
1-1-3-1	08	Initialize chipset registers with initial POST values
1-1-3-2	09	Set in POST flag
1-1-3-3	0A	Initialize CPU registers
1-1-4-1	0C	Initialize cache to initial POST values
1-1-4-3	0E	Initialize I/O
1-2-1-1	10	Initialize Power Management
1-2-1-2	11	Load alternate registers with initial POST values
1-2-1-3	12	Jump to UserPatch0
1-2-2-1	14	Initialize keyboard controller
1-2-2-3	16	BIOS ROM checksum
1-2-3-1	18	8254 timer initialization
1-2-3-3	1A	8237 DMA controller initialization
1-2-4-1	1C	Reset Programmable Interrupt Controller
1-3-1-1	20	Test DRAM refresh
1-3-1-3	22	Test 8742 Keyboard Controller
1-3-2-1	24	Set ES segment to register to 4 GB
1-3-3-1	28	Autosize DRAM
1-3-3-3	2A	Clear 512K base RAM
1-3-4-1	2C	Test 512 base address lines

Beeps	Code	Meaning
1-3-4-3	2E	Test 512K base memory
1-4-1-3	32	Test CPU bus-clock frequency
1-4-2-1	34	CMOS RAM read/write failure (check ISA card seating)
1-4-2-4	37	Reinitialize the chipset
1-4-3-1	38	Shadow system BIOS ROM
1-4-3-2	39	Reinitialize the cache
1-4-3-3	3A	Autosize cache
1-4-4-1	3C	Configure advanced chipset registers
1-4-4-2	3D	Load alternate registers with CMOS values
2-1-1-1	40	Set Initial CPU speed
2-1-1-3	42	Initialize interrupt vectors
2-1-2-1	44	Initialize BIOS interrupts
2-1-2-3	46	Check ROM copyright notice
2-1-2-4	47	Initialize manager for PCI Options ROMs
2-1-3-1	48	Check video configuration against CMOS
2-1-3-2	49	Initialize PCI bus and devices
2-1-3-3	4A	Initialize all video adapters in system
2-1-4-1	4C	Shadow video BIOS ROM
2-1-4-3	4E	Display copyright notice
2-2-1-1	50	Display CPU type and speed
2-2-1-3	52	Test keyboard
2-2-2-1	54	Set key click if enabled
2-2-2-3	56	Enable keyboard
2-2-3-1	58	Test for unexpected interrupts
2-2-3-3	5A	Display prompt Press F2 to enter SETUP
2-2-4-1	5C	Test RAM between 512 and 640k
2-3-1-1	60	Test expanded memory
2-3-1-3	62	Test extended memory address lines
2-3-2-1	64	Jump to UserPatch1
2-3-2-3	66	Configure advanced cache registers
2-3-3-1	68	Enable external and CPU caches
2-3-3-2	69	Initialise SMI handler
2-3-3-3	6A	Display external cache size
2-3-4-1	6C	Display shadow message
2-3-4-3	6E	Display non-disposable segments
2-4-1-1	70	Display error messages
2-4-1-3	72	Check for configuration errors
2-4-2-1	74	Test real-time clock
2-4-2-3	76	Check for keyboard errors
2-4-4-1	7C	Set up hardware interrupts vectors
2-4-4-3	7E	Test coprocessor if present
3-1-1-1	80	Disable onboard I/O ports
3-1-1-3	82	Detect and install external RS232 ports
3-1-2-1	84	Detect and install external parallel ports
3-1-2-3	86	Re-initialize onboard I/O ports
3-1-3-1	88	Initialize BIOS Data Area
3-1-3-3	8A	Initialize Extended BIOS Data Area
3-1-4-1	8C	Initialize floppy controller
3-2-1-1	90	Initialize hard-disk controller
3-2-1-2	91	Initialize local-bus hard-disk controller

Beeps	Code	Meaning
3-2-1-3	92	Jump to UserPatch2
3-2-2-1	94	Disable A20 address line
3-2-2-3	96	Clear huge ES segment
3-2-3-1	98	Search for option ROMs
3-2-3-3	9A	Shadow option ROMs
3-2-4-1	9C	Set up Power Management
3-2-4-3	9E	Enable hardware interrupts
3-3-1-1	A0	Set time of day
3-3-1-3	A2	Check key lock
3-3-3-1	A8	Erase F2 prompt
3-3-3-3	AA	Scan for F2 key stroke
3-3-4-1	AC	Enter SETUP
3-3-4-3	AE	Clear in-POST flag
3-4-1-1	B0	Check for errors
3-4-1-3	B2	POST done--prepare to boot operating system
3-4-2-1	B4	One beep
3-4-2-3	B6	Check password (optional)
3-4-3-1	B8	Clear global descriptor table
3-4-4-1	BC	Clear parity checkers
3-4-4-3	BE	Clear screen (optional)
3-4-4-4	BF	Check virus and backup reminders
4-1-1-1	C0	Try to boot with INT 19
4-2-1-1	D0	Interrupt handler error
4-2-1-3	D2	Unknown interrupt error
4-2-2-1	D4	Pending interrupt error
4-2-2-3	D6	Initialize option ROM error
4-2-3-1	D8	Shutdown error
4-2-3-3	DA	Extended Block Move
4-2-4-1	DC	Shutdown 10 error
4-2-4-3	DE	Keyboard controller failure (RAM or cache)
Flash BIOS Integrity Test		
4-3-1-3	E2	Initialize the chipset
4-3-1-4	E3	Initialize refresh counter
4-3-2-1	E4	Check for Forced Flash
4-3-2-2	E5	Check HW status of ROM
4-3-2-3	E6	BIOS ROM is OK
4-3-2-4	E7	Do a complete RAM test
Flash recovery		
4-3-3-1	E8	Do OEM initialization
4-3-3-2	E9	Initialize interrupt controller
4-3-3-3	EA	Read in bootstrap code
4-3-3-4	EB	Initialize all vectors
4-3-4-1	EC	Boot the Flash program
4-3-4-2	ED	Initialize the boot device
4-3-4-3	EE	Boot code was read OK

Quadtel

v3.07 AT BIOS (Phoenix 3.07)

Code	Meaning
02	Flag test
04	Register test
06	System hardware initialisation
08	Initialise chipset registers
0A	BIOS ROM checksum
0C	DMA page register test
0E	8254 timer test
10	8254 timer initialisation
12	8237 DMA controller test
14	8237 DMA initialisation
16	Initialise 8259/reset coprocessor
18	8259 interrupt controller test
1A	Memory refresh test
1C	Base 64K address test
1E	Base 64K memory test
20	Base 64K test (upper 16 bits) for 386 systems
22	8742 keyboard self test
24	MC 146818 CMOS test
26	Start first protected mode test
28	Memory sizing test
2A	Autosize memory chips
2C	Chip interleave enable test
2E	First protected mode test exit
30	Unexpected shutdown
31	DDNIL bit scan failure
32	System board memory size
34	Relocate shadow RAM if configured
36	Configure EMS system
38	Configure wait states
3A	Retest 64K base RAM
3C	CPU speed calculation
3E	Get switches from 8042
40	Configure CPU speed
42	Initialise interrupt vectors
44	Verify video configuration
46	Initialise video system
48	Test unexpected interrupts
4A	Start second protected mode test
4C	Verify LDT instruction
4E	Verify TR instruction
50	Verify LSL instruction
52	Verify LAR instruction
54	Verify VERR instruction
56	Unexpected exception
58	Address line 20 test
5A	Keyboard ready test

Code	Meaning
5C	Determine AT or XT keyboard
5E	Start third protected mode test
60	Base memory test
62	Base memory address test
64	Shadow memory test
66	Extended memory test
68	Extended address test
6A	Determine memory size
6C	Display error messages
6E	Copy BIOS to shadow memory
70	8254 clock test
72	MC 146818 RTC test
74	Keyboard stuck key test
76	Initialise hardware interrupt vectors
78	Maths coprocessor test
7A	Determine COM ports available
7C	Determine LPT ports available
7E	Initialise BIOS data area
80	Determine floppy/fixed disk controller
82	Floppy disk test
84	Fixed disk test
86	External ROM scan
88	System key lock test
8A	Wait for <F1> key pressed
8C	Final system initialisation
8E	Interrupt 19 boot loader
B0	Unexpected interrupt before or after boot up.

16K XT

Code	Meaning
03	Test flag register
06	Test CPU Register
09	Initialise system hardware
0C	Test BIOS ROM checksum
0F	Initialise 8237 DMA page register
12	Test 8237 address and count registers
15	Initialise 8237 DMA
18	Test 8253 timer
1B	Initialise 8253 timer
1E	Start memory refresh test
21	Test base 64K RAM, Cycling POST display shows POST code, the upper then lower bytes of the failing address, separated by delays
24	Set up common INT temp stack
27	Initialize 8259 interrupt controller
2A	Test interrupt mask register
2D	Test for hot (unexpected) interrupt
30	Test V40 DMA if present
31	Test for DDNIL bits present
33	Verify system clock interrupt

Code	Meaning
36	Test keyboard
39	Set up interrupt table
3C	Read system configuration switches
3F	Test video
42	Determine COM ports available
45	Determine LPT ports available
48	Determine if game port available
4B	Display copyright message
4E	Calculate CPU speed
54	Test system memory
55	Test floppy drive
57	Initialize system before boot
5A	Call Interrupt 19 boot loader

SuperSoft

PC/XT/AT

	XT	AT
11	CPU register or logic error	CPU register or logic
12	ROM POST checksum error	ROMPOST A checksum error
13	8253 timer channel 0 error	ROMPOST B checksum error
14	8253 timer channel 1 error	8254 timer channel 0 error
15	8253 timer channel 2 error	8254 timer channel 1 error
16	8237A DMA controller error	8254 timer channel 2 error
17	8255 parity error detected	8237A DMA controller 1 err
18	16K critical RAM region error	8237A DMA controller 2 err
19	Memory refresh error	DMA page registers error
1A	-	8042 parity error detected
21	8259 Interrupt controller error	16K critical RAM region
22	Unexpected interrupt detected	Memory refresh error
23	Interrupt 0 (timer) error	CPU protected mode error
24	Nonmaskable interrupt error	8259 Interrupt controller 1 err
25	MDA video memory error	8259 Interrupt controller 2 err
26	CGA video memory error	Unexpected interrupt detected
27	EGA/VGA memory error	Interrupt 0 (timer) error
28	8087 math chip error	CMOS real time clock error
29	Keyboard controller error	Nonmaskable interrupt error
2A	-	8Ox87 math chip error
31	Keyboard scan lines/stuck key	Keyboard controller error
32	Floppy controller error	Stuck key or CMOS RAM err
33	Floppy disk read error	Floppy controller error
34	Memory error at address x	Floppy disk read error
35	Slow refresh, address x	MDA video memory error
36, 37	-	CGA, EGA/VGA RAM error
38	-	BIOS checksum error
41	BIOS checksum error	Memory error at address x
42	BASIC ROM 1 checksum	Slow refresh, address x
43-45	BASIC ROM 2, 3, 4	Display pass count

	XT	AT
59	No monitor	No monitor

Tandon

Slimline 286, 386SX and 486; 486 EISA

Type A AT 29 Feb 1988

Code	Meaning
01	Test 80286 CPU flags and registers
02	Test BIOS ROM checksum
03	Test MC146818 CMOS RAM battery (RTC)
04	Test 8254 timer
05	8254 timer test failed
06	Initialize RAM refresh
07	Test first 16K RAM
08	Initialize cold boot interrupt vectors
09	Test 8259 interrupt controller and interrupt vectors
0A	Fill in temporary interrupt vectors
0B	Initialize interrupt vector table 1
0C	Initialize interrupt vector table 2
0D	Initialize fixed disk vector
0E	Interrupt vector test failed
0F	Clear keyboard controller input buffer
10	Keyboard controller input buffer clearing failed
11	Run keyboard controller self-test
12	Initialize equipment check data area
13	Determine presence of and install 80287 math coprocessor
14	Test MC146818 CMOS RAM disk value range
15	Test for and install parallel port
16	Test for and install serial port
17	Invoke INT 19 to boot operating system

Type B AT—1992

Code	Meaning
01	Cold boot started
06	Initialize chipset if any
07	Warm boot entry. About to start 8042 keyboard controller self-test
08	Part of cold boot keyboard initialization passed
09	Keyboard self-test finished. Test ROM BIOS checksum.
0A	Test CMOS RAM battery level
0B	Save CMOS RAM battery condition in CMOS diagnostic/status register
0C	Finished saving CMOS RAM battery condition
0D	Test 8254 PIT. Disable RAM parity, I/O parity, DMA controllers, and speaker; enable timer channel 2.
0E, AA, xx	8245 test failed. xx is the failing channel number.
0F	Initialize 8254 timer channels (0 to mode 3 for 55 ms square wave, 1 to mode 2 as rate generator for refresh) and conduct memory refresh test.
10	Refresh test failed
11	Test base 64K RAM and fill with zeros

Code	Meaning
12	64K RAM test failed. 3 long beeps and halt.
13	RAM test passed
14	Set up stack, disable mappers for systems that support EMS drivers (for warm boot), initialize battery beep flag parameters for notebook, perform read/write test of CMOS RAM, enable error message if failed.
15	CMOS RAM read/write test complete
16	Calculating CPU speed; may set to low if CMOS RAM failed
18	Test and initialize both 8259 interrupt controllers
1A	8259 initialization complete
1B	Install interrupt handler and vector for INT 0F to check for unexpected (spurious) interrupts. Halt if spurious interrupt occurs.
1C	Spurious interrupt did not occur (test pass). Test 8254 timer channel 0, IRQ0, and software INT8 tests.
1D	Error. Timer 0 interrupt did not occur when expected. Halt system.
1E	Both 8259 interrupt controllers passed the tests
20	Set up interrupt vectors 02-1F
21	Set up interrupt vectors 70-77
22	Clear interrupt vectors for 41 and 46 (disk parameter pointers).
23	Read 8042 self-test result, DMA page reg ch 2 (port 81).
24	Test for proper 8042 self-test result (55).
25	Error: Keyboard controller self-test failed, display message and halt.
26	Keyboard controller self-test passed
27	Confirm DMA working; prepare DMA channel 2 for floppy data transfer
28	Reinitialize video (cold boot)
29	Reinitialize video with cursor off (warm boot)
2A	Video parameters are initialized
2B	Enable NMI and I/O channel check, disable 8254 timer channel 2 and speaker
2C	Run RAM test to determine size of RAM
2D	RAM sizing complete
2E	Send reset command to keyboard controller to initiate a keyboard scan cycle
2F	Keyboard has been initialized. Initialize the CMOS RTC
30	CMOS RTC has been initialized. Initialize on-board floppy if any
31	Install the hard disk controller
32	Disk controller has been installed; prepare DMA channel 2 for floppy transfers
33	Perform equipment check and initialize numeric data processor (math chip)
34	Install the serial/parallel ports
35	Test CMOS RAM battery level
36	Check for keypress—Esc=Setup, Spacebar=menu; do speed beeps 2=high, l=low
37	Enable 8254 timer channel 0 for system tick, enable keyboard and slave interrupt controller 8259 #2
38	Timer tick, keyboard and 8259 #2 have been enabled; enable/disable cache per CMOS RAM
39	Enable keyboard interface and interrupts. Go to built-in Setup program as necessary; shadow ROMs as appropriate.
3A	Setup finished, so clear the screen and display Please Wait message
3B	Test the fixed and floppy drives
3C	Scan for and invoke the adapter ROMs in C800-E000
3D	Turn off Gate A20; restore vectors 3bh-3fh with temporary interrupt service routines.
3E	Gate A20 is turned off
3F	Invoke INT19 to boot operating system.

These accompanied by 5 long beeps:

Code	Meaning
BF	486-based, 386SX/20c or 386SX/25c processor module boards are used in a system where the WD76C10 chipset is not revision F or above.

Code	Meaning
CF	CPU on a 486-based processor module has failed its internal self-test.
DF	386SX/20c or 386SX/25c processor module board failed correctly to initialize its on-board cache (bad cache RAM. illegal configuration, etc., or unknown module ID).
EF	Extended CMOS RAM within the WD76C10 chipset failed its self-test

486 EISA—10 Oct 1989

Code	Meaning
	Power on or system reset: enable 8042, RTC; disable 82C601 chip serial, parallel, floppy, hard drive, NMI; check 8042 status.
AA, 01, xx	Show 80486 BIST (built-in self-test) result: xx=00 if OK, FF if not.
01	Disable cache, enable ROM, high speed on, turn off caches, disable EISA NMIs, set master and slave IRQs to edge-triggered, disable reset chaining. disable 82C601 chip but set it valid.
05	Initialize address decoder, 640K RAM; set BIOS as cacheable, enable extended memory.
06	Clear Shutdown Flag.
07	8042 and keyboard test: wait till 8042 buffer empty, disable 8042 command, read 8042 output buffer, set response OK to DMA page reg channel 2.
08	Send 8042 NOP command, self-test command; get 8042 self-test result, send to DMA page reg channel 2.
AA, 01, xx	Show 8042 self-test result: xx=55 if OK
09	Test BIOS ROM checksum; 3 short beeps and halt if bad
0A	Read CMOS registers 3 times to clear pending CMOS RTC interrupts, and disable RTC interrupts. Check battery.
0B	Bad CMOS RAM battery.
0C	Send command to port 61 to disable parity and speaker, enable timer; disable DMA.
0D	Test 8254 counter timer: set all 3 counters to mode 3 (square wave), start them and read the counts.
0E	A counter timer is bad (at least one is 0 and not counting).
AA, 01, xx	Show failing counter address (xx = 40, 41, or 42), then beep L-S-L-S and halt.
0F	Enable and check memory refresh (set timer 1 to mode 2 for 15 microsecond refresh, and turn on DMA to perform it); delay 1 ms and check bit 4 of port 61 for 0-to-1 toggle.
10	Memory refresh failed (no toggle); beep short-long-short, and halt.
11	Check and clear the first 64K of RAM in real mode: disable NMI, clear parity latches, fill 64K with 5555 and check it, then AAAA and check it, then 0000.
AA, 06, mmnn, oopp, qqrr	First 64K memory test failed. mmnn=location lsb, msb; oopp= value read lsb, msb; qqrr=value expected lsb, msb.
AA, 01, xx	Test port 61 for parity error (bits 7, 6=1) and display error xx=value read from port 61 if parity error occurred.
12	First 64K memory test failed. Clear parity latches, give 3 long beeps, and halt.
13	First 64K memory test passed.
14	Reset the warm boot flag (40:72) and test CMOS RAM. Turn off caches, shadow the BIOS, set speed high, calculate high speed and initialize GP flag, set speed low and turn off cache if CMOS not good or CMOS speed not high, otherwise turn on cache and set speed high.
16	Check Shutdown Flag 123x.
17	Reset was cold boot. Set 40:e9 bit 7 (disk_status).
18	Prepare 8259 interrupt controllers; send FF to mask register and check it.
19	Interrupt controller initialization failed; initialize video, display the error message, and halt.
1A	Test interrupt controller: set all 256 ints to slipped interrupt vector. If warm boot (40:e9 bit 7), skip to POST 1E.
1B	Set int 0F to spurious interrupt vector, check for spurious interrupts.
1C	Set int 08 (timer 0) to timer 0 int vector, enable timer and int, wait for int from timer.
1D	Timer interrupt did not occur. Initialize video, display error message and halt.
1E	Initialize interrupt vectors.
1F	Initialize interrupt vectors 00-6F to temporary interrupt service routine.
20	Set vectors for interrupt 02-1F.
21	Set interrupt vectors for 70-77, clear vectors 60-67 and 78-FF.

Code	Meaning
22	Clear interrupt vectors for 41 and 46 (disk parameter pointers).
23	Read 8042 self-test result from DMA page reg ch 2 (port 81).
24	Test for proper 8042 self-test result (55).
25	8042 self-test failed. Get keyboard controller status, init video, display error msg, and halt.
26	Initialize 8042 keyboard controller, transfer 128K mem. exp. bit from 8042 to CMOS RAM (IBM compatible, but not used), read state of security switch and initialize RAM variable.
27	Check Shutdown Flag = 123x. No= cold boot.
28	If cold boot or CMOS RAM is bad, install video ROM and establish video, initialize equipment flags according to primary video adapter and CMOS RAM content, initialize POST status, initialize video.
29	If not cold boot and CMOS RAM is OK, install Video ROM and establish video for mono/CGA, initialize equipment flags according to primary video adapter and CMOS RAM contents, initialize video warm boot, initialize video.
2A	Check for bad CMOS RAM and queue the message if so; command port 61 to clear parity latches, disable the speaker and disable timer channel 2; enable NMI.
2B	Check Shutdown Flag = 123x. if warm boot, use memory sizes from CMOS RAM.
2C	If cold boot, turn caches off, test memory for appropriate size, and restore cache status.
2D	Turn off POST Fail CMOS RAM bit and display any queued error messages; initialize keyboard RAM (40:17-30) + (40:E0-E7).
2E	Initialize 8042 keyboard controller and test keyboard.
2F	Initialize time of day in the real time clock chip.
30	Test for and install floppy controller.
31	Enable C&T 82C601 chip IDE interface, test for and install hard drive.
32	Test 8259 DMA registers with 55 then AA, and initialize them to 0 (ports D2 and D4).
33	Test for and initialize math coprocessor chip
34	Test for and initialize parallel and serial ports, on and off board.
35	Initialize RAM variables for bad CMOS time, date, checksum, and battery condition.
36	Wait for user to press Esc, space. Check keyboard lock, clear the keyboard lock override, beep to indicate speed, display any queued messages. Esc=setup, space=boot menu.
37	Enable system clock tick (IRQ0), keyboard (IRQ1), and slave interrupt controller (IRQ2)
38	Initialize RAM variables for Ctrl-Alt-Esc, Ctrl-Alt-Ins
39	Enter setup if user pressed Ctrl-Alt-Esc. If EISA, revert to ISA if tab key pressed.
3A	Clear screen and update equipment flags according to CMOS contents (may have changed during setup). Shadow any ROMs per setup. Enable/disable cache per CMOS RAM.
3B	Initialize floppy and fixed disk drives.
3C	Set POST Fail bit in CMOS RAM, then scan for and invoke adapter option ROMs.
3D	Clear the Shutdown Flag to 0, turn off gate A20 to enable memory wrap in real mode.
3E	Set vectors for interrupts 3B-3F, clear Post Fail bit in CMOS RAM, home the cursor, display any error messages, clear MSW of 32-bit registers (ISC Unix).
3F	Invoke INT 19 to boot operating system.

Tandy

Uses OEM version of Phoenix BIOS.

Wyse

Uses OEM version of Phoenix BIOS.

Zenith

LEDs on system board to indicate the status of various stages of boot-up. All will light up first of all, then go out in sequence when the test concerned is completed. Zenith computers may also use an AMI (Plus, normally) or a Phoenix BIOS.

Post Procedures

Procedure	Meaning
CPU	Perform a read/write test on the internal register. Check for defective CPU or clock generator.
ROM BIOS	Check the CRC value stored in ROM against the computed value of this test. Check the BIOS or I/O circuitry.
RAM	Check first 64K of memory to see that data can be stored in it so the BIOS can use it later.
DMA	Test the register functions of the DMA chips.
PIT/PIC	Perform tests on the main support chips and enable the appropriate interrupts when completed. Check also for AC ripple.
RTC/CMOS	Check the validity of the CMOS RAM and compare value in CMOS with appropriate devices. The BIOS will use the values from the CMOS to set up appropriate IRQ routines for disk and other I/O access. Check for defective CMOS/battery/adapter or CMOS setting.
Video Display	Attempts will be made to initialise video to a mono screen very early on so error messages can be displayed. This test is for initialising upper video modes available with EGA/VGA.
Test/Boot to Diskette	Check the floppy subsystem and prepare the drive for boot if there is a bootable floppy in the A: drive.
Boot to Fixed Disk	Initialise any fixed disks in the CMOS and give control to the first one if a bootable floppy has not been detected previously. Check for corrupt boot code if not a hardware error.

POST Codes

Code	Meaning
01	VGA check
02	MDA initialise
03	Initialise video
05	Set hard reset
07	Check ROM at E000
08	Check ROM shadow at F000
09	Remap video to E000
0B	Keyboard controller test
0C	CMOS/8042 test
0D	DMA test
0E	DMA page register
0F	Test 64K memory
10	Test base memory
11	Second VGA unit
12	Mono initialisation
13	RTC/CMOS test
15	CPU register test
16	CPU add test
17	RTC/8042 test
18	Enter protected mode
19	Testing memory
1A	Testing extended memory
1B	Leaving protected mode
1C	Testing system board

Code	Meaning
1D	Testing system board
1E	Testing system board
1F	Bus sizing
20	Set BIOS data area
21	Testing DMA
22	Checking C800 for ROM
24	Testing base memory
25	8042 test
26	8042 test
27	8042 test
28	Memory parity test
29	PIT test
2A	Testing floppy disk
2B	Testing FDC/drives
2C	Testing HDC/drives
2D	Checking CMOS settings
2E	Soft configuration
30	Checking adapter ROM
31	Checking CMOS settings
32	Enabling interrupts
33	Soft configuration
34	Soft configuration
35	Jump to boot code
00	Boot to OS

Orion 4.1E—1992

Checkpoints 00h-1Fh and F0h-FFh are displayed after the indicated function is completed.

Code	Meaning
02	Cold Boot, Enter Protected Mode
03	Do Machine Specific Initialization
F0	Start of Basic HW Initialization for Boot
F1	Clear CMOS Pre-Slush Status Location
F2	Starting CLIO Initialization
F3	Initialize SYSCFG Register
F4	DXPI Initialization for Boot Block
F5	Turning OFF Cache
F6	Configure CPU Socket Pins
F7	Checking for 387SX
F8	82C206 DEFAULT Initialization
F9	Superior Default Initialization
FF	End of Machine-specific Boot Block
04	Check Flash Checksum
05	Flash OK, jump into Flash (FFFD Flash Code
06	Reset or Power-Up
07	CLIO Default init command
08	SYSCFG REG initialised
09	CMOS Pre-slush error words initialisation
10	SCP initialised

Code	Meaning
11	DRAM autosizing complete
12	Parity check enabled. Enable Memory Parity (EMP) LED turned off
13	Start of slushware test
14	Slushware at 000F0000h OK
15	BIOS ROM copied to slushware
16	Back in Real Mode
17	ROM BIOS Slushing is finished. CPU LED Turned off
18	Video ROM (C0000 Slushware Test
19	Internal Video ROM Slushed
1A	Back in Real Mode
1B	Internal video hardware enabled.
1C	CPU clock frequency determined
1E	BIOS RAM cleared

20-EF are displayed before the indicated function has been attempted. 20-2A indicate restart after system shutdown, usually to return to real mode from protected mode. The CMOS RAM shutdown byte (0F) will contain a value indicating the reason for the shutdown.

Code	Meaning
20	RESET (CMOS 0)
21	Continue after Setting Memory Size (CMOS 0F=1)
22	Continue after Memory Test (CMOS 0F=2)
23	Continue after Memory Error (CMOS 0F=3)
24	Continue with Boot Loader Request (CMOS 0F=4)
25	Jump to execute User Code (flush) (CMOS 0F=5)
26	Continue after Protected Mode Test Passed (CMOS 0F=6)
27	Continue after Protected Mode Test Failed (CMOS 0F=7)
28	Continue after Extended Protected Mode Test (CMOS 0F=8)
29	Continue after Block Move (CMOS 0F=9)
2A	Jump to execute User Code (CMOS 0F=A)
2B	Reserved
2C	Reserved
2D	Reserved
2E	Reserved
2F	Reserved
30	Exit from Protected Mode
31	TEST-RESET passed (80386). Warm Boot
32	Check the ROM Checksum. ROM LED Turned Off
33	Clear the Video Screen On
34	Check System DRAM Config Update CMOS-TOTAL-MEM-SIZE Value
35	Pro-load CMOS if CMOS is
36	Turn Off the UMB RAM
37	Turn Parity Generation
38	Initialize System Variable
39	Check for errors in POWER
3A	Initialize SCP MODE
3B	Test CMOS Diag. Power Reset
3C	Test CPU Reset 80386 & Determine State Number
3D	Save CPU ID & Processor-T

Code	Meaning
3E	Init the Video & Timers
3F	Init DMA Ports, Clear Page
40	Set Speed too Fast for Now
41	Test EEPROM Checksum
42	Enable/Disable Superior's Parallel, FDC & HDC Per CMOS
43	Slush External Video BIOS if on CMOS
44	Turn Cache off for Memory
45	Test Extended RAM (1-16Mb)
46	Test BASE RAM (0-64 OK). RAM LED turned off by Base RAM Test
47	Determine Amount of System
48	Set WARM-BOOT Flag if RES Indicates Cold Boot
49	Clear 16K of Base RAM
4A	Install BIOS Interrupt Vector
4B	Test System Timer. INT LED turned off if CLOCK Test passes
4C	(Re)Initialize Interrupt
4D	Enable Default Hardware Initialization
4E	Determine Global I/O Configuration
4F	Initialize Video
50	Init WD90C30 Scratchpad
51	Check for Errors before Boot
52	Reserved
53	Test (Ext Only) and Initialize
54	Reserved
55	Initialize the Keyboard Processor
56	Initialize the PS/2 Mouse
57	Configure CLIO for Mouse
58	Configure CLIO for LAN
59	Configure CLIO for SCSI
5A	Configure CLIO for WAM
5B	Wait for User to Enter Code
5C	Init System Clock TOD, Enable
5D	Test, Init Floppy Drive Sensor. Disk LED Turned off
5E	Check for Z150 Style Disk
5F	Init Winchester Subsystem
60	Set Default I/O Device Parameters
61	Get LAN ID Info from LAN
62	*Install ROMs at 0C8000h
63	*Install ROMs at 0E000h
64	Initialize SCSI Interface
65	Run with A2O off in PC Mode
66	Really turn off the SCP
67	Set Machine Speed using CMOS
68	Turn on Cache
69	Calibrate 1ms Constants
6A	*Enable Non-Maskable Interpreter
6B	Reserved
6C	Clear the warm-boot flag
6D	Check for Errors before Boot
6E	Boot

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Code	Meaning
0	Start of Slush Test
1	Processor Test
2	CACHE and CLIO
3	ISP Defaults Set
4	Into Protected Mode
5	Memory SIMMs Count
6	Memory Controller
7	Preped to Test Block
8	First 1Mb of Ram
9	Checksum OEM ROM
10	Low Flash ROM Checks
11	F000 ROM Checks
12	Aurora VIDEO ROM
13	F000 ROM Slushed
14	Sep Initialized
15	Language Slushed
16	Do VIDEO Specific tests
17	Done Slushing
32	Point Interrupt Vectors
33	Turn on Parity Generation
34	Initialize System Variables
35	Init Interrupt Controllers
36	Check Error that Occurred
37	Reinitialize SCP Warm Boot
38	Test CMOS Diag, Power, Reset
39	Reserved, or DDNIL status flag check
3A	Test CPU Reset (80386)
3B	Save the CPU ID in GS
3C	Slush Video ROM to C0000
3D	Init the Video and Timers
3E	Init CMA Ports, Clear Page
3F	Set Speed too Fast for now
40	Checksum the Nonvolatile RAM
41	Initialize Configuration
42	Init Expansion Boards from VRAM
43	Turn Cache off for Memory Test
44	Init Memory Ctrlr, test Extd Memory
45	Test Base RAM
46	Determine amount of System RAM
47	Test and Init Cache if installed
48	Test System Timer Tick
49	Initialize the Write queues
4A	Initialize Monitor RAM
4B	Clear 16K of Base RAM
4C	Install BIOS Interrupt Vectors
4D	Enable Default Hardware Initialization
4E	Determine Global I/O configuration
4F	Reserved

Code	Meaning
50	Initialize Video
51	Init WD90C30 Scratchpad register
52	Initialise the keyboard processor
53	Turn off IRQ 12 if mouse is off
54	Wait for user to enter correct password
55	Init System Clock Time of Day
56	Test, Init Floppy System, Track Seeks
57	Init Winchester subsystem, Messages
58	Install ROMs starting at C80000H
59	Install ROM starting at E0000H
5A	Initialise SCSI interface
5B	Set default I/O Device Parameters
5C	Init the cache speed and clock
5D	Always tell System ROM 'Cold
5E	Run with A20 off in PC Mode
5F	Really turn off the SCP
60	Set machine speed using CFG
61	Turn on cache if machine halt
62	Calibrate 1ms constants
63	Enable NMI
64	Test for errors before boot
65	Boot

Notes

Nasty Noises

These are for error conditions that occur before the screen is initialised, or for troubleshooting without a monitor. A text message is often sent to mono and CGA CRTs; EGA/VGA cards may not yet be initialised. Beep codes occur after the fact.

ALR

See *Phoenix*.

Ambra

See *Phoenix*.

AMI

All fatal, except no 8.

Beeps	What they mean	What to do
1	The memory refresh circuitry is faulty.	Reseat/replace memory.
2	Parity Errors in first 64K memory (detection may be defective).	Reseat/replace memory.
3	Failure in the first 64K of memory (could be address line error).	Reseat/replace memory.
4	System Timer failure; Timer #1 on the motherboard isn't working properly (an error with Timer #2 is non-fatal).	Repair motherboard.
5	CPU has generated an undetectable error.	Repair motherboard.
6	8042-Gate A20 Failure. The BIOS cannot switch the CPU into protected mode.	Reseat or replace keyboard or controller.
7	The CPU has generated an exception error.	Repair motherboard.
8	Video adapter is missing or has faulty memory (non-fatal).	Replace memory or the card itself.
9	The ROM checksum does not match that in the BIOS.	Reseat/replace BIOS.
10	The shutdown register for the CMOS Interrupt channel #2 has failed the so the	Repair motherboard.

Beeps	What they mean	What to do
	system board can't retrieve CMOS contents during POST.	
11	Ext (L2) cache memory has failed testing and has been disabled.	
2 short	POST failed; failure of one of the hardware testing procedures.	
1 long 2 short	Video failure; Video BIOS ROM failure where a checksum error was encountered or the video adapter has a horizontal retrace failure.	
1 long, 3 short	Video failure; The video DAC the monitor detection process or the video RAM has failed.	
1 long, 3 short	Conventional/extended memory test failure (older BIOSes)	
1 long, 8 short	Display test and display vertical and horizontal retrace test failed	
1 long	POST passed.	

AST

Long	Short	Problem
0	1	Failed POST 1; Low level processor verification test.
0	2	Failed POST 2; Clears keyboard controller buffers.
0	3	Failed POST 3; Keyboard controller reset.
0	4	Failed POST 4; Low level keyboard controller interface test.
0	5	Failed POST 5; Reading data from keyboard controller.
0	6	Failed POST 6; System board support chip initialisation.
0	7	Failed POST 7; Processor register r/w verify test.
0	8	Failed POST 8; CMOS timer initialisation.
0	9	Failed POST 9; ROM BIOS Checksum test.
0	10	POST 10; Initialise primary video (never fails).
0	11	Failed POST 11; 8254 timer channel 0 test.
0	12	Failed POST 12; 8254 timer channel 1 test.
0	13	Failed POST 13; 8254 timer channel 2 test.
0	14	Failed POST 14; CMOS power on and time test.
0	15	Failed POST 15; CMOS shutdown byte test.
1	0	Failed POST 16; DMA channel 0 test.
1	1	Failed POST 17; DMA channel 1 test.
1	2	Failed POST 18; DMA page register test.
1	3	Failed POST 19; Keyboard controller interface test.
1	4	Failed POST 20; Memory refresh toggle test.
1	5	Failed POST 21; First 64K memory test.
1	6	Failed POST 22; Setup interrupt vector table.
1	7	Failed POST 23; Video initialisation.
1	8	Failed POST 24; Video memory test.

Advantage/Bravo/Manhattan/Ascentia/Premium/Premmia

Short	Long	Short	Replaceable Unit
3	1	X	System board
3	2	X	System board
3	3	X	System board
3	4	X	System board
3	5	X	SIMM memory
3	6	X	Integrated VGA or video board

Advantage/Bravo

Beeps	Replaceable Unit
1	System board
2	SIMM memory; System board
3	SIMM memory; System board
4	SIMM memory; System board
5	Processor; System board
6	Keyboard controller; System board
7	Processor; System board
8	Video adapter; Video RAM; System board
9	BIOS; System board
10	System board
11	External cache; System board

Manhattan

Beeps	Error Type	Replaceable Unit
1	Memory Refresh	DIMMs
2	Parity	DIMMs
3	Base 64KB Memory	DIMMs
4	Timer Not Operational	Processor board
5	Processor	Microprocessor or processor board
6	Gate A20	Keyboard or system board
7	Processor Interrupt	microprocessor or processor board
8	Video Memory	Add-in video/system board (not fatal)
9	ROM Checksum	System board
10	CMOS Register	System board
11	Cache Memory Bad	Processor or processor board

Beeps	Replaceable Unit
2-2-3	System Board
3-1-1	SIMMs; Processor board
3-1-3	System board
3-4-1	SIMMs; Processor board
3-4-3	SIMMs, Processor board
2-1-2-3	Flash BIOS; System board
2-2-3-1	System board; Processor board

Ascentia J

Beeps	Replaceable Unit
2-2-3	System Board
3-1-1	SIMMs; Processor board
3-1-3	System board
3-4-1	SIMMs; Processor board
3-4-3	SIMMs, Processor board
2-1-2-3	Flash BIOS; System board
2-2-3-1	System board; Processor board

Ascentia 810/800/Explorer/Bravo

Short	Long	Short	Replaceable Unit
1	1	X	Processor board
1	2	X	System board
1	3	X	Processor board memory
1	4	X	Processor board
2	X	X	Processor board memory
3	1	X	System board
3	2	X	System board
3	3	X	Video (Processor board, LCD)
3	4	X	Video (Processor board, LCD)
4	2	X	Processor board
4	3	X	Processor board
4	4	1	Serial port / System board
4	4	2	Parallel port / System board
4	4	3	Processor board

BIOS Update Beep Codes

Long	Short	Description
2	0	Update Successful.
2	2	CMOS Checksum failure; try again, but be prepared to replace the system board.
2	3	Floppy disk adapter. Reinsert the disk.
2	4	Disk belongs to another machine.
2	5	Not a BIOS update disk.
2	7	Flash programming error.
2	8	Flash programming error.
2	9	Flash programming error.
2	10	Flash programming error.
2	11	Flash programming error.
2	12	Flash programming error.
2	13	Flash programming error.
2	14	Flash programming error.

AST Enhanced

Short	Long	Short	Processor failure
3	1	X	Flash Loader failure (BIOS)
3	2	X	System Board component failure
3	3	X	System Board component failure
3	4	X	Memory failure
3	5	X	Video failure
0	6	X	Flash BIOS update error. Not early POST failure
	2	Any	Used by AST for low level diagnostics.

Early Premium 286

Short	Long	Meaning
1	2	Video Error
1	3	Keyboard Error
2	0	Any Fatal Error

Short	Long	Meaning
1	0	No errors during POST

Early POSTBeep Codes

Beeps	Meaning
1	System Board
2	SIMM Memory; System Board
3	SIMM Memory; System Board
4	SIMM Memory; System Board
5	Processor; System Board
6	Keyboard Controller; System Board
7	Processor; System Board
8	Video Adapter; Video RAM; System Board
9	BIOS; System Board
10	System Board
11	External cache; System Board

AST Phoenix

Beeps	Meaning
1-1-3	CMOS read/write error. Fatal.
1-1-4	ROM BIOS Checksum failure. Fatal.
1-2-1	Programmable interval timer failure. Fatal.
1-2-2	DMA Initialisation failure. Fatal.
1-2-3	DMA Page Register r/w failure. Fatal.
1-3-1	RAM refresh verification error. Fatal.
1-3-3	First 64K RAM chip or data or data line failure multibit. Fatal.
1-3-4	First 64K RAM odd/even logic failure. Fatal.
1-4-1	Address line failure first 64K RAM. Fatal.
1-4-2	Parity failure first 64K RAM. Fatal.
2-1-1	First 64K RAM failure bit 0. Fatal.
2-1-2	First 64K RAM failure bit 1. Fatal.
2-1-3	First 64K RAM failure bit 2. Fatal.
2-1-4	First 64K RAM failure bit 3. Fatal.
2-2-1	First 64K RAM failure bit 4. Fatal.
2-2-2	First 64K RAM failure bit 5. Fatal.
2-2-3	First 64K RAM failure bit 6. Fatal.
2-2-4	First 64K RAM failure bit 7. Fatal.
2-3-1	First 64K RAM failure bit 8. Fatal.
2-3-2	First 64K RAM failure bit 9. Fatal.
2-3-3	First 64K RAM failure bit A. Fatal.
2-3-4	First 64K RAM failure bit B. Fatal.
2-4-1	First 64K RAM failure bit C. Fatal.
2-4-2	First 64K RAM failure bit D. Fatal.
2-4-3	First 64K RAM failure bit E. Fatal.
2-4-4	First 64K RAM failure bit F. Fatal.
3-1-1	Slave DMA register failure. Fatal.
3-1-2	Master DMA register failure. Fatal.
3-1-3	Slave interrupt mask register failure. Fatal.
3-1-4	Slave interrupt mask failure. Fatal.
3-2-4	Keyboard controller test failure. Fatal.

Beeps	Meaning
3-3-4	Screen memory test failure. Fatal.
3-4-1	Screen initialisation failure. Fatal.
3-4-2	Screen retrace test failure. Fatal.
3-4-3	Search for video ROM failure
4-2-1	No timer tick. Non-fatal.
4-2-3	Gate A20 failure. Non-fatal.
4-2-4	Unexpected interrupt in protected mode. Non-fatal.

Award

v4.5

Beeps	Meaning
1 long 3 short	Video error

XT 8086/88 v3.0

Beeps	Meaning
1 long, 2 short	Video error
2 short with PRESS F1 KEY TO CONTINUE	Any non-fatal error
1 short	No error during POST

286/386 v3.03

Beeps	Meaning
1 long, 2 short	Video error
2 short with PRESS F1 KEY TO CONTINUE	Any non-fatal error
1 short	No error during POST
1 long, 3 short, with system halt.	Keyboard controller error

EGA BIOS v1.6

Beeps	Meaning
1 long, 2 short	Video error
1 long, 3 short	EGA memory error

Compaq

General

Message	Beeps	What they mean
163 Time and date not set	2 Short	Invalid time or date
	2 V Short	Power-on successful
RESUME F1 key	None	Any failure
	3 Long	Processor Self-test
	2 Long	Memory map failure
101—I/O ROM error	1 Long 1 Short	Option ROM checksum
101—ROM error	1 Long 1 Short	System ROM checksum

Message	Beeps	What they mean
102—System Board Failure	None	DMA or timers
102—System or Memory Board Failure	None	High-order addresses
162—System Options Error	2 Short	No diskette drives/mismatched types
162—System Options Not Set (Run SETUP)	2 Short	System SETUP
163—Time and Date Not Set	2 Short	Invalid time or date in CMOS
164—Memory Size Error	2 Short	Memory size discrepancy
170—Expansion Device not Responding (Run SETUP)	1 Short	Expansion device not responding
172—EISA Configuration Memory Corrupt	1 Short	CMOS Corrupt
173—PCI Slot ID Mismatch	1 Short	CMOS not Updated
174—ISA/PCI Configuration Slot Mismatch	1 Short	Plug & Play board not found
175—ISA/PCI Configuration Slot Mismatch	1 Short	CMOS not updated (Plug & Play)
176—Slot with No Readable ID (Run SETUP)	1 Short	CMOS not updated (Plug & Play)
177—SETUP Not Complete (Run SETUP)	1 Short	EISA Configuration not complete
178—Processor SETUP Invalid (Run setup)	None	Processor SETUP invalid
201—Memory Error	None	RAM failure
203—Memory Error	None	RAM failure
205—Cache Memory Failure	None	Cache Memory Error
206—Secondary Cache Controller Failure	None	Cache Memory Controller Failure
301—Keyboard Error	None	Keyboard failure
301—Keyboard Error or Test Fixture Installed	None	Keyboard test fixture
303—Keyboard Controller Error	None	Keyboard controller
304—Keyboard or System Unit Error	None	Keyboard interface
401—Printer Error	None	Printer controller
401—Port 1 Address Assignment conflict	2 Short	Ext/Internal Port assignments to Port 1
402—Monochrome Adapter Failure	1 Long 2 short	Monochrome display controller
501—Display Adapter Failure	1 Long 2 short	Video display controller
601—Diskette Drive Controller Error	None	Diskette drive controller
602—Diskette Drive Boot Record Error	None	Diskette media not bootable
605—Diskette Drive Type Error	2 Short	Wrong drive type used in setup
607—Diskette Drive Controller Error	2 Short	Configuration error
611—Primary Diskette Drive Assignment Conflict	2 Short	Configuration error
612—Secondary Diskette Drive Assignment Conflict	2 Short	Configuration error
702—A-Coprocessor Detection Error	2 Short	Add copro or configuration error
703—Coprocessor Detection Error	2 Short	Add copro or configuration error
1125—Internal Serial Port Failure	2 Short	Defective internal serial port
1150—xx Comm Port Setup Error	2 Short	Setup not correct (run SETUP)
1151—COM1 Address Assignment Conflict	2 Short	Ext/internal port assignments to COM1
1152—COM2 Address Assignment Conflict	2 Short	Ext/int port assignments to COM2
1153—COM3 Address Assignment Conflict	2 Short	Ext/int port assignments to COM3
1153—COM 4 Address Assignment Conflict	2 Short	Ext/int port assignments to COM4
1154—Port 4 Address Assignment Conflict	2 Short	Incorrect COM 4 assignment
1600—32-Bit System Manager Board Failure	2 Short	Configuration mismatch
1730—HD 0 Does Not Support DMA Mode	2 Short	Configuration mismatch
1731—HD 1 Does Not Support DMA Mode	2 Short	Configuration mismatch
1740—HD 0 Failed Set Block Mode Command	2 Short	Configuration mismatch
1741—HD 1 Failed Set Block Mode Command	None	Wrong drive type
1750—Hard Drive 0 Failed Identify Command	None	Wrong drive type
1751—Hard Drive 0 Failed Identify Command	None	Wrong drive type

Message	Beeps	What they mean
1760—Hard Drive 0 Does Not Support Block Mode	2 Short	Configuration mismatch
1761—Hard Drive 1 Does Not Support Block Mode	2 Short	Configuration mismatch
1771—Primary Drive Port Address Assignment Conflict	2 Short	Int and ext hard drive controllers assigned to primary address
1772—Secondary Disk Port Address Assignment Conflict		Internal and external hard drive controllers assigned to sec address
1780—Hard Drive 0 Failure	None	Hard drive/format error
1781—Hard Drive 1 Failure	None	Hard drive/format error
1782—Hard Drive Controller Failure	None	Hard drive controller
1790—Hard Drive 0 Error	None	Wrong drive type used in SETUP
1791—Hard Drive 1 Error	None	Wrong drive type used in SETUP
1792—Secondary Drive Controller Error	None	Hard drive error or wrong drive type
1793—Secondary Controller or Drive Failure	None	Hard drive error or wrong drive type
XX000Y ZZ Parity Check 2	None	RAM parity failure NOTE: XX000Y ZZ Address (XX), byte (Y), data bit (ZZ) of failed memory test
Hard Drive Parameter Table or BIOS Error	3 Long	Configuration or hardware failure
IOCHECK Active, Slot X	None	Defective board in slot x
Bus Master Timeout Slot X	None	Defective board in slot x
Audible	1 Short	Power-On successful
Audible	2 Short	Power-On successful
(RESUME F1 KEY)	None	As indicated to continue

Contura 400 Family

Message on Screen	Beeps	What They Mean
101 System ROM Error	1 L 1 S	System ROM Checksum
101 I/0 ROM Error	None	Option ROM Checksum
102 System Board Failure	None	DMA, timers, etc or unsupported processor
162 System Options Error	2 Short	No diskette drive or drive type mismatch
162 System Options Not Set	2 Short	Configuration incorrect
163 Time & date Not Set	2 Short	Invalid time or date in CMOS
164 Memory Increase Detected	2 Short	CMOS incorrect
164 Memory Decrease Detected	2 Short	CMOS incorrect
168 CMOS Checksum invalid		
201 Memory Error	None	RAM failure
203 Memory Address Error	None	RAM failure
205 Memory Error	None	Cache memory error
207 Invalid Memory Configuration Module	None	Memory module installed incorrectly
209 NCA RAM Error	None	RAM Failure Error
211 Memory Failure	None	RAM Failure
301 Keyboard Error	None	Keyboard Failure
303 Keyboard Controller Error	None	System board keyboard controller
304 Keyboard or System Unit Error	None	Keyboard or System Unit Error
401 Printer Error	None	Printer controller
402 Monochrome Adapter Failure	1 L 2 S	Monochrome display controller.
501 Display Adapter Failure	1 L 2 S	Video display controller
601 Diskette Controller Error	None	Diskette controller circuitry
602 Diskette Boot	None	Diskette in drive A not
605 Diskette Drive Error	2 Short	Mismatch in drive type
702 Coprocessor Detection Error	None	Coprocessor upgrade detection error
702A Coprocessor Detection Error	2 Short	Coprocessor upgrade detection error

Message on Screen	Beeps	What They Mean
703 A Coprocessor Detected by POST	2 Short	Coprocessor or CMOS Error
1125 Internal Serial Port Failure	2 Short	Defective internal serial port
1780 Disk 0 failure	None	Hard drive/format error
1782 Disk Controller	None	Hard drive circuitry error
1790 Disk 0 Failure	None	Hard drive error or wrong drive type
Audible	1 Short	Poweron successful
Audible	2 Short	Poweron successful

Dell (Phoenix)

Beeps	Meaning
1-1-2	Microprocessor register failure
1-1-3	Non-volatile RAM
1-1-4	ROM BIOS Checksum failure
1-2-1	Programmable interval timer
1-2-2	DMA Initialisation failure
1-2-3	DMA Page Register r/w failure
1-3	Video memory test failure
1-3-1/2-4-4	SIMMs not properly identified or used
3-1-1	Slave DMA register failure
3-1-2	Master DMA register failure
3-1-3	Master interrupt mask register failure
3-1-4	Slave interrupt mask register failure
3-2-2	Interrupt vector loading failure
3-2-4	Keyboard controller test failure
3-3-1	Non-volatile RAM power loss
3-3-2	Non-volatile RAM configuration
3-3-4	Video memory test failure
3-4-1	Screen initialisation failure
3-4-2	Screen retrace failure
3-4-3	Search for video ROM failure
4-2-1	No time tick
4-2-2	Shutdown failure
4-2-3	Gate A20 failure
4-2-4	Unexpected interrupt in protected mode
4-3-1	Memory failure above address
4-3-3	Timer chip counter 2 failure
4-3-4	Time-of-day clock stopped
4-4-1	Serial port test failure
4-4-2	Parallel port test failure
4-4-3/4-4-4	Maths coprocessor test failure/Cache test failure

IBM

Beeps	Meaning
1-1-3	CMOS Read/Write Error
1-1-4	ROM BIOS Check Error
1-2-X	DMA Error
1-3-X	Memory Module

Beeps	Meaning
1-4-4	Keyboard
1-4-X	Error in first 64K RAM
2-1-1	Run Setup
2-1-2	Run Setup
2-1-X	1st 64K RAM failed
2-2-2	Video Adapter
2-2-X	1st 64K RAM failed
2-3-X	Memory Module
2-4-X	Run Setup
3-1-X	DMA Register failed
3-2-4	Keyboard controller failed
3-3-4	Screen initialisation failed
3-4-1	Screen retrace test detected an error
3-4-2	POST searching for video ROM
4	Video adapter
All others	System board
1 long, 1 Short	Base 640K or Shadow RAM error
1 Long, 2-3 short	Video adapter
3 Short	System Board Memory
Continuous	System Board
Repeating Short	Keyboard stuck
None	System Board

AT

Beeps	Meaning
1 short	Normal POST, OK
2 short	POST error—check messages on display
None	Power supply, system board
Continuous	Power supply, system board
Repeating short beeps	Power supply, system board
1 long, 1 short	System board
1 long, 2 short	Display adapter (MDA, CGA)
1 long, 3 short	EGA adapter
3 long	3270 keyboard card

MR BIOS

More under *POST Codes*.

Long	Short	Problem
0	1	Failed POST 1; Low level processor verification test.
0	2	Failed POST 2; Clears keyboard controller buffers.
0	3	Failed POST 3; Keyboard controller reset.
0	4	Failed POST 4; Low level keyboard controller i/f test.
0	5	Failed POST 5; Reading data from keyboard controller.
0	6	Failed POST 6; System board support chip initialisation.
0	9	Failed POST 9; ROM BIOS Checksum test.
0	13	Failed POST 13; 8254 timer channel 2 test.
0	15	Failed POST 15; CMOS shutdown byte test.
1	0	Failed POST 16; DMA channel 0 test.

Long	Short	Problem
1	1	Failed POST 17; DMA channel 1 test.
1	2	Failed POST 18; DMA page register test.
1	5	Failed POST 21; First 64K memory test.
1	6	Failed POST 22; Setup interrupt vector table.
1	7	Failed POST 23; Video initialisation.
1	8	Failed POST 24; Video memory test.

Mylex/Eurosoft

Beep	Meaning	386 Codes
1	Always present. (e.g. start)	1L
2	Video Adapter (missing?)	2L
3	Keyboard controller	1L-1S-1L
4	Keyboard	1L-2S-1L
5	8259 PIC 1	1L-3S-1L
6	8259 PIC 2	1L-4S-1L
7	DMA page register	1L-5S-1L
8	RAM Refresh	1L-6S-1L
9	RAM data test	1L-7S-1L
10	RAM parity	1L-8S-1L
11	8237 DMA controller 1	1L-9S-1L
12	CMOS RAM	1L-10S-1L
13	8237 DMA controller 2	1L-11S-1L
14	CMOS battery	1L-12S-1L
15	CMOS RAM checksum	1L-13S-1L
16	BIOS ROM checksum	1L-14S-1L
	Multiple errors	1L +

Packard Bell

See *Phoenix*.

Phoenix

Refer to *POST Codes*.

Quadtel

Beeps	Meaning
1	POST OK
2	Configuration Error; CMOS has changed.
1 long, 2 short	Video or adapter RAM
1 long, 3 short	Faulty expansion card.

Tandon

Slimline 286, 386SX and 486; 486 EISA

Beeps	Meaning

Beeps	Meaning
L-S-L-S	8254 counter timer.
S-L-S	RAM Refresh
L-L-L	System RAM
S-S-S	BIOS ROM Checksum
L-L	Distinct lack of video adapter
L-L-L-L	Video Adapter Failure

Notes

Error Messages/Codes

AMI

Message	Fault	Action
CH-2 Timer Error	Non fatal. Could be a peripheral.	
INTR #1 Error	Interrupt Channel 1 has failed POST	Check exp cards for IRQs 0-7.
INTR #2 Error	As above, but for Interrupt Channel 2	Check exp cards for IRQs 8-15.
CMOS Battery State Low		Replace battery.
CMOS Checksum Failure	A checksum is generated when CMOS values are saved for error checking purposes on subsequent startups. This will appear if the checksum is different	Run Setup again.
CMOS Memory Size Mismatch	You've added memory, or some of what you've got has stopped working	Run Setup.
CMOS System Options Not Set	CMOS values are either corrupt or non-existent	Run Setup.
CMOS Display Type Mismatch	The display in the CMOS does not match what is actually found by the POST	Run Setup.
CMOS Memory Size Mismatch	The memory in the BIOS does not match that actually found on the motherboard	Run Setup again.
Display Switch Not Proper	Some motherboards have a switch or jumper setting which is changed if a monochrome or colour monitor is fitted	Reset the switch.
Keyboard is locked ... Unlock it		Unlock keyboard.
Keyboard Error	There is a timing problem with the keyboard	Check keyboard BIOS compatible, or set to Not Installed, to skip keyboard test.
K/B Interface Error	Error with the keyboard connector.	
FDD Controller Failure	The BIOS cannot communicate with the floppy drive controller	It may just be disabled, or the cable may be loose.

Message	Fault	Action
HDD Controller Failure	As above, but for hard disks.	
C: Drive Error	There is no response from hard disk drive C:	Hard disk type may be set incorrectly, not formatted, or not properly connected.
D: Drive Error	As above.	
C: Drive Failure	As above but more serious.	
D: Drive Failure	As above.	
CMOS Time & Date Not Set		Run the Setup program.
Cache Memory Bad, Do Not Enable Cache!	Speaks for itself	You may need new cache memory. Try reseating first.
8042 Gate-A20 Error	The gate-A20 portion of the keyboard controller has failed	Replace the keyboard chip (8042).
Address Line Short!	There is an error in the memory address decoding circuitry	Try rebooting, it might go away!
DMA #1 Error	There is an error in the first DMA channel on the motherboard	Could be a peripheral device.
DMA #2 Error	There is an error in the second DMA channel on the motherboard	Could be a peripheral device.
DMA Error	There is an error within the DMA controller on the motherboard.	
No ROM Basic	There is nothing to boot from; may be no bootable sector on the boot up disk (A or C). The original IBM PC ran Basic from a ROM at this point (it was in a ROM next to the BIOS), but modern machines don't have it, hence this message	Check you haven't disabled booting from the A: drive, or that you've got A:, C: as the boot sequence. You might not have an active partition.
Diskette Boot Failure	The diskette in drive A: is corrupt.	
Invalid Boot Diskette	As above, but the disk is readable.	
On Board Parity Error	There is a parity error with memory on the motherboard at address XXXX (hex). On board means the memory is not on an expansion card.	Possibly correctable with software from motherboard manufacturer
Off Board Parity Error	There is a parity error with memory installed in an expansion slot at address XXXX (hex)	Possibly correctable with software from the motherboard manufacturer. You could try reseating your SIMMs.
Parity Error ????	A parity error with memory somewhere in the system, but God knows where. Possibly correctable with software from the motherboard manufacturer.	
Memory Parity Error at XXXX	Memory failed. If determined, it is displayed as XXXX. If not, as ????.	
I/O Card Parity Error at XXXX	An expansion card failed. If the address can be determined, it is displayed as XXXX, otherwise ????.	
DMA Bus Time-out	A device has driven the bus signal for more than 7.8 microseconds.	
Memory mismatch, run Setup		Try disabling Memory Relocation.
EISA CMOS Checksum Failure	The checksum for EISA CMOS is bad, or the battery.	
EISA CMOS inoperational	Read/Write error in ext CMOS RAM	The battery may be bad.
Expansion Board not ready at Slot X, Y, Z.	AMI BIOS cannot find the expansion board in whatever slot is indicated	Make sure the board is in the correct slot and is correctly seated.
Fail-Safe Timer NMI Inoperational	Devices that depend on the fail-safe NMI timer are not operating correctly.	

Message	Fault	Action
ID information mismatch for Slot X, Y, Z	The ID of the EISA Expansion Board in whatever slot is indicated does not match the ID in EISA CMOS RAM.	
Invalid Configuration Information for Slot X, Y, Z	The configuration information for EISA Expansion Board X, Y or Z is not correct. The board cannot be configured	Run the ECU.
Software Port NMI Inoperational	The software port NMI is not working.	
BUS Timeout NMI at Slot n	There was a bus timeout NMI at whatever slot is indicated.	
(E)nable (D)isable Expansion Board?		Type E to enable the expansion board that had an NMI, or D to disable it.
Expansion Board disabled at Slot n	The expansion board at whatever slot is indicated has been disabled.	
Expansion Board NMI at Slot n.	An expansion board NMI was generated from whatever slot is indicated.	
Fail-Safe Timer NMI	A fail-safe timer NMI has been generated.	
Software Port NMI	A software port NMI has been generated.	

Apricot

Code	Meaning
02	Drive not ready (disk removed during boot)
04	CRC error (corrupt disk data)
06	Seek error (possible unformatted or corrupt disk)
07	Bad media (corrupt disk media block)
08	Sector not found (unformatted or corrupt diskette)
11	Bad read (corrupt data field on disk)
12	Disk failure (disk hardware or media fault)
20	PROM checksum error (corrupt boot PROM)
21	Sound generator failure (suspect sound chip)
22	Serial I/O failure (Z80 SIO fails r/w test)
23	Video chip failure (CRTC fails r/w test)
24	Video pointer RAM failure (system RAM failed)
25	System RAM failure (system RAM failure)
26	Parallel port failure (port driver problem)
27	Interrupt controller failure (8259A PIC failed r/w test)
28	Floppy disk controller failure (FCD failed r/w test)
29	Counter timer failure (CTC failed r/w test)
30	Serial channel failure (Ch A of Z80 SIO failed test)
31	Keyboard failure (initialisation test failed)
32	Timer accuracy failure (CTC accuracy check against timing loop failed)
33	Timer/PIC interaction failure (CTC/PIC timing interaction test failed)
34	IO processor failure (8089 IOP failed init/memory move test)
99	Non system disk

AST

See *AMI*.

Award

v4.5x

Code	Meaning
6	Cache/controller.
10	More than 1 IDE interface.
40	IDE floppy controller.
80	IDE controller.

XT 8086/88 v3.0

Code	Meaning
201	Memory test failed.
301	Keyboard error
601	Diskette power on diagnostic test failed.
1801	I/O expansion unit failed power on diagnostic.
Parity Check 1	Parity error in system board memory. Fatal.
Parity Check 2	Parity error in expansion unit memory. Fatal.

286/386 v 3.03

Msg	Meaning
Refresh Timing Error	The refresh clock is not operating as expected.
Keyboard Error/No Keyboard	Either a keyboard problem, or the keyboard is not attached.
Equipment Configuration Error	The system configuration determined by POST is different from what was defined using SETUP.
Memory Size Error	The amount of memory found by POST is different than the amount defined using SETUP.
Real Time Clock Error	The real time clock is not operating as expected.
Error initialising Hard Drive	Reset of fixed disk failed.
Error Initialising HD Controller	Fixed disk controller fails internal diagnostic.
Floppy Disk Cntrlr Error Or No Cntrlr Present	The floppy disk controller is failing self test, or it is not present.
CMOS RAM Error	The CMOS is invalid. This can be caused by the battery not operating correctly. SETUP must be run.
Press A key To Reboot	A call has been made to ROM BASIC; not in the Award BIOS.
Memory Addressing Error At XXXX	Memory errors. Values are as close as possible.
Disk Boot Failure, Insert System Disk And Press Enter	The system is unable to load the system from the boot disk.
Parity Error In Segment XXXX	This fatal error occurs during POST memory test.
Memory Verify Error	POST error. AA is # of MBytes AA:SSSS:FFFF boundary; SSSS=segment FFFF=offset.
IO Parity Error—System Halted	These occur after POST has finished.

ISA/EISA v4.5

Message	Meaning
CMOS BATTERY HAS FAILED	CMOS battery is no longer functional. It should be replaced.
CMOS CHECKSUM ERROR	Checksum of CMOS is incorrect. This can indicate that CMOS has become corrupt. This error may have been caused by a weak battery. Check the battery and replace if necessary.
DISK BOOT FAILURE, INSERT SYSTEM DISK AND PRESS ENTER	No boot device was found. Either a boot drive was not detected or the drive has no proper system files. Insert a system disk into Drive A: and press Enter. If you assumed the system

Message	Meaning
	would boot from the hard drive make sure the controller is inserted correctly and all cables are properly attached. Also be sure the disk is formatted as a boot device. Then reboot the system.
DISKETTE DRIVES OR TYPES MISMATCH ERROR—RUN SETUP	Type of diskette drive installed in the system is different from the CMOS definition. Run Setup to reconfigure the drive type correctly.
DISPLAY SWITCH IS SET INCORRECTLY	Display switch on the motherboard can be set to either monochrome or colour. This indicates the switch is set to a different setting than indicated in Setup. Determine which setting is correct, and then either turn off the system and change the jumper, or enter Setup and change the VIDEO selection.
DISPLAY TYPE HAS CHANGED SINCE LAST BOOT	Since last powering off the system, the display adapter has been changed. Reconfigure the system.
EISA Configuration Checksum Error	Run the EISA Configuration Utility. The EISA non-volatile RAM checksum is incorrect or cannot correctly read the EISA slot. Either the EISA non-volatile memory has become corrupt or the slot has been configured incorrectly. Also make sure the card is installed firmly in the slot. When this error appears, the system will boot in ISA mode, which allows you to run the EISA Configuration Utility.
EISA Configuration Is Not Complete	Run the EISA Configuration Utility. The slot configuration information stored in the EISA non-volatile memory is incomplete. When this error appears, the system will boot in ISA mode, which allows you to run the EISA Configuration Utility.
ERROR ENCOUNTERED INITIALIZING HARD DRIVE	Hard drive cannot be initialized. Be sure the adapter is installed correctly and all cables are correctly and firmly attached. Also make sure the correct hard drive type is selected in Setup.
ERROR INITIALIZING HARD DISK CONTROLLER	Cannot initialize controller. Make sure the cord is correctly installed. Be sure the correct hard drive type is selected in Setup. Also check to see if any jumper needs to be set correctly on the hard drive.
FLOPPY DISK CNTRLR ERROR OR NO CNTRLR PRESENT	Cannot find or initialize the floppy drive controller. make sure the controller is installed correctly and firmly. If there are no floppy drives installed, be sure the Diskette Drive selection in Setup is set to NONE.
Invalid EISA Configuration	Run the EISA Configuration Utility. The non-volatile memory containing EISA configuration information was programmed incorrectly or has become corrupt. Re-run EISA configuration utility to correctly program the memory. When this error appears, the system will boot in ISA mode, which allows you to run the EISA Configuration Utility.
KEYBOARD ERROR OR NO KEYBOARD PRESENT	Cannot initialize the keyboard. Make sure the keyboard is attached correctly and no keys are being pressed during the boot. If you are purposely configuring the system without a keyboard, set the error halt condition in Setup to HALT ON ALL, BUT KEYBOARD. This will cause the BIOS to ignore the missing keyboard and continue the boot.
Memory Address Error at ...	Indicates a memory address error at a specific location. You can use this location along with the memory map for your system to find and replace the bad memory chips.
Memory parity Error at ...	Indicates a memory parity error at a specific location. You can use this location along with the memory map for your system to find and replace the bad memory chips.
MEMORY SIZE HAS CHANGED SINCE LAST BOOT	Memory has been added or removed since the last boot. In EISA mode use Configuration Utility to reconfigure the memory configuration. In ISA mode enter Setup and enter the new memory size in the memory fields.
Memory Verify Error at ...	Indicates an error verifying a value already written to memory. Use the location along with your system's memory map to locate the bad chip.
OFFENDING ADDRESS NOT FOUND	This message is used in conjunction with the I/O CHANNEL CHECK and RAM PARITY ERROR messages when the segment that has caused the problem cannot be isolated.
OFFENDING SEGMENT:	This message is used in conjunction with the I/O CHANNEL CHECK and RAM PARITY ERROR messages when the segment that has caused the problem has been isolated.
PRESS A KEY TO REBOOT	This will be displayed at the bottom screen when an error occurs that requires you to reboot. Press any key and the system will reboot.
PRESS F1 TO DISABLE NMI, F2 TO REBOOT	When BIOS detects a Non-maskable Interrupt condition during boot, this will allow you to disable the NMI and continue to boot, or you can reboot the system with the NMI enabled.

Message	Meaning
RAM PARITY ERROR—CHECKING FOR SEGMENT ...	Indicates a parity error in Random Access Memory.
Should Be Empty But EISA Board Found	When this error appears, the system will boot in ISA mode, which allows you to run the EISA Configuration Utility. A valid board ID was found in a slot that was configured as having no board ID. When this error appears, the system will boot in ISA mode, which allows you to run the EISA Configuration Utility.
Should Have EISA Board But Not Found	Run EISA Configuration utility. The board installed is not responding to the ID request, or no board ID has been found in the slot. The system will boot in ISA mode, so you can run the EISA Configuration Utility.
Slot Not Empty	A slot designated as empty by the Configuration Utility actually contains a board. When this error appears, the system will boot in ISA mode, which allows you to run the EISA Configuration Utility.
SYSTEM HALTED, (CTRL-ALT-DEL) TO REBOOT ...	Present boot attempt has been aborted and system must be rebooted. Press and hold down the CTRL and ALT keys and press DEL.
Wrong Board In Slot	Run EISA Configuration Utility. The board ID does not match the ID stored in the EISA non-volatile memory. When this error appears, the system will boot in ISA mode, which allows you to run the EISA Configuration Utility.

Compaq

101—Processor

Code	Meaning
101—01	CPU test failed
101—02	32 Bit CPU test failed
101—91	Multiplication test failed
101—92	Multiplication test failed
101—93	Multiplication test failed
101—94	Multiplication test failed
102—01	Numeric coprocessor initial status word incorrect
102—02	Numeric coprocessor initial control word incorrect
102—03	Numeric coprocessor tag word not all ones
102—04	Numeric coprocessor tag word not all zeros
102—05	Numeric coprocessor exchange command failed
102—06	Numeric coprocessor masked exception incorrectly handled
102—07	Numeric coprocessor unmasked exception incorrectly handled
102—08	Numeric coprocessor wrong mask bit set in Status register
102—09	Numeric coprocessor unable to store real number
102—10	Numeric coprocessor real number calculation test failed
102—11	Numeric coprocessor speed test failed
102—12	Numeric coprocessor pattern test failed
102—15	Numeric coprocessor is inoperative or socket is unoccupied
102—16	Weitek coprocessor not responding
102—17	Weitek coprocessor failed register transfer test
102—18	Weitek coprocessor failed arithmetic operations test
102—19	Weitek coprocessor failed data conversion test
102—20	Weitek coprocessor failed interrupt test
102—21	Weitek coprocessor failed speed test
103—01	DMA page registers test failed
103—02	DMA byte controller test failed

Code	Meaning
103—03	DMA word controller test failed
104—01	Interrupt controller master test failed
104—02	Interrupt controller slave test failed
104—03	Interrupt controller software RTC is inoperative
105—01	Port 61 bit not at zero
105—02	Port 61 bit not at zero
105—03	Port 61 bit not at zero
105—04	Port 61 bit not at zero
105—05	Port 61 bit not at zero
105—06	Port 61 bit not at one
105—07	Port 61 bit not at one
105—08	Port 61 bit not at one
105—09	Port 61 bit not at one
105—10	Port 61 I/O test failed
105—11	Port 61 bit not at zero
105—12	Port 61 bit not at zero
105—13	No interrupt generated by fail-safe timer
105—14	NMI not triggered by fail-safe timer
106—01	Keyboard controller self-test failed
107—01	CMOS RAM test failed
108—02	CMOS interrupt test failed
108—03	CMOS interrupt test, CMOS not properly initialized
109—01	CMOS clock load data test failed
109—02	CMOS clock rollover test failed
109—03	CMOS clock test, CMOS not properly initialized
110—01	Programmable timer load data test failed
110—02	Programmable timer dynamic test failed
110—03	Program timer 2 load data test failed
111—01	Refresh detect test failed
112—01	Speed test Slow mode out of range
112—02	Speed test Mixed mode out of range
112—03	Speed test Fast mode out of range
112—04	Speed test unable to enter Slow mode
112—05	Speed test unable to enter Mixed mode
112—06	Speed test unable to enter Fast mode
112—07	Speed test system error
112—08	Unable to enter Auto mode in speed test
112—09	Unable to enter High mode in speed test
112—10	Speed test High mode out of range
112—11	Speed test Auto mode out of range
112—12	Speed test Variable Speed mode inoperative
113—01	Protected mode test failed
114—01	Speaker test failed
116—xx	Way 0 read/write test failed
199—00	Installed devices test failed

200—Memory

Code	Meaning
200—04	Real memory size changed

Code	Meaning
200—05	Extended memory size changed
200—06	Invalid memory configuration
200—07	Extended memory size changed
200—08	CLIM memory size changed
201—01	Memory machine ID test failed
202—01	Memory system ROM checksum failed
202—02	Failed RAM/ROM map test
202—03	Failed RAM/ROM protect test
203—01	Memory read/write test failed
203—02	Error while saving block under test in read/write test
203—03	Error while restoring block under test in read/write test
204—01	Memory address test failed
204—02	Error while saving block under test in address test
204—03	Error while restoring block under test in address test
204—04	A20 address test failed
204—05	Page hit address test failed
205—01	Walking I/O test failed
205—02	Error while saving block under test in walking I/O test
205—03	Error while restoring block under test in walking I/O test
206—xx	Increment pattern test failed
210—01	Memory increment pattern test
210—02	Error while saving memory in increment pattern test
210—03	Error while restoring memory in increment pattern test
211—01	Memory random pattern test
211—02	Error while saving memory in random memory pattern test
211—03	Error while restoring memory in random memory pattern test

301—Keyboard

Code	Meaning
301—01	Keyboard short test, 8042 self-test failed
301—02	Keyboard short test, interface test failed
301—03	Keyboard short test, echo test failed
301—04	Keyboard short test, keyboard reset failed
301—05	Keyboard short test, keyboard reset failed
302—01	Keyboard long test, failed
303—01	Keyboard LED test, 8042 self-test failed
303—02	Keyboard LED test, reset test failed
303—03	Keyboard LED test, reset failed
303—04	Keyboard LED test, LED command test failed
303—05	Keyboard LED test, LED command test failed
303—06	Keyboard LED test, LED command test failed
303—07	Keyboard LED test, LED command test failed
303—08	Keyboard LED test, command byte restore test failed
303—09	Keyboard LED test, LEDs failed to light
304—01	Keyboard repeat key test failed
304—02	Unable to enter mode 3
304—03	Incorrect scan code from keyboard
304—04	No Make code observed
304—05	Cannot disable repeat key feature

Code	Meaning
304—06	Unable to return to Normal mode

401—Printer

Code	Meaning
401—01	Printer failed or not connected
402—01	Printer Data register failed
402—02	Printer Control register failed
402—03	Printer Data register and Control register failed
402—04	Printer loopback test failed
402—05	Printer loopback test and Data register failed
402—06	Printer loopback test and Control register failed
402—07	Loopback test; Data register and Control register failed
402—08	Printer interrupt test failed
402—09	Printer interrupt test and Data register failed
402—10	Printer interrupt test and Control register failed
402—11	Printer interrupt; Data register and Control register failed
402—12	Printer interrupt test and loopback test failed
402—13	Interrupt test; loopback test and Data register failed
402—14	Interrupt test; loopback test and Control register failed
402—15	Interrupt test; loopback test Data/Control registers failed
402—16	Unexpected interrupt received
403—01	Printer pattern test failed
498—00	Printer failed or not connected

501—Video

Code	Meaning
501—01	Video controller test failed
502—01	Video memory test failed
503—01	Video attribute test failed
504—01	Video character set test failed
505—01	Video 80 x 25 mode 9 x 14 character cell test failed
506—01	Video 80 x 25 mode 8 x 8 character cell test failed
507—01	Video 40 x 25 mode test failed
508—01	Video 320 x 200 mode colour set 0 test failed
509—01	Video 320 x 200 mode colour set 1 test failed
510—01	Video 640 x 200 mode test failed
511—01	Video screen memory page test failed
512—01	Video grey scale test failed
514—01	Video white screen test failed
516—01	Video noise pattern test failed

600—Diskette Drive

Code	Meaning
600—xx	Diskette drive ID test
600—05	Failed to reset controller
600—20	Failed to get drive type
601—xx	Diskette drive format
601—05	Failed to reset controller

Code	Meaning
601—09	Failed to format a track
601—23	Failed to set drive type in ID media
602—xx	Diskette read test
602—01	Exceeded maximum soft error limit
602—02	Exceeded maximum hard error limit
602—03	Previously exceeded maximum soft error limit
602—04	Previously exceeded maximum hard error limit
602—05	Failed to reset controller
602—06	Fatal error while reading
603—xx	Diskette drive read/write compare test
603—01	Exceeded maximum soft error limit
603—02	Exceeded maximum hard error limit
603—03	Previously exceeded maximum soft error limit
603—04	Previously exceeded maximum hard error limit
603—05	Failed to reset controller
603—06	Fatal error while reading
603—07	Fatal error while writing
603—08	Failed compare of read/write buffers
604—xx	Diskette drive random seek test
604—01	Exceeded maximum soft error limit
604—02	Exceeded maximum hard error limit
604—03	Previously exceeded maximum soft error limit
604—04	Previously exceeded maximum hard error limit
604—05	Failed to reset controller
604—06	Fatal error while reading
605—xx	Diskette drive ID media test
605—20	Failed to get drive type
605—24	Failed to read diskette media
605—25	Failed to verify diskette media
606—xx	Diskette drive speed test
606—26	Failed to read media in speed test
606—27	Failed speed limits
607—xx	Diskette wrap test
607—10	Failed sector wrap test
608—xx	Diskette drive write-protect test
608—28	Failed write-protect test
609—xx	Diskette drive reset controller test
609—05	Failed to reset controller
610—xx	Diskette drive change line test
610—21	Failed to get change line status
610—22	Failed to clear change line status
694—00	Pin 34 not cut on 360 KB Diskette drive
697—00	Diskette type error
6xx—01	Exceeded maximum soft error limit
6xx—02	Exceeded maximum hard error limit
6xx—03	Previously exceeded maximum soft error limit
6xx—04	Previously exceeded maximum hard error limit
6xx—05	Failed to reset controller
6xx—06	Fatal error while reading
6xx—07	Fatal error while writing

Code	Meaning
6xx—08	Failed compare of read/write buffers
6xx—09	Failed to format a track
6xx—10	Failed sector wrap test
6xx—20	Failed to get drive type
6xx—22	Failed to clear change line status
6xx—23	Failed to set drive type in ID media
6xx—24	Failed to read diskette media
6xx—25	Failed to verify diskette media
6xx—26	Failed to read media in speed test
6xx—27	Failed speed limits
6xx—28	Failed write-protect test
698—00	Diskette drive speed not within limits
699—00	Drive/media ID error—rerun SETUP

1101—Serial Interface

Code	Meaning
1101—01	Serial port test; UART DLAB bit failure
1101—02	Serial port test; line input or UART fault
1101—03	Serial port test; address line fault
1101—04	Serial port test; data line fault
1101—05	Serial port test; UART control signal failure
1101—06	Serial port test; UART THRE bit failure
1101—07	Serial port test; UART DATA READY bit failure
1101—08	Serial port test; UART TX/RX buffer failure
1101—09	Serial port test; INTERRUPT circuit failure
1101—10	Serial port test; COM1 set to invalid interrupt
1101—11	Serial port test; COM2 set to invalid interrupt
1101—12	Serial port test; DRIVER/RECEIVER control signal failure
1101—13	Serial port test; UART control signal interrupt failure
1101—14	Serial port test; DRIVER/RECEIVER data failure
1109—01	Clock register initialization failure
1109—02	Clock register rollover failure
1109—03	Clock reset failure
1109—04	Input line or clock failure
1109—05	Address line fault
1109—06	Data line fault
1150—xx	Comm port SETUP error (run SETUP)

1201—Modem

Code	Meaning
1201—xx	Modem internal loopback test
1201—01	UART DLAB bit failure
1201—02	Line input or UART failure
1201—03	Address line fault
1201—04	Data line fault
1201—05	UART control signal failure
1201—06	UART THRE bit failure
1201—07	UART DATA READY bit failure
1201—08	UART TX/RX buffer failure

Code	Meaning
1201—09	Interrupt circuit failure
1201—10	COM1 set to invalid interrupt
1201—11	COM2 set to invalid interrupt
1201—12	DRIVER/RECEIVER control signal failure
1201—13	UART control signal interrupt failure
1201—14	DRIVER/RECEIVER data failure
1201—15	Modem detection failure
1201—16	Modem ROM and checksum failure
1201—17	Tone detection failure
1202—xx	Modem internal test
1202—01	Modem timeout waiting for SYNC (local loopback mode)
1202—02	Modem timeout waiting for response (local loopback mode)
1202—03	Modem exceeded data block retry limit (local loopback mode)
1202—11	Timeout waiting for SYNC (analogue loopback originate mode)
1202—12	Timeout waiting for modem response (analogue loopback originate mode)
1202—13	Exceeded data block retry limit (analogue loopback originate mode)
1202—21	Timeout waiting for SYNC (analogue loopback answer mode)
1202—22	Timeout waiting for modem response (analogue loopback answer mode)
1202—23	Exceeded data block retry limit (analogue loopback answer mode)
1203—xx	Modem external termination test
1203—01	Modem external TIP/RING failure
1203—02	Modem external DATA TIP/RING failure
1203—03	Modem line termination failure
1204—xx	Modem auto originate test
1204—01	Modem timeout waiting for SYNC
1204—02	Modem timeout waiting for response
1204—03	Modem exceeded data block retry limit
1204—04	RCV exceeded carrier lost limit
1204—05	XMIT exceeded carrier lost limit
1204—06	Timeout waiting for dial tone
1204—07	Dial number string too long
1204—08	Modem timeout waiting for remote response
1204—09	Modem exceeded maximum redial limit
1204—10	Line quality prevented remote connection
1204—11	Modem timeout waiting for remote connection
1205—xx	Modem auto answer test
1205—01	Modem timeout waiting for SYNC
1205—02	Modem timeout waiting for response
1205—03	Modem exceeded data block retry limit
1205—04	RCV exceeded carrier lost limit
1205—05	XMIT exceeded carrier lost limit
1205—06	Timeout waiting for dial tone
1205—07	Dial number string too long
1205—08	Modem timeout waiting for remote response
1205—09	Modem exceeded maximum redial limit
1205—10	Line quality prevented remote connection
1205—11	Modem timeout waiting for remote connection
1206—xx	Dial multifrequency tone test
1206—17	Tone detection failure
1210—xx	Modem direct connect test

Code	Meaning
1210—01	Modem timeout waiting for SYNC
1210—02	Modem timeout waiting for response
1210—03	Modem exceeded data block retry limit
1210—04	RCV exceeded carrier lost limit
1210—05	XMIT exceeded carrier lost limit
1210—06	Timeout waiting for dial tone
1210—07	Dial number string too long
1210—08	Modem timeout waiting for remote response
1210—09	Modem exceeded maximum redial limit
1210—10	Line quality prevented remote connection
1210—11	Modem timeout waiting for remote connection

1700—Hard Drive

Code	Meaning
1700—xx	Hard Drive ID test
1700—05	Failed to reset controller
1700—09	Failed to format a track
1700—41	Failed to ID hard (drive not ready)
1700—42	Failed to recalibrate drive
1700—45	Failed to get drive parameters from ROM
1700—46	Invalid drive parameters found in ROM
1700—66	Failed to initialize drive parameter
1700—69	Failed to read drive size from controller
1700—70	Failed translate mode
1700—71	Failed non-translate mode
1701—xx	Hard drive format
1701—05	Failed to reset controller
1701—09	Failed to format a cylinder
1701—42	Failed to recalibrate drive
1701—58	Failed to write sector buffer
1701—59	Failed to read sector buffer
1701—66	Failed to initialize drive parameter
1702—xx	Hard drive read test
1702—01	Exceeded maximum soft error limit
1702—02	Exceeded maximum hard error limit
1702—03	Previously exceeded maximum soft error limit
1702—04	Previously exceeded maximum hard error limit
1702—05	Failed to reset controller
1702—06	Fatal error while reading
1702—40	Failed cylinder 0
1702—65	Exceeded maximum bad sectors per track
1702—68	Failed to read long
1702—70	Failed translate mode
1702—71	Failed non-translate mode
1702—72	Bad track limit exceeded
1702—73	Previously exceeded bad track limit
1703—xx	Hard drive read/write compare test
1703—01	Exceeded maximum soft error limit
1703—02	Exceeded maximum hard error limit

Code	Meaning
1703—03	Previously exceeded maximum soft error limit
1703—04	Previously exceeded maximum hard error limit
1703—05	Failed to reset controller
1703—06	Fatal error while reading
1703—07	Fatal error while writing
1703—08	Failed compare of read/write buffers
1703—40	Cylinder 0 error
1703—55	Cylinder 1 error
1703—63	Failed soft error rate
1703—65	Exceeded maximum bad sectors per track
1703—67	Failed to write long
1703—68	Failed to read long
1703—70	Failed translate mode
1703—71	Failed non-translate mode
1703—72	Bad track limit exceeded
1703—73	Previously exceeded bad track limit
1704—xx	Hard drive random seek test
1704—01	Exceeded maximum soft error limit
1704—02	Exceeded maximum hard error limit
1704—03	Previously exceeded maximum soft error limit
1704—04	Previously exceeded maximum hard error limit
1704—05	Failed to reset controller
1704—06	Fatal error while reading
1704—40	Cylinder 0 error
1704—55	Cylinder 1 error
1704—65	Exceeded maximum bad sectors per track
1704—70	Failed translate mode
1704—71	Failed non-translate mode
1704—72	Bad track limit exceeded
1704—73	Previously exceeded bad track limit
1705—xx	Hard drive controller test
1705—05	Failed to reset controller
1705—44	Failed controller diagnostics
1705—56	Failed controller RAM diagnostics
1705—57	Failed controller to drive diagnostics
1706—xx	Hard drive ready test
1706—41	Drive not ready
1707—xx	Hard drive recalibrate test
1707—42	Failed to recalibrate drive
1708—xx	Hard drive format bad track test
1708—02	Exceeded maximum hard error limit
1708—05	Failed to reset controller
1708—09	Format bad track failed
1708—42	Recalibrate drive failed
1708—58	Failed to write sector buffer
1708—59	Failed to read sector buffer
1709—xx	Hard drive reset controller test
1709—05	Failed to reset controller
1710—xx	Hard drive park head test
1710—45	Failed to get drive parameters from ROM

Code	Meaning
1710—47	Failed to park heads
1714—xx	Hard drive file write test
1714—01	Exceeded maximum soft error limit
1714—02	Exceeded maximum hard error limit
1714—03	Previously exceeded maximum soft error limit
1714—04	Previously exceeded maximum hard error limit
1714—05	Failed to reset controller
1714—06	Fatal error while reading
1714—07	Fatal error while writing
1714—08	Failed compare of read/write buffers
1714—10	Failed diskette sector wrap during read
1714—48	Failed to move disk table to RAM
1714—49	Failed to read diskette media in file write test
1714—50	Failed file I/O write test
1714—51	Failed file I/O read test
1714—52	Failed file I/O compare test
1714—55	Failed cylinder 1
1714—65	Exceeded maximum bad sectors per track
1714—70	Failed translate mode
1714—71	Failed non-translate mode
1714—72	Bad track limit exceeded
1714—73	Previously exceeded bad track limit
1715—xx	Hard drive head select test
1715—45	Failed to get drive parameters from ROM
1715—53	Failed drive head register test
1715—54	Failed digital input register test
1716—xx	Hard drive conditional format test
1716—01	Exceeded maximum soft error limit
1716—02	Exceeded maximum hard error limit
1716—05	Failed to reset controller
1716—06	Fatal error while reading
1716—07	Fatal error while writing
1716—08	Failed compare of read/write buffers
1716—40	Cylinder 0 error
1716—42	Failed to recalibrate
1716—55	Cylinder 1 error
1716—58	Failed to write sector buffer
1716—59	Failed to read sector buffer
1716—60	Failed to compare sector buffer
1716—65	Exceeded maximum bad sectors per track
1716—66	Failed to initialize drive
1716—70	Failed translate mode
1716—71	Failed non-translate mode
1716—72	Bad track limit exceeded
1716—73	Previously exceeded bad track limit
1717—xx	Hard drive ECC test
1717—01	Exceeded maximum soft error limit
1717—02	Exceeded maximum hard error limit
1717—03	Previously exceeded maximum soft error limit
1717—04	Previously exceeded maximum hard error limit

Code	Meaning
1717—05	Reset controller failed
1717—06	Fatal error while reading (BIOS statusor0 x 20)
1717—07	Fatal error while writing
1717—08	Compare data failed
1717—40	Cylinder 0 failed
1717—55	Cylinder 1 failed
1717—61	Failed uncorrectable error
1717—62	Failed correctable error
1717—65	Exceeded maximum bad sectors per track
1717—67	Failed to write long
1717—68	Failed to read long
1717—70	Failed translate mode
1717—71	Failed non-translate mode
1717—73	Previously exceeded bad track limit
1719—xx	Hard drive power mode test failed
1799—00	Invalid hard disk drive type
17xx—01	Exceeded maximum soft error limit
17xx—02	Exceeded maximum hard error limit
17xx—03	Previously exceeded maximum soft error limit
17xx—04	Previously exceeded maximum hard error limit
17xx—05	Failed to reset controller
17xx—06	Fatal error while reading
17xx—07	Fatal error while writing
17xx—08	Failed compare of read/write/compare
17xx—09	Failed to format a track
17xx—10	Failed sector wrap test
17xx—19	Controller failed to deallocate bad sectors
17xx—40	Failed cylinder 0
17xx—41	Drive not ready
17xx—42	Recalibrate failed
17xx—43	Failed to format bad track
17xx—44	Failed controller diagnostics
17xx—45	Failed to get drive parameters from ROM
17xx—46	Invalid drive parameters found in ROM
17xx—47	Failed to park heads
17xx—48	Failed to move hard drive table to RAM
17xx—49	Failed to read media in file write test
17xx—50	Failed file I/O write test
17xx—51	Failed file I/O read test
17xx—52	Failed file I/O compare test
17xx—53	Failed drive/head register test
17xx—54	Failed digital input register test
17xx—55	Failed cylinder 1
17xx—56	Hard drive controller RAM diagnostics failed
17xx—57	Hard drive controller to drive test failed
17xx—58	Failed to write sector buffer
17xx—59	Failed to read sector buffer
17xx—60	Failed uncorrectable ECC error
17xx—62	Failed correctable ECC error
17xx—63	Failed soft error rate

Code	Meaning
17xx—65	Exceeded maximum bad sectors per track
17xx—66	Failed initial drive parameter
17xx—67	Failed to write long
17xx—68	Failed to read long
17xx—69	Failed to read drive size from controller
17xx—70	Failed translate mode
17xx—71	Failed non-translate mode
17xx—72	Bad track limit exceeded
17xx—73	Previously exceeded bad track limit

1900—Tape Drive

Code	Meaning
1900—xx	Tape ID failed
1900—01	Hard drive not installed
1900—02	Cartridge not installed
1900—26	Cannot identify hard drive
1900—27	Hard drive incompatible with controller
1900—36	Hard drive not installed in correct position
1901—xx	Tape Servo Write
1901—01	Drive not installed
1901—02	Cartridge not installed
1901—03	Tape motion error
1901—04	Drive busy error
1901—05	Track seek error
1901—06	Tape write-protected error
1901—07	Tape already Servo written
1901—08	Unable to Servo Write
1901—11	Drive recalibration error
1901—21	Servo pulses on second time, but not first
1901—22	Never got to EOT after Servo check
1901—25	Unable to erase cartridge
1901—27	Drive not compatible with controller
1901—91	Power lost during test, replace cartridge, or bulk erase it
1902—xx	Tape format
1902—01	Drive not installed
1902—02	Cartridge not installed
1902—03	Tape motion error
1902—04	Drive busy error
1902—05	Track seek error
1902—06	Tape write-protected error
1902—09	Unable to format
1902—10	Format mode error
1902—11	Drive recalibration error
1902—12	Tape not Servo Written
1902—13	Tape not formatted
1902—21	Got servo pulses second time, but not first
1902—22	Never got to EOT after servo check
1902—27	Drive not compatible with controller
1902—28	Format gap error

Code	Meaning
1903—xx	Tape drive sensor test
1903—01	Drive not installed
1903—23	Change line unset
1903—27	Drive not compatible with controller
1904—xx	Tape BOT/EOT test
1904—01	Drive not installed
1904—02	Cartridge not installed
1904—03	Tape motion error
1904—04	Drive busy error
1904—05	Track seek error
1904—15	Sensor error flag
1904—27	Drive not compatible with controller
1904—30	Exception bit not set
1904—31	Unexpected drive status
1904—32	Device fault
1904—33	Illegal command
1904—34	No data detected
1904—35	Power-on reset occurred
1905—xx	Tape read test
1905—01	Drive not installed
1905—02	Cartridge not installed
1905—03	Tape motion error
1905—04	Drive busy error
1905—05	Track seek error
1905—14	Drive timeout error
1905—16	Block locate (block ID) error
1905—17	Soft error limit exceeded
1905—18	Hard error limit exceeded
1905—19	Write error (probable ID error)
1905—27	Drive not compatible with controller
1905—30	Exception bit not set
1905—31	Unexpected drive status
1905—32	Device fault
1905—33	Illegal command
1905—34	No data detected
1905—35	Power-on reset occurred
1906—xx	Tape read/write compare test failed
1906—01	Drive not installed
1906—02	Cartridge not installed
1906—03	Tape motion error
1906—04	Drive busy error
1906—05	Track seek error
1906—06	Tape write-protected error
1906—14	Drive timeout error
1906—16	Block locate (block ID) error
1906—17	Soft error limit exceeded
1906—18	Hard error limit exceeded
1906—19	Write error (probable ID error)
1906—20	NEC fatal error
1906—27	Drive not compatible with controller

Code	Meaning
1906—30	Exception bit not set
1906—31	Unexpected drive status
1906—32	Device fault
1906—33	Illegal command
1906—34	No data detected
1906—35	Power-on reset occurred
1907—xx	Tape write-protected test
1907—24	Failed write-protected test
1907—30	Exception bit not set
1907—31	Unexpected drive status
1907—32	Device fault
1907—33	Illegal command
1907—34	No data detected
1907—35	Power-on reset occurred
19xx—01	Drive not installed
19xx—02	Cartridge not installed
19xx—03	Tape motion error
19xx—04	Drive busy error
19xx—05	Track seek error
19xx—06	Tape write-protected error
19xx—07	Tape already Servo Written
19xx—08	Unable to Servo Write
19xx—09	Unable to format
19xx—10	Format mode error
19xx—11	Drive recalibration error
19xx—12	Tape not Servo Written
19xx—13	Tape not formatted
19xx—14	Drive timeout error
19xx—15	Sensor error flag
19xx—16	Block locate (block ID) error
19xx—17	Soft error limit exceeded
19xx—18	Hard error limit exceeded
19xx—19	Write (probably ID) error
19xx—20	NEC fatal error
19xx—21	Got servo pulses second time but not first
19xx—22	Never got to EOT after servo check
19xx—23	Change line unset
19xx—24	Write-protect error
19xx—25	Unable to erase cartridge
19xx—26	Cannot identify drive
19xx—27	Drive not compatible with controller
19xx—28	Format gap error
19xx—36	Failed to set FLEX format mode
19xx—37	Failed to reset FLEX format mode
19xx—38	Data mismatched on directory track
19xx—39	Data mismatched on track 0
19xx—40	Failed self-test
19xx—91	Power lost during test

2402—Video

Code	Meaning
2402—01	Video memory test failed
2403—01	Video attribute test failed
2404—01	Video character set test failed
2405—01	Video 80 x 25 mode 9 x 14 character cell test failed
2406—01	Video 80 x 25 mode 8 x 8 character cell test failed
2407—01	Video 40 x 25 mode test failed
2408—01	Video 320 x 200 mode colour set 0 test failed
2409—01	Video 320 x 200 mode colour set 1 test failed
2410—01	Video 640 x 200 mode test failed
2411—01	Video screen memory page test failed
2412—01	Video grey scale test failed
2414—01	Video white screen test failed
2416—01	Video noise pattern test failed
2417—01	Lightpen Text mode test failed, no response
2417—02	Lightpen Text mode test failed, invalid response
2417—03	Lightpen medium resolution mode test failed, no response
2417—04	Lightpen medium resolution mode failed, invalid response
2418—01	ECG memory test failed
2418—02	ECG shadow RAM test failed
2419—01	ECG ROM checksum test failed
2420—01	ECG attribute test failed
2421—01	ECG 640 x 200 Graphics mode test failed
2422—01	ECG 640 x 350 16-colour set test failed
2423—01	ECG 640 x 350 64-colour set test failed
2424—01	ECG monochrome Text mode test failed
2425—01	ECG monochrome Graphics mode test failed
2431—01	640 x 480 Graphics test failure
2432—01	320 x 200 Graphics (256-colour mode) test failure
2448—01	Advanced VGA Controller test failed
2451—01	132-column Advanced VGA test failed
2456—01	Advanced VGA 256-colour test failed

3206—Audio

Code	Meaning
3206—xx	Audio System internal error

5234—Advanced Graphics 1024 Board

Code	Meaning
5234—01	Failed AGC controller test
5235—01	Failed AGC memory test, AGC board
5235—02	Failed AGC memory test, expansion board
5235—03	Failed AGC memory test, dualport memory
5235—04	Failed AGC memory test, program memory
5236—01	Failed AGC 640 x 480 Graphics test, 16 colours
5237—01	Failed AGC 640 x 480 Graphics test, 256 colours
5238—01	Failed AGC 1024 x 768 Graphics test, 16 colours
5239—01	Failed AGC 1024 x 768 Graphics test, 256 colours

Code	Meaning
5240—xx	Failed shared memory arbitration test

6000—Network Interface

Code	Meaning
6000—xx	Pointing device interface
6014—xx	Ethernet Configuration test failed
6016—xx	Ethernet reset test failed
6028—xx	Ethernet internal loopback test failed
6029—xx	Ethernet external loopback test failed
6054—xx	Token Ring Configuration test failed
6056—xx	Token Ring reset test failed
6068—xx	Token Ring internal loopback test failed
6069—xx	Token Ring external loopback test failed
6089—xx	Token Ring open

XXXX—SCSI Interface

Code	Meaning
XXXX—02	Drive not installed
XXXX—03	Media not installed
XXXX—05	Seek failure
XXXX—06	Drive timed out
XXXX—07	Drive busy
XXXX—08	Drive already reserved
XXXX—09	Reserved
XXXX—10	Reserved
XXXX—11	Media soft error
XXXX—12	Drive not ready
XXXX—13	Media error
XXXX—14	Drive hardware error
XXXX—15	Illegal drive command
XXXX—16	Media was changed
XXXX—17	Tape write protected
XXXX—18	No data detected
XXXX—21	Drive command aborted
65XX—24	Media hard error
66XX—24	Media hard error
67XX—24	Media hard error
XXXX—25	Reserved
XXXX—30	Controller timed out
XXXX—31	Unrecoverable error
XXXX—32	Controller/drive not connected
XXXX—33	Illegal controller command
XXXX—34	Invalid SCSI bus phase
XXXX—35	Invalid SCSI bus phase
XXXX—36	Invalid SCSI bus phase
XXXX—39	Error status from drive
XXXX—40	Drive timed out
XXXX—41	SCSI bus stayed busy
XXXX—42	ACK/REQ lines bad

Code	Meaning
XXXX—43	ACK did not deassert
XXXX—44	Parity error
XXXX—50	Data pins bad
XXXX—51	Data line 7 bad
XXXX—52	MSG, C/D, or I/O lines bad
XXXX—53	BSY never went busy
XXXX—54	BSY stayed busy
XXXX—60	Controller CONFIG-1 register fault
XXXX—61	Controller CONFIG-2 register fault
XXXX—65	Media not unloaded
XXXX—90	Fan failure
XXXX—91	Over temperature condition
XXXX—92	Side panel not installed
XXXX—99	AutoLoader reported tape not loaded properly

8601—Pointing Device

Code	Meaning
8601—xx	Pointing device interface
8601—01	Mouse ID fails
8601—02	Left button is inoperative
8601—03	Left button is stuck closed
8601—04	Right button is inoperative
8601—05	Right button is stuck closed
8601—06	Left block not selected
8601—07	Right block not selected
8601—08	Timeout occurred
8601—09	Mouse loopback test failed
8601—10	Pointing device is inoperative

Compaq Expanded Memory Manager (CEMM)

Code	Meaning
00	LGDT instruction
01	LIDT instruction
02	LMSW instruction
03	LL2 instruction
04	LL3 instruction
05	MOV CRx instruction
06	MOV DRx instruction
07	MOV TRx instruction

CEMM Exception Errors

Code	Meaning
00	Divide
01	Debug exception
02	NMI or parity
03	INT 0 (Arithmetic Overflow)
04	INT 3
05	Array bounds check

Code	Meaning
06	Invalid opcode
07	Coprocessor device not available
08	Double fault
09	Coprocessor segment overrun
10	Invalid TSS
11	Segment not present
12	Stack fault
13	General protection fault
14	Page fault
16	Coprocessor
32	Attempt to write to protected area
33	Reserved
34	Invalid software interrupt

Deskpro 286 Memory Error Codes

These are in the *XX000B YYZZ* format:

- ❑ XX represents which bank of 18 chips
- ❑ B determines which byte the defective chip is in (0=low byte, 1=high byte).
- ❑ YY or ZZ identifies which bit or individual chip is bad. See below for XX/YY references.

For example, 040001 0010 specifies chip U24. For Version 2 (Assy No. 000361) and Version 3 (Assy No. 000555) System Boards, use the formula defined above (XX000B YYZZ). If XX = 08 or 09, replace the system board. Does not apply to Version 1 (Assy No. 000094) system boards.

64K Chip	XX = 06, 07	XX = 04, 05	XX = 02, 03	XX = 00, 01
256K Chips	XX = 2027	XX = 181F	XX = 1017	XX = 0007
Bank 4	Bank 3	Bank 2	Bank 1	
Data Bit	B = 0B = 1	B = 0B = 1	B = 0B = 1	B = 0B = 1
YY or ZZ	LowHigh	LowHigh	LowHigh	LowHigh
80	U27U40	U52U66	U82U93	U107 U124
40	U28U41	U53U67	U83U94	U108 U125
20	U29U42	U54U68	U84U95	U109 U126
10	U30U43	U55U69	U85U96	U110 U127
08	U31U44	U56U70	U86U97	U111 U128
04	U32U45	U57U71	U87U98	U112 U129
02	U33U46	U58U72	U88U99	U113 U130
01	U34U47	U59U73	U89U100	U114 U131
00	U35U48	U60U74	U90U101	U115 U132

General

Message	Meaning
Invalid ROM Parameter Table	Probably from NetWare, on Phoenix 286/386 BIOSes and AMI 286 BIOSes when the user definable parameters are not compatible.
WARNING: Cannot disable Gate A20	Gate A20 is an alternate method of controlling memory above 1Meg, which needs to be actively controlled by HIMEM.SYS. Unset from BIOS.

HP Vectra

Code	Meaning
000f	Microprocessor error
001x	BIOS ROM error
008x	Video ROM error
009x-bx	Option ROM error while testing address range c800-dfff
00cx-dx	Option ROM error while testing address range e000-efff
011x	RTC error while testing the CMOS register
0120	RTC error
0130	RTC/System configuration error
0240	CMOS memory/system configuration error
0241	CMOS memory error
0250	Invalid configuration
0280	CMOS memory error
02c0-c1	EEPROM error
02d0	Serial # not present
030x-3x	Keyboard/Mouse controller error
034x-5x	Keyboard test failure
03e0-4	Keyboard/Mouse controller error
03e5-b	Mouse test failure
03ec	Keyboard/Mouse controller error
0401	Protected Mode failure
050x	Serial Port error
0506	Datacomm conflict
0510-20	Serial Port error
0543-5	Parallel Port error
0546	Datacomm conflict
06xx	Keyboard key stuck
07xx	Processor speed error
0800	Boot ROM conflict
0801	Boot ROM not found
081x	Integrated Ethernet Interface errors
0900	Fan error
110x-01	Timer error
20xa	Memory mismatch
21xx/22xx	DMA error
30xx	HP-HIL error
4xxx	RAM error
5xxx	As above
61xx	Memory address line error
62xx	RAM parity error/memory controller error
630x	RAM test error
6400	As above
6500	BIOS ROM shadow error
6510	Video BIOS shadowing error/system ROM error
6520	Option ROM shadowing error
65a0-f0	Shadow error probably caused by system board memory
66xx	Shadow error probably caused by memory on accessory board
7xxx	Interrupt error
8003	Bad drive configuration

Code	Meaning
8004	CMOS Drive/System Configuration error
8005-6	Bad drive configuration
8007	CMOS Drive/System Configuration error
8048-a	Hard disk drive identity error
8050	Hard disk drive controller conflict
84xx	Bad boot sector
8x0d	Controller Busy/Controller Error
8x0e	Hard disk error
8x0f	Hard disk drive mismatch
8x10	Controller Busy/Controller Error
8x11	Hard disk drive control error
8x12	Controller Busy/Controller Error
8x13	Hard disk drive control error
8x20-1	Controller Busy/Controller Error
8x28	Hard disk drive splitting error
8x30	Hard disk drive control error
8x38	Controller Busy/Controller Error
8x39-b	Hard disk drive control error
8x3c	Controller Busy/Controller Error
8x40	As above
8x41-4	Hard disk drive control error
8x45	Controller Busy/Controller Error
8x49	Hard disk drive control error
8x4b	As above
9xxx	Flexible disk drive error
9x0a	Flexible disk drive conflict
9x10	As above
A00x	Numeric coprocessor error
B300	Cache controller error
B320	Memory cache module error
Cxxx	Extended RAM error (for HP-HIL PCs)
Exxx	Bus memory error

IBM AT

10X—System Board/Setup/90-95 proc board

Code	Meaning
000	SCSI Adapter not enabled
02X	SCSI Adapter
08X	SCSI terminator
101	System Board or Interrupt failure.
102	ROM Checksum or timer error, 90/95 proc board
102	Timer failure (AT)
103	ROM Checksum Error (PC)
103	Timer interrupt failure (AT)
104	Protected mode failure (AT)
105	Last 8042 command not accepted.
106	Converting logic test

Code	Meaning
107	Interrupt failure or Hot NMI test.
108	Timer bus test.
109	Direct memory access test error.
110	Planar parity error, memory, system board
111	I/O perity error, memory adapter or memory
112	Watchdog timeout, any adapter, system board
113	DMA arbitration tiimeout, any adapter.
114	Ext ROM error, any adapter
115	80386 protected mode failure/BIOS checksum
116	80386 16/32 bit test failed/planar/read/write
118	System board memory, riser, cache
119	2.88 Mb drive installed but not supported
120	90-95 processor self-test failure
121	Unexpected hardware interrupts occurred.
129	Internal (L2) cache test
131	Cassette wrap test failed (bad system board)
132	DMA extended registers
133	DMA verify logic
134	DMA arbitration logic
151	Real Time Clock Failure (or CMOS error on 5170)
152	CMOS Date and Time error (5170)
160	Planar ID not recognised
161	System Options Error (Battery failure) CMOS chip power
162	System options error (Run Setup) CMOS Checksum error
163	Time and date not set (Run Setup).
164	Memory size error (Run Setup) CMOS does not match sys.
165	System options not set – reconfigure
166	Adapter busy; any adapter, comm cartridge
167	Clock not updating
169	Set configuration/features
170	90-95 ASCII setup error, PCC user error
171	I/O card failure, battery
172	90-95 NVRAM rolling bit error
173	PCC only, diskette in use when suspended
174	Set configuration/features
175	Security error; system board. Primary secure data, Riser card
176	Chassis intrusion detector not cleared.
177	Security error; system board, Administrator password
178	Security error; system board, Riser card
179	Run Diags for more info; More Utilites, error log
181	Any adapter, run auto config
182	Privileged access password needed; reset pw jump
183	Enter priv access rather than PW on password
184	Thinkpad 700 system board password corrupt
185	Thinkpad 700 system board password corrupt
186	Security error; system board, Riser Card
187	Set system ID from ref disk
188	Thinkpad 700 system board password corrupt
189	3 password attempts
190	System Board. Chassis intrusion detector cleared.

Code	Meaning
191	82385 cache test failed, system board
192	N51 Lid switch, Thinkpad 700 run diags
193	System board, memory, riser(90/95), proc bd
194	System board, memory, riser(90/95), proc bd
199	User indicated configuration not correct.

2XX—Memory

Code	Meaning
201	Memory test failed.
202	Memory address error (line error 00..15)
203	Memory address error (line error 16..23)
204	Relocated memory (run diags again)
205	CMOS error
207	ROM failure
210	Processor board or memory riser
211	Base 64K on I/O channel failed
215	Base memory or daughter card
216	Base memory or daughter card
221	This is a COINS error code. ROM-RAM parity
225	Wrong speed SIMM
229	L2 cache test
231	Expanded memory option error
241	Unsupported SIMM
251	SIMM location changed
262	Base or Extended memory error

3XX—Keyboard

Code	Meaning
301	Keyboard software reset failure or stuck key failure
302	User indicated error or PCAT system unit keylock is locked.
303	Keyboard or system unit error.
304	Keyboard or system unit error; CMOS does not match system.
305	Keyboard 5v error, external keypad
306	System board, aux input device
307	System board, aux input device
308	Numeric keyboard, system board
365	Replace Keyboard
366	Replace Interface Cable
367	Replace Enhancement Card or Cable

4XX—Monochrome/Printer Adapter

Code	Meaning
401	Monochrome memory test or horizontal sync frequency test
408	User indicated display attributes failure.
416	User indicated character set failure.
424	User indicated 80X25 mode failure.
432	Parallel port test failed (monochrome adapter).

5XX – CGA or Video Adapter

Code	Meaning
501	Colour memory test failed
508	User indicated display attribute failure.
516	User indicated character set failure.
524	User indicated 80X25 mode failure.
532	User indicated 40X25 mode failure.
540	User indicated 320X200 graphics mode failure.
548	User indicated 640X200 graphics mode failure.
556	Light pen test failed.
564	User indicated screen paging test failure.

6XX—Diskette Drive and Adapter

Code	Meaning
601	Diskette power on diagnostics test failed.
602	Diskette test failed; boot record is not valid.
603	Diskette size failure
604	Wrong diskette drive type
605	POST cannot unlock diskette drive
606	Diskette verify function failed.
607	Write protected diskette.
608	Bad command diskette status returned.
610	Diskette initialization failed.
611	Timeout diskette status returned (could not read dskt)
612	Bad NEC diskette status returned (BIOS dskt routines)
613	Bad DMA diskette status returned (overrun failure)
614	DMA boundary software problem.
621	Bad seek.....Diskette status returned.
622	Bad CRC....diskette status returned. Reformat scratch diskette, retry.
623	Record not found....diskette status returned. Reformat diskette, retry.
624	Bad address mark....diskette status returned. Reformat scratch diskette and retry.
625	Bad NEC seek.....diskette status returned.
626	Diskette data compare error. Reformat scratch diskette, retry before accepting.
627	Diskette line change error
628	Diskette removed (invalid media)
630	Index stuck hi/lo A drive
631	Index stuck hi/lo A drive
632	Track 0 stuck off/on A drive
633	Track 0 stuck off/on A drive
640	Index stuck hi/lo B drive
641	Index stuck hi/lo B drive
642	Track 0 stuck off/on B drive
643	Track 0 stuck off/on B drive
650	Drive speed error
651	Format, verify failure
652	Format, verify failure
653	Read, write
654	Read, write
655	Controller failure
656	Drive failure

Code	Meaning
662	Wrong drive type installed, drive, cable
663	Wrong media type
657	Write protect stuck
658	Change line stuck
659	Write protect stuck
660	Change line stuck
670	System board, drive, cable
675	System board, drive, cable

7XX—Maths Coprocessor

Code	Meaning
701	CoPro Failure; replace Coprocessor

9XX—Parallel Printer Adapter

Code	Meaning
901	Parallel printer adapter test failed.
914	Conflict between 2 parallel printer adapters.

10XX—Parallel Printer Adapter

Code	Meaning
1001	Parallel printer adapter test failed.
1014	Conflict between 2 parallel printer adapters.

11XX—Async Adapter

Code	Meaning
1101	Asynchronous or 16550 failure. Make sure adapter not set for current loop.
1102	Card selected feedback error
1103	Port 102h fails register check
1106	Serial option cannot be put to sleep
1107	Serial device cable, system board
1108	Async IRQ3/4 error
1109	Async IRQ3/4 error
1110	Modem Status Register not clear/16550 register test failure
1111	Ring Indicate failure/Internal or external 16550 wrap failed
1112	Trailing Edge Ring indicate failure/ Ring Indicate failure/Internal or external 16550 wrap failed
1113	Receive and Delta Receive line signal detect failure/16550 transmit or receive error
1114	16550 transmit or receive error
1115	Delta Receive line signal detect failure. 16550 receive data not match transmit
1116	Line Control Register (all bits cannot be set). 16550 interrupt.
1117	Line Control Register (all bits cannot be reset). 16550 failed baud rate
1118	Transmit holding and/or shift register stuck on. 16550 interrupt driven wrap
1119	Data Ready stuck on. 16550 FIFO
1120	Interrupt Enable Register (all bits cannot be set)
1121	Interrupt Enable Register (all bits cannot be reset)
1122	Interrupt pending stuck on
1123	Interrupt ID register stuck on
1124	Modem Control Register (all bits cannot be set)

Code	Meaning
1125	Modem Control Register (all bits cannot be reset)
1126	Modem Status Register (all bits cannot be set)
1127	Modem Status Register (all bits cannot be reset)
1128	Interrupt ID Failure
1129	Cannot force overrun error
1130	No Modem Status Interrupt
1131	Invalid Interrupt status pending
1132	No data ready
1133	No data available Interrupt
1134	No Transmit Holding Interrupt
1135	No Interrupts
1136	No Receive Line Status Interrupt
1137	No Receive data available
1138	Transmit Holding Register not empty
1139	No Modem Status Interrupt
1140	Transmit Holding Register not empty
1141	No Interrupts
1142	NO IRQ4 Interrupt
1143	No IRQ3 Interrupt
1144	No Data Transferred
1145	Max Baud rate failed
1146	Min Baud rate failed
1148	Timeout Error
1149	Invalid Data Returned
1150	Modem Status Register error
1151	No DSR to Delta DSR
1152	No Data Set Ready
1153	No Delta
1154	Modem Status Register not clear
1155	No CTS and Delta CTS
1156	No Clear to Send
1157	No delta CTS

12XX—Alternate Async Adapter

As for 11XX.

13XX—Game Controller

Code	Meaning
1301	Game control adapter test failed.
1302	Joystick test failed.

14XX—Graphics Printer

Code	Meaning
1401	Printer failure
1402	Printer not ready
1403	No paper, interrupt failure
1404	System board timeout
1405	Parallel adapter failure

Code	Meaning
1406	Presence test failed

15XX—SDLC Adapter

Code	Meaning
1501	Adapter test failed.
1510	8255 port B failure.
1511	8255 port A failure.
1512	8255 port C failure.
1513	8253 timer 1 did not reach terminal count.
1514	8253 timer 1 stuck on.
1515	8253 timer 0 did not reach terminal count.
1516	8253 timer 0 stuck on.
1517	8253 timer 2 did not reach terminal count.
1518	8253 timer 2 stuck on.
1519	8273 port B error
1520	8273 port A error.
1521	8273 command ADAPTER Read timeout.
1522	Interrupt level 4 failure.
1523	Ring Indicate stuck on.
1524	Receive clock stuck on.
1525	Transmit clock stuck on.
1526	Test indicate stuck on.
1527	Ring indicate not on.
1528	Receive clock not on.
1529	Transmit clock not on.
1530	Test indicate not on.
1531	data set ready not on.
1532	Carrier detect not on.
1533	Clear to send not on.
1534	Data set ready stuck on.
1536	Clear to send stuck on.
1537	Level 3 interrupt failure.
1538	Receive interrupt results error.
1539	Wrap data miscompare.
1540	DMA channel 1 error.
1541	DMA channel 1 error.
1542	Error in 8273 error checking or status reporting.
1547	Stray interrupt level 4.
1548	Stray interrupt level 3.
1549	Interrupt presentation sequence timeout.

16XX—Display Station Emulation

Code	Meaning
1604	Adapter error
1608	Adapter error
1624	Adapter error.
1634	Adapter error.
1644	Adapter error.
1652	Adapter error.

Code	Meaning
1654	Adapter error.
1658	Adapter error.
1664	Adapter error.
1662	Interrupt Level switches set incorrectly or DSEA Adapter error.
1668	Interrupt Level switches set incorrectly or DSEA Adapter error.
1674	Station address error or DSEA Adapter error.
1684	Feature not installed or Device address switches set incorrectly.
1688	Feature not installed or Device address switches set incorrectly.

17XX—Fixed Disk Drive and Adapter (ST 506)

Code	Meaning
1701	PC Fixed disk POST error (drive not ready)
1701	PCAT Hardfile adapter test failed
1702	PC Fixed disk adapter error.
1702	PCAT Timeout error
1703	PC Fixed disk drive error.
1703	PCAT Seek Failure
1704	PC Fixed disk adapter or drive error.
1704	PCAT Controller Failure
1705	No Record Found
1706	Write Fault Error
1707	Track 0 Error
1708	Head Select Error
1709	Bad ECC.
1710	Read Buffer Overrun. drive not ready
1711	Bad Address Mark. Drive not ready
1712	Bad Address Mark. Load Adv. Diags. from cold boot (5170 only)
1713	Data Compare Error. DMA boundary
1714	Drive Not Ready. POST error
1715	Track 0 error (wrong drive?)
1716	Diag track (CE) bad
1717	Surface read errors
1726	Data compare error
1730	Replace Adapter
1731	Replace Adapter
1732	Replace Adapter
1735	Bad command
1750	Drive verify/read/write error
1751	Drive verify/read/write error
1752	Drive verify/read/write error
1753	Random read test error
1754	Seek test error
1755	ST506 controller
1756	ECC test error
1757	Head select test error
1780	Fixed disk 0 failure (fatal no IPL Capability). Timeout
1781	Fixed disk 1 failure (fatal drive 0 may still be OK). Timeout
1782	Fixed disk controller failure (fatal no IPL from hardfile)
1790	Fixed disk 0 error (non fatal...f1 can attempt IPL from drive) check for improper cabling.

Code	Meaning
1791	Fixed disk 1 error (non fatal...f1 can attempt IPL from drive)

18XX—Expansion Unit Errors

Code	Meanings
1800	PCI adapter requested a hardware interrupt not available.
1801	I/O expansion unit POST error. PCI adapter requested memory resources not available.
1802	System board PCI adapter requested I/O address not available.
1803	PCI adapter requested memory address not available.
1804	PCI adapter requested memory address not available
1805	PCI adapter ROM error.
1810	Enable/Disable failure.
1811	Extender card warp test failed (disabled).
1812	High order address lines failure (disabled).
1813	Wait state failure (disabled). If 3278/79 adapter or /370 adapter installed check for down level Extender Adapter (ECA011).
1814	Enable/Disable could not be set on.
1815	Wait state failure (disabled).
1816	Extender card warp test failed (enabled).
1817	High order address lines failure (enabled).
1818	Disable not functioning.
1819	Wait request switch not set correctly.
1820	Receiver card wrap test failure.
1821	Receiver high order address lines failure.
1850	PnP adapter requested a hardware interrupt not available.
1851	PnP adapter requested memory resources not available.
1852	PnP adapter requested I/O address not available.
1853	PnP adapter requested memory address not available.
1854	PnP adapter requested memory address not available.
1855	PnP adapter ROM error.
1856	PnP adapter requested DMA address not available
1962	Startup sequence error.

20XX—Binary Synchronous Communications Adapter

Code	Meaning
2001	POST failed.
2010	8255 port A failure.
2011	8255 port B failure.
2012	8255 port C failure.
2013	8253 timer 1 did not reach terminal count.
2014	8253 timer 1 stuck on.
2016	8253 timer 2 did not reach terminal count or timer 2 stuck on.
2017	8251 Data set ready failed to come on.
2018	8251 Clear to send not sensed.
2019	8251 Data set ready stuck on.
2020	8251 error
2021	8251 hardware reset failed.
2022	8251 software reset failed.
2023	8251 software error reset failed.
2024	8251 transmit ready did not come on.
2025	8251 receive ready did not come on.

Code	Meaning
2026	8251 could not force overrun error status.
2027	Interrupt failure—no timer interrupt.
2028	Interrupt failure....transmit, replace card or planar.
2029	Interrupt failure....transmit, replace card.
2030	Interrupt failure....receive, replace card or planar.
2031	Interrupt failure....receive, replace card.
2033	Ring indicate stuck on.
2034	Receive clock stuck on.
2035	Transmit clock stuck on.
2036	Test indicate stuck on.
2037	Ring indicate stuck on.
2038	Receive clock not on.
2039	Transmit clock not on.
2040	Test indicate not on.
2041	Data set ready not on.
2042	Carrier detect not on.
2043	Clear to send not on.
2044	Data set ready stuck on.
2045	Carrier detect stuck on.
2046	Clear to send stuck on.
2047	Unexpected transmit interrupt.
2048	Unexpected receive interrupt.
2049	Transmit data did not equal receive data.
2050	8251 detected overrun error.
2051	Lost data set ready during data wrap.
2052	Receive timeout during data wrap.

21XX—Alternate Binary Synchronous Communications Adapter

As for 20XX. Also 16-bit AT Fast SCSI Adapter or Riser Card.

22XX—Cluster Adapter Errors

Code	Meaning
2201	Cluster Adapter Failure
2221	Replace Cluster Adapter

23XX—Plasma Monitor Adapter

24XX—EGA Adapter

Code	Meaning
2401	EGA Failure – if screen colours change. Otherwise, system board
2402	Diagnostic video error planar 8512
2409	Display
2410	System board or display in that order
2462	Video (memory) configuration error.

26XX—PC/370

27XX—PC/3277

28XX—3278/79 Emulation Adapter

Code	Meaning
2801	Adapter failure (coax not attached). If 3270PC, check Keyboard/Timer ROM (ECA040)
2854	Diagnostic Incompatibility
2859	Possible bad BSC Card

29XX—Colour Printer

Code	Meaning
2901	Colour Graphics printer tests failed

30XX – PC Network Adapter

Code	Meaning
3001	Adapter Failure Replace Primary LAN Adapter
3002	ROM Failure....Replace Primary LAN Adapter
3003	ID Failure....Replace Primary LAN Adapter
3004	RAM Failure....Replace Primary LAN Adapter
3005	Host Interrupt Failure....Replace Primary LAN Adapter
3006	NEG 12V DC Failure....Replace Primary LAN Adapter
3007	Digital Wrap Failure....Replace Primary LAN Adapter
3008	Host Interrupt Failure....Replace Primary LAN Adapter
3009	Sync Failure....Replace Primary LAN Adapter
3010	Time Out Failure....Replace Primary LAN Adapter
3011	Time Out Failure....Replace Primary LAN Adapter
3012	Adapter Failure....Replace Primary LAN Adapter
3013	Digital Failure....Replace Primary LAN Adapter
3014	Digital Failure....Replace Primary LAN Network Adapter
3015	Analogue Failure (RF) (adapter not hooked to translator). Check for missing wrap or terminator on adapter. Network attached?
3016	Analogue failure
3020	ROM BIOS Failure
3041	Continuous RF Signal Detected. Hot carrier (not this card)
3042	Continuous RF Signal Sent.. Hot carrier (this card)

31XX—Alternate LAN Network

As for 30XX.

32XX—3270 PC Display Adapter

35XX—Enhanced Display Station Adapter

Code	Meaning
3504	Adapter connected to twinax during off line tests
3508	Workstation address conflictorrect Diags or Adapter
3588	Feature not installed or Device addr. switches set
3588	incorrectly or Adapter error.

36XX—GPIB Adapter

Code	Meaning
3601	Base Address incorrect
3602	Write to SPMR failed
3603	Write to ADR failed or addressing problems
3610	Adapter cannot be programmed to listen
3611	Adapter cannot be programmed to talk
3612	Adapter cannot take control with IFC
3613	Adapter cannot go to standby
3614	Adapter cannot take control asynchronously
3615	Adapter cannot take control synchronously
3616	Adapter cannot pass control
3617	Adapter cannot be addressed to listen
3618	Adapter cannot be unaddressed to listen
3619	Adapter cannot be addressed to talk
3620	Adapter cannot be unaddressed to talk
3621	Adapter unaddressable to listen with extended addressing
3622	Adapter unaddressable to listen with extended addressing
3623	Adapter unaddressable to listen with extended addressing
3624	Adapter unaddressable to listen with extended addressing
3625	Adapter cannot write to self
3626	Adapter cannot generate handshake error
3627	Adapter cannot detect DCL message
3628	Adapter cannot detect SDC message
3629	Adapter cannot detect END with EOI
3630	Adapter cannot detect EOI with EOI
3631	Adapter cannot detect END with 8 bit EOS
3632	Adapter cannot detect END with 7 bit EOS
3633	Adapter cannot detect GET
3634	Mode 3 addressing not functioning
3635	Adapter cannot recognize undefined command
3636	Adapter cannot detect REM
3637	Adapter cannot clear REM or LOK
3638	Adapter cannot detect SRQ
3639	Adapter cannot conduct serial poll
3640	Adapter cannot conduct parallel poll
3650	Adapter cannot DMA to 7210
3651	Data error on DMA to 7210
3652	Adapter cannot DMA form 7210
3653	Data error on DMA from 7210
3658	Unevoked interrupt received
3659	Adapter cannot interrupt of ADSC
3660	Adapter cannot interrupt on ADSC
3661	Adapter cannot interrupt on CO
3662	Adapter cannot interrupt on DO
3663	Adapter cannot interrupt on DI
3664	Adapter cannot interrupt on ERR
3665	Adapter cannot interrupt on DEC
3666	Adapter cannot interrupt on END
3667	Adapter cannot interrupt on DET

Code	Meaning
3668	Adapter cannot interrupt on APT
3669	Adapter cannot interrupt on CPT
3670	Adapter cannot interrupt on REMC
3671	Adapter cannot interrupt on LOKC
3672	Adapter cannot interrupt on SRQI
3673	Adapter cannot interrupt terminal count on DMA to 7210
3674	Adapter cannot interrupt terminal count on DMA from 7210
3675	Spurious DMA terminal count interrupt
3697	Illegal DMA configuration setting detected
3698	Illegal interrupt level configuration setting detected

38XX—Data Acquisition (DAC) Adapter

Code	Meaning
3801	Adapter test failed
3810	Timer read test failed
3811	Timer interrupt test failed
3812	Delay, BI14 test failed
3813	Rate, BI13 test failed
3814	BO14, ISIRQ test failed
3815	BOO, Counting test failed
3816	Countout, BISTB test failed
3817	BOO, BOCTS test failed
3818	BO1, BIO test failed
3819	BO2, BI1 test failed
3820	BO3, BI2 test failed
3821	BO4, BI3 test failed
3822	BO5, BI4 test failed
3823	BO6, BI5 test failed
3824	BO7, BI6 test failed
3825	BO8, BI7 test failed
3826	BO9, BI8 test failed
3827	BO10, BI9 test failed
3828	BO11, BI10 test failed
3829	BO12, BI11 test failed
3830	BO13, BI12 test failed
3831	BO15, AICE test failed
3832	BOSTB, BOGATE test failed
3833	BICTS, BIHOLD test failed
3834	AICO, BI15 test failed
3835	Counter interrupt test failed
3836	Counter read test failed
3837	AO0 Ranges test failed
3838	AO1 Ranges test failed
3839	AI0 Values test failed
3840	AI1 Values test failed
3841	AI2 Values test failed
3842	AI3 Values test failed
3843	Analog input interrupt test failed
3844	AI23 Address or Value test failed

39XX—Professional Graphics Adapter

Code	Meaning
3901	Adapter Tests failed
3902	Rom1 self test failure
3903	Rom2 self test failure
3904	Ram self test failure
3905	Coldstart failure cycle power
3906	Data error in communications RAM
3907	Address error in communications RAM
3918	Bad data detected while read/write to 6845 'like' registers
3909	Bad data in lower EOH bytes read/writing 6845 'like' registers
3910	PGC display bank output latches
3911	Basic clock failure
3912	Command control error
3913	VSYNC scanner
3914	HSYNC scanner
3915	Intech failure
3916	LUT address error
3917	LUT red RAM chip error
3918	LUT green RAM chip error
3919	LUT blue RAM chip error
3920	LUT data latch error
3921	Horizontal display failure
3922	Vertical display failure
3923	Light pen
3924	Unexpected error
3925	Emulator addressing error
3926	Emulator data latch
3927	Emulator RAM base for error codes 27—30
3931	Emulator H/V display problem
3932	Emulator cursor position
3933	Emulator attribute display problem
3934	Emulator cursor display
3935	Fundamental emulation RAM problem
3936	Emulation character set problem
3937	Emulation graphics display
3938	Emulator character display problem
3939	Emulator bank select error
3940	Display RAM U2
3941	Display RAM U4
3942	Display RAM U6
3943	Display RAM U8
3944	Display RAM U10
3945	Display RAM U1
3946	Display RAM U3
3947	Display RAM U5
3948	Display RAM U7
3949	Display RAM U9
3950	Display RAM U12
3951	Display RAM U14

Code	Meaning
3952	Display RAM U16
3953	Display RAM U18
3954	Display RAM U20
3955	Display RAM U11
3956	Display RAM U13
3957	Display RAM U15
3958	Display RAM U17
3959	Display RAM U19
3960	Display RAM U22
3961	Display RAM U24
3962	Display RAM U26
3963	Display RAM U28
3964	Display RAM U30
3965	Display RAM U21
3966	Display RAM U23
3967	Display RAM U25
3968	Display RAM U27
3969	Display RAM U29
3970	Display RAM U32
3971	Display RAM U34
3972	Display RAM U36
3973	Display RAM U38
3974	Display RAM U40
3975	Display RAM U31
3976	Display RAM U33
3977	Display RAM U35
3978	Display RAM U37
3979	Display RAM U39
3980	PGC RAM timing failure
3981	PGC R/W latch
3982	S/R bus output latches
3983	Addressing error (vertical column of memory..U2 at top)
3984	Addressing error (vertical column of memory..U4 at top)
3985	Addressing error (vertical column of memory..U6 at top)
3986	Addressing error (vertical column of memory..U8 at top)
3987	Addressing error (vertical column of memory..U10 at top)
3988	Base for error codes 8891 (hbank data latch errors)
3992	RAS/CAS PGC failure
3993	Multiple write modes/nibble mask errors
3994	Row nibble failure (display RAM)
3995	PGC addressing failure

44XX—3270/G/GX Display

45XX—IEEE-488 Adapter

46XX – Mulitport/2 Adapter

Code	Meaning
4611	Mulitport/2 Interface Board

Code	Meaning
4612	Memory Module Package
4613	Memory Module Package
4630	Mulitport/2 Interface Board
4640	Memory Module Package
4641	Memory Module Package
4650	Interface Cable

5001-5017—Thinkpad, L40, N51 System Board

5018—Thinkpad, L40, N51 LCD Assembly

5019,22,23—Thinkpad, L40, N51 System Board or LCD Assembly

5030,31—Thinkpad, L40, N51 External display or system board

5032,33,37—Thinkpad, L40, N51 External display

5038 – Thinkpad, L40, N51 External CRT

5041—Thinkpad, N51 External display, system board, I/O panel

5051,62—Thinkpad, N51 System Board, LCD components

56XX—Financial System Controller Adapter

Code	Meaning
5601	Personal System 2 keyboard is not attached.
5602	Keyboard self test failed. Use a keyboard
5603	Invalid configuration of keyboards detected.
5604	No port has keyboard attached to financial input conn.
5605	Keyboard self test failed.
5606	Selected 4700 keyboard not attached to system.
5607	Invalid key code from keyboard on PIN Keypad (diagnostic selection invalid).
5608	4700 keyboard not operating correctly
5609	Invalid system for the keyboard program.
5610	No PIN Keypad attached (diagnostic selection error)
5611	Key code received other than expected by DIAG PROG. PIN keypad failed.
5612	Encrypting PIN Keypad detected data of an incorrect length
5614	No PIN Keypad attached to Financial Input Conn.
5615	Key on 4700 Kybd used to cancel PIN entries has incorrect code. Pin Pad Failed Self Test.
5616	The Pin Keypad is not attached to the pointing device connector
5617	Pin Keypad failed self test
5618	Pin Keypad has a communication error
5619	System invalid for PIN keypad driver
5621	Magnetic Stripe device error
5622	Magnetic Stripe reader/encoder error Wrong Diagnostic Diskette Level.
5623	No Magnetic Stripe device connected to the Financial Input Conn.
5624	The key on the 4700 Kybd that is used to cancel PIN entries has an incorrect code.

Code	Meaning
5625	No Magnetic Stripe device connected
5626	Data read and data encoded by mag stripe device do not match
5627	Magnetic stripe unit self test failed
5629	System invalid for the magnetic stripe unit driver
5630	STATUS = F1 system attempted unsuccessful IPL from diskette.
5631	STATUS REMOTE START attempt to establish connection with 4700 controller has begun.
5632	Diagnostics failed to load from diskette drive
5633	STATUS REMOTE IPL. Initial loading of a program from the 4700 controller is in progress.
5634	remote ipl error between 4700 pc and controller
5641	Financial Input adapter failed
5651	Financial Output adapter failed
5652	Output failure of printer or adapter
5653	The customization data for the printer missing
5654	Loop cable for the printer not connected
5655	PRINTER REDIRECT error in the order of config.sys
5661	Financial Security adapter failed
5662	Data Encryption tried during normal operation without the Financial Security adapter installed
5663	No Master Key is present in the Financial Security adapter
5690	4700PC banking features not those expected

59XX – CD ROM

Code	Meaning
5962	Configuration Error

62XX—Store Loop Adapter

63XX – 2nd Store Loop Adapter

64XX – Network Adapter

69XX—SYS 36/PC Driver Card

Code	Meaning
6907	System/36PC expansion cable left attached to PC while running 36 Driver Card diagnostics

71XX—Voice Adapter

73XX—3.5 Adapter

74XX—PS/2 Display Adapter

75XX – XGA Display

76XX—Page Printer

Code	Meaning
7601	Adapter failure
7602	Adapter failure

Code	Meaning
7603	Failure
7604	Cable problem

78XX—High Speed Adapter

79XX—3117 Scanner

Code	Meaning
7901	Adapter failure
7902	Lamp problem
7902	Device Card problem
7903	Device Card problem

80XX—PCMCIA

82XX—4055 Info Window

Code	Meaning
8200	INFO WINDOW INVALID error. Contact your support structure.
8201	INFO WINDOW NORMAL POWER ON. No action necessary
8202	INFO WINDOW TIMER RESET (TIMEOUT) System controller
8203	INFO WINDOW 8031 CHIP System controller board
8204	INFO WINDOW RAM System controller board
8205	INFO WINDOW ROM CRC ROM System controller board
8206	INFO WINDOW RAM CRC System controller board
8207	INFO WINDOW NVRAM CRC. Could be setting display power switch off during an update.
8208	INFO WINDOW NVRAM BATTERY NVRAM battery System controller board
8209	INFO WINDOW NVRAM FAILURE System controller board
8210	INFO WINDOW NVRAM DATA INVALID
8211	INFO WINDOW ANALOG-TO-DIGITAL System controller board
8212	INFO WINDOW GRAPHIC SYNC FAILURE Sync card System controller board
8213	INFO WINDOW TIME OF DAY Clock Set time and Date
8214	INFO WINDOW SPEECH LOGIC FAILURE Audio card System controller board Power supply
8215	INFO WINDOW INTERNAL RS 232C WRAP System controller
8216	INFO WINDOW EXTERNAL RS 232C WRAP Run test with the wrap plug on display to identify failure. System controller board
8217	INFO WINDOW HIGH RESOLUTION SYNCS If the test screen was distorted: IBM EGA card IBM EGA jumper card If the test screen was readable: Sync card System controller board
8218	INFO WINDOW LOW FREQUENCY SYNCS If the test screen was distorted: IBM EGA card

Code	Meaning
	IBM EGA jumper card. If the test screen was readable: Sync card System controller board
8219	INFO WINDOW EGA RGB SIGNALS TEST IBM EGA card IBM EGA jumper card Sync card System controller board
8220	INFO WINDOW RGB INSERT COMPARE Sync card
8221	INFO WINDOW MISSING HI/LOW BEEPS Audio card System controller board
8222	INFO WINDOW RT CHANNEL AUDIO Audio card System controller board
8223	INFO WINDOW LT CHANNEL AUDIO Audio card System controller board
8224	INFO WINDOW NO SYNCS VIDEO #1 Sync card Decoder card System controller board
8225	INFO WINDOW NO SYNCS VIDEO #2 Sync card Decoder card System controller board
8226	INFO WINDOW 16/64 COLOUR MODE Switching card System controller board
8227	INFO WINDOW LEFT/RIGHT SHIFT Deflection board System controller board Switching card
8228	INFO WINDOW AUX MONITOR ON/OFF Decoder card System controller board
8229	INFO WINDOW INTERLACE ON/OFF Sync card Deflection board
8230	INFO WINDOW VIDEO INPUT SELECT Decoder card System controller board
8231	INFO WINDOW RGB ONLY MODE Sync card
8232	INFO WINDOW COMPOSITE ONLY MODE Sync card System controller board Switching card Decoder card
8233	INFO WINDOW OVERLAY Switching card Deflection board

Code	Meaning
	Sync card
8234	INFO WINDOW RGB/VIDEO Sync card
8235	INFO WINDOW SYSTEM TIMER TEST System controller card
8236	INFO WINDOW INTERNAL PROGRAM Verify system diskette and ROM levels are compatible. System controller board
8237	INFO WINDOW CANNOT CALIBRATE System controller board Touch screen Power supply
8238	INFO WINDOW CONTROL PROGRAM Contact your support structure. Possible system controller board
8239	INFO WINDOW CONTROL PROGRAM Contact your support structure. Possible system controller board
8240	INFO WINDOW CPU NOT LISTENING IBM GPIB card System controller board
8241	INFO WINDOW GPIB SEND/RECV COUNT Contact your support structure.
8242	INFO WINDOW RS-232C INTERFACE Run the wrap test with the wrap plug on the System controller board
8243	INFO WINDOW TOUCH SCREEN System controller board
8244	INFO WINDOW FAILURE OF VDP-1 Problem in VDP-1 cable
8245	INFO WINDOW FAILURE OF VDP-2 Problem in VDP-2 cable
8246	INFO WINDOW A1/A2 DETECTION Sync card/System controller board
8247	INFO WINDOW HIGH RESOLUTION SYNCS Sync card
8248	INFO WINDOW TV FREQUENCY SYNCS Sync card
8249	INFO WINDOW GPIB (BUS) System controller board
8250	INFO WINDOW CRC errors DETECTED IEEE 488 cable IBM GPIB card System controller board
8251	INFO WINDOW CRC errors DETECTED IEEE 488 cable IBM PC GPIB card System controller board
8252	INFO WINDOW GPIB TIME OUT IBM PC GPIB card System controller board IEEE 488 cable Power supply Videodisc player problem
8253	INFO WINDOW GPIB TIME OUT

Code	Meaning
	IBM PC GPIB card System controller board IEEE 488 cable Power supply Videodisc player problem
8254	INFO WINDOW GPIB SEQUENCE Contact your support structure.
8255	INFO WINDOW INT PROGRAM error Contact your support structure. System controller board
8256	INFO WINDOW TIME OUT System controller board Sync card IEEE 488 cable IBM PC GPIB card
8257	INFO WINDOW RETRIES OF CRC errors System controller board IEEE 488 cable IBM PC GPIB card
8258	INFO WINDOW error IN GPIB COMMS System controller board IEEE 488 cable IBM PC GPIB card
8259	INFO WINDOW GPIB CONTROLLER error IBM PC GPIB card IEEE 488 cable System controller board
8260	INFO WINDOW INSERT CONTROL LOGIC Sync card System controller board
8261	INFO WINDOW WRONG RGB COLOUR Video output board Switching card Sync card System controller board CRT and yoke assembly
8262	INFO WINDOW PLAYER RESPONSE Verify that videodisc is on and contains a videodisc Go to the IBM Infowindow Guide to Operations and test the videodisc player interface.
8263	INFO WINDOW ADDITIONAL EQUIPMENT Audio problem: Replace audio card Dual frequency monitor failure: Replace switching card Colour composite monitor failure: Replace decoder card
8264	INFO WINDOW RGB OUTPUT SIGNALS Sync card
8265	INFO WINDOW EGA CLOCK error IBM EGA jumper card IBM EGA card
8266	IBM EGA JUMPER INTERRUPT error IBM EGA card switch settings IBM EGA jumper card IBM EGA card
8267	INFO WINDOW EGA GRAPHICS SYNC

Code	Meaning
	IBM PC graphic sync cable IBM EGA jumper card Sync card IBM EGA card
8268	SYNC PRESENT WITHOUT CABLE IBM EGA card
8269	NO AUDIO VIDEODISC 1/L INPUT Audio card
8270	NO AUDIO VIDEODISC 2/R INPUT Audio card
8271	INFO WINDOW IBM EGA CARD MAP 0222: Failure isolation for the IBM EGA card. Perform IBM EGA card failure isolation
8272	INFO WINDOW EGA MEMORY FAILURE Replace IBM EGA card
8273	INFO WINDOW EGA GRAPHICS MEMORY MAP 0225: Failure isolation for memory modules. Perform memory module failure isolation
8274	RESERVED Contact your support structure and report this error code.
8275	RESERVED Contact your support structure and report this error code.
8276	DISKETTE CANNOT SUPPORT See IBM Infowindow DISPLAY ROM LEVEL compatibility levels
8277	RESERVED Contact your support structure and report this error code
8278	INFO WINDOW HI RES DISPLAY Switching card Sync card MAP 0222: Failure isolation for the IBM EGA card. Perform IBM EGA card failure isolation.
8279	INFO WINDOW TIME OF DAY CLOCK System controller board
8280	IBM PC DOS error OCCURRED Follow directions on screen. Contact your support structure and report this error code.

84XX—Speech Adapter errors

85XX—Expanded Memory Adapter errors

86XX – Mouse

Code	Meaning
8601	Mouse
8602	Mouse
8603	System board
8604	System board or mouse
8611	Thinkpad 700 Keyboard (pointing stick)
8612	Thinkpad 700 Keyboard control card
8613	Thinkpad 700 system board

89XX – Music Card

91XX—3363 Optical Drive

Code	Meaning
9101	POST error—Drive #1 failed—Reseat Cables and Adapter
9102	Drive #1 failed—Reinsert Cartridge, Reseat Adapter
9103	Drive #1 failed—Reseat Cables and Adapter
9104	Drive #2 failed—Reseat Cables and Adapter
9105	Drive #2 failed—Reinsert cartridge. Reseat Cables and Adapter
9106	Drive #2 failed—Reseat Cables and Adapter
9107	Adapter hung on BUSY—Reseat Cables and Adapter
9110	DIAGS error—Data not recorded—Check Adapter, Drive, Cable
9111	Data not readable—Check Adapter, Drive, Cable
9112	Sector demarked—Check Adapter, Drive, Cable
9113	Controller Error—Check Adapter, Drive, Cable, switches on Adapter DS302 (8088 vs 80286)
9114	Sector Read/Write Error—Check Drive, Adapter, or Cable
9115	Scramble Buffer Error—Check Drive, Adapter, Cable
9116	Data Buffer Error—Check Drive, Adapter, Cable
9117	Drive RAM/ROM Error—Check Drive, Adapter, Cable
9118	Invalid Command—Check Drive, Adapter, Cable
9119	Track Jump Error—Check Drive, Adapter, Cable
9120	Laser Error—Check Drive, Adapter or Cable
9121	Focus Error—Check Cartridge, Drive, Adapter or Cable
9122	Motor Sync Error—Cartridge upside down, Check Drive, Adapter, Cable
9123	Write Fault—Check Drive, Adapter or Cable
9124	General Drive Error—Check Drive, Adapter, Cable
9125	Sense Command Failed—Check Drive, Adapter, Cable
9126	Invalid Command—Check Drive, Adapter, Cable
9127	Sense Command Failed—Check Drive, Adapter, Cable
9128	Disk Not Initialized—Check Drive, Adapter, Cable
9129	Disk ID Did Not Match—Check Drive, Adapter, Cable
9130	Read-Only Disk Installed—Check Disk, Drive
9131	No Disk Present—Check Disk, Drive, Adapter, Cable
9132	Illegal Disk Detected—Check Disk, Adapter, Drive, Cable
9133	No Disk Change Detected—Check Drive, Adapter, Cable
9134	Read-Only Disk Detected—Check Drive, Adapter, Cable
9135	Illegal Disk Detected—Check Drive, Adapter, Cable
9136	Sense Command Failed—Check Adapter, Drive, Cable
9138	No Disk Change Detected—Retry test again. Check Drive, Adapter, Cable
9141	No Disk Change Detected—Retry tests. Check Drive, Adapter, Cable
9144	WRITE-PROTECT Window Not Opened—Retry tests. Check Drive, Adapter, Cable
9145	No Disk Change Detected—Retry tests. Check Drive, Adapter, Cable
9146	WRITE-PROTECT Window Not Closed—Retry tests. Check Drive, Adapter, Cable
9148	Adapter Card—Check Adapter, Drive or Cable
9150	Seek Command Failed—Check Drive, Adapter, cable
9151	Not At Track Zero—Check Drive, Adapter, Cable
9152	Track Address Error—Check Drive, Adapter, cable
9153	Not At Track 17099—Check Drive, Adapter, Cable
9154	Track Address Error—Check Drive, Adapter, Cable
9155	Track Address 17K Not Found—Check Drive, Adapter, Cable

Code	Meaning
9156	Seek Time Too Long—Check Drive, Adapter, Cable
9157	Sense Command Failed—Check Drive, Adapter, Cable
9158	No Data Read Error Found—Check Drive, Adapter, Cable
9159	No Null Sector Found—Check Drive, Adapter, Cable
9160	Sense Command Failed—Check Drive, Adapter, Cable
9161	Write Command Failed—Check Drive, Adapter, Cable
9162	Data Compare Error—Check Drive, Adapter, Cable
9163	Read Verify Error—Check Drive, Adapter, Cable
9164	Demark Verify Failed—Check Drive, Adapter, Cable
9165	Demark Bit Not Set—Check Drive, Adapter, Cable
9166	Seek 1/3 Timing Error—Check Drive, Adapter, Cable
9167	Seek 2/3 Timing Error—Check Drive, Adapter, Cable
9168	Seek 3/3 Timing Error—Check Drive, Adapter, Cable
9170	Seek Error Set—Check Drive
9171	Controller RAM/ROM Error—Check Drive, Adapter, Cable
9172	Demark Function Error—Check Drive, Adapter
9173	Detected Error Set—Check Drive, Adapter, Cable
9174	Modulator/Demodulator Error—Check Drive, Adapter, Cable
9175	Invalid Command—Check Adapter, Drive, Cable
9176	Illegal Disk Error—Check Adapter, Drive, Cable
9177	Both drives set to same address or wrong address
9178	ID Mismatch—Check Drive, Adapter or Cable
9179	Sector Not Found—Check Drive, Adapter, Cable
9181	Sense Command Failed—Check Drive, Adapter, Check Cable
9182	Read Command Error—Check Drive, Adapter, Cable
9185	Diagnostic Track Error—Check Drive, Adapter, Cable
9186	Diagnostic Demark Error—Check Drive, Adapter, Cable
9187	No Demark Bit Set—Check Drive, Adapter, Cable
9198	Invalid Command—Re-IPL CPU with ON/OFF switch

96XXXY – SCSI Adapter

100XX – Multiprotocol Adapter

101XX – Modem

Check Drivers!

Code	Meaning
10117	Speaker, cable, External DAA, Modem
10118	Modem Slot
10119	Non-IBM Modem
10120	Cable
10132-52	Modem
10153	Data/Fax Modem

104XX – ESDI drive

Code	Meaning
10400	Unknown failure; replace drive, controller then system board
10436	Thinkpad, N51, system board, fixed disk, cable

Code	Meaning
10450	Read/write/verify failure; replace drive
10451	Read/write/verify failure; replace drive
10452	Seek test failure, replace drive
10453	Wrong drive type detected
10454	Controller failure (sector buffer test)
10455	Controller failure
10456	Controller failure
10458	Hard disk (integrated controller)
10459	Drive diagnostic command failure
10460	Unknown failure; replace drive then controller, system board
10461	Drive format error
10462	Controller seek error
10464	Primary map not readable, Read error
10465	ECC error bit 8,9
10466	ECC error bit 8,9
10467	Drive, soft/hard seek error (non-fatal)
10468	Drive, soft/hard seek error (fatal)
10469	Drive, soft error count exceeded
10470	Controller wrap error
10471	Controller wrap error
10472	Controller wrap error
10473	Corrupt data; low level format HD
10474	Unknown, refer to 10460
10475	Unknown, refer to 10460
10476	Unknown, refer to 10460
10477	Unknown, refer to 10460
10478	Unknown, refer to 10460
10479	Unknown, refer to 10460
10480	ESDI HD, cable, controller or system board. Switches 2,3,5 ON with 70/115 drive
10481	ESDI wrap mode interface error
10482	Drive select/transfer acknowledgement bad
10483	Controller head selectXX selected bad
10484	Controller head selectXX selected bad
10485	Controller head selectXX selected bad
10486	Controller head selectXX selected bad
10487	Controller head selectXX selected bad
10490	Drive 0,1 read failure
10499	Controller failure

106XX – Ethernet Adapter

Code	Meaning
10635	Power off, wait 10 secs, power on
10651	Cables
10660	Cables

107XX – External 360/1.2Mb drive

109XX – Action Media Adapter

Code	Meaning
10917	Audio wrap or speaker problem
10919	Video cable bad/not connected
1094X	Capture option bad

112XX – SCSI Adapter

119XX – 3119 Adapter

121XX – Modem

Code	Meaning
12101	ISDN adapter error
121110	Defective ISDN connector
121120	ISDN wrap connector or adapter

129XX – L2 processor board

Code	Meaning
12901	Processor card or system board
12902	Processor card or system board
12903	Processor card or system board
12917	Processor card (90/95). Verify jumper at 1-2 (20 MHz)
12930	90/95 only. J4 not on correct pins

130XX – Thinkpad Indicator Assy

136XX – ISDN Primary Rate Adapter

137XX – Thinkpad 700, N51

Any serial component or System Board

141XX – Real Time Interface

143XX – Japanese Display

147XX – System Board Video

148XX – Display

149XX – Display

Code	Meaning
14901	Video Adapter
14902	Video Adapter

Code	Meaning
1491X	Video Adapter
14922	Video Adapter
14932	External display (P75)
14952	Plasma display assembly (P75)

152XX – XGA Adapter

Video memory module, system board

161XX – Fax Concentrator Adapter

164XX – Internal Tape

165XX – 6157 Tape Adapter

166XX – Primary Token Ring Adapter

167XX—Token Ring Adapter

180X – PCI Configuration or Resource

Code	Meaning
18001-29	Wizard Adapter
18031-39	Wizard Adapter Cable

184XX – Enhanced 80386 Memory Adapter

Code	Meaning
18441	Unsupported memory module
18451	Reconfigure – module changed

185X – PCI Configuration or Resource

Or DBCS Japanese Display Adapter /A

194XX – 2-8 80286 Memory Adapter

1962 – Boot Sequence

200XX – Image(-I) Adapter /A

Code	Meaning
20001-3	Image(-I) Adapter /A
20004	Memory Module DRAM, VRAM
20005-10	Image(-I) Adapter /A

201XX – Printer/Scanner

Code	Meaning
20101-3	Printer/Scanner
20104	Memory Module, DRAM, VRAM

Code	Meaning
20105-10	Printer/Scanner

206XX – SCSI-2 Adapter

208XX – Any SCSI Device

Check for duplicate IDs

209X – Diskette Drive

210XXXY – SCSI Device

Y=1, external bus

211XXxx – Sequential Access (SCSI 2.3Gb Tape)

212XX – SCSI Printer

213XX – SCSI Processor

214XX – WORM Drive

215XXxx – CD-ROM

216XX – Scanner

217XX – Optical R/W Drive

218XX – Changer

219XX – SCSI Communications Device

24201 – ISDN/2 Adapter

24210 – ISDN/2 Adapter

273XX – MCA IR LAN Adapter

275XX – ServerGuard Adapter

Code	Meaning
27509	Run Auto Config
27512	wmself.dgs diags file missing
27535	3v Lithium backup battery
27554	Internal temperature out of range
27557	7.2v NiCad Main Battery Pack
27558-61	PCMCIA Modem

Code	Meaning
27562	External power control not connected
27563	External power control
27564	External power control

278XX – Personal Dictation System

Parity errors

Code	Meaning
Parity Check 1 Error	Memory on System Board
Parity Check 2 Error	Memory on Memory Expansion Card

ROM errors

Code	Meaning
F0000-ROM error	Replace System Board
F1000-ROM error	Replace System Board
F2000-ROM error	Replace System Board
F3000-ROM error	Replace System Board
F4000-ROM error	Replace System Board
F5000-ROM error	Replace System Board
F6000-ROM error	Replace System Board
F7000-ROM error	Replace System Board
F8000-ROM error	Replace System Board
F9000-ROM error	Replace System Board
FA000-ROM error	Replace System Board
FB000-ROM error	Replace System Board
FC000-ROM error	Replace System Board
FD000-ROM error	Replace System Board
FE000-ROM error	Replace System Board
C0000-ROM error	Replace keyboard timer card
CA000-ROM error	Replace Keyboard timer card
C8000-ROM error	Replace Fixed Disk Adapter
C8000-ROM error	Replace System Board
CC000-ROM error	Replace System Board
D0000-ROM error	Replace Cluster Adapter
D8000-ROM error	Replace Store Loop Adapter

Olivetti

M24 Memory Errors

Code	Meaning	
XXX	Last bank tested	
CC	RAM configuration number	
	01	128K on m'bd
	02	256K on m'bd
	03	384K (256+128 exp)
	04	512K (256+256 exp)
	05	640K (256+384 exp)

Code	Meaning	
	06	640K (512 on bank 0 + 128K on bank 1)
Y	128K bank failure number (000=segment, ZZZZ=Offset)	
	1	Bank 0 on m'bd
	2	Bank 1 on m'bd
	3	Bank 1 on expansion
	4	Bank 1 on expansion
	5	Bank 2 on expansion
WWWW	Data Written (good byte)	
RRRR	Data Read (bad byte)	

Phoenix

Message	Fault	Action
Diskette Drive x Error	Drive x is present, fails POST	Check cabling and Setup.
Diskette drive reset failed		Check adapter.
Diskette read failure-strike F1 to retry boot	Diskette not formatted/defective.	Replace and retry.
Display adapter failed—using alternate.	Colour/mono switch is set wrong, or primary video adapter failed.	Check switch or adapter.
Errors found; incorrect configuration information. Memory size miscompare.	The size of base or extended memory does not agree with the CMOS contents.	Run Setup.
Extended RAM failed at offset:nnnn	Extended memory not working or configured properly.	Try restoring original values, or contact your dealer.
Failing Bits:nnnn	Hex number nnnn is a map of the bits at the RAM address (System, Extended or Shadow Memory) which failed testing. Each 1 represents a failed bit.	Contact your dealer on this one.
Fixed Disk configuration error.	Configuration is not supported.	
Fixed Disk drive failure.		Reboot, or replace fixed disk.
Fixed Disk read failure—strike F1 to retry boot.		Reboot, or replace fixed disk.
Gate A20 function not operating.	8042 is not accepting commands.	Check system board.
Keyboard error nn	nn represents the scan code for a stuck key.	
Keyboard clock line failure.	Keyboard or cable is defective.	Check connections.
Keyboard data line failure.	Keyboard controller has failed.	
Memory failure at xxxx, read xxxx expecting xxxx.	Memory chip circuitry has failed.	Turn PC off, then on again. Otherwise, contact dealer.
No boot device available—press F1 to retry boot.	Either diskette drive A:, the diskette or fixed disk is defective.	
No boot sector on fixed disk—press F1 to retry boot.	Drive C: is not formatted or otherwise bootable.	
No timer tick interrupt.	Timer chip has failed.	Turn PC off, then on again.
Option ROM checksum failure.	Expansion card contains bad ROM.	Reboot, or replace card.
Parity Check 1	Parity error in the system bus.	
Parity Check 2	Parity error found in the I/O bus.	
Pointer device failure.	Mouse failed.	Reboot, check mouse and cable.
Real Time Clock Error	RTC failed BIOS test.	May require board repair.
Shadow RAM failed at offset:nnnn	Shadow RAM failed at offset nnnn of the 64K block at which the error was detected.	
Shutdown failure.	Kbd controller or logic failed.	Check keyboard controller.

Message	Fault	Action
System Cache Error—Cache disabled	RAM cache failed the BIOS test, and has been disabled.	Contact your dealer.
System RAM failed at offset:nnnn	Shadow RAM failed at offset nnnn of 64K block where error is.	
System Timer Error		Requires repair of motherboard.
Timer 2 failure	Timer chip failed	Turn PC off, then on again. Otherwise, contact dealer.
Timer or interrupt controller bad.	Either timer chip or interrupt controller is defective.	Check timer chip on system board.
Timer interrupt did not occur.	Either timer chip or interrupt controller is defective.	Check timer chip on system board.
Unexpected interrupt in prot mode	Hardware interrupt or NMI occurred.	Check timer chip or int controller.

Sirius

Code	Meaning
11	Noise encountered on sync line
12	Bad header block ID
13	Checksum error in header
14	Header GCR error
15	Wrong track
16	Wrong sector
17	Bad job code
21	Bad data block ID (Invalid data on diskette)
22	Checksum error in data (Invalid data on diskette)
23	GCR error (Invalid data on diskette)
24	Sync time out (Invalid data on diskette)
31	Bad data block ID (Defective drive or diskette)
32	Verify error (Defective drive or diskette)
33	Checksum error (Defective drive or diskette)
34	GCR error (Defective drive or diskette)
41	No sync found—bad or missing diskette (Format program)
42	Bad header ID (Format program)
43	Wrong track (Format program)
44	Wrong sector (Format program)
45	Bad header checksum (Format program)
46	Gap error (Format program)
47	GCR error (Format program)
48	No data sync (Format program)
49	Bad data ID (Format program)
4A	Data verify error (Format program)
4B	Data checksum (Format program)
4C	Gap 2 error (Format program)
4D	GCR error (Format program)
F1	Cannot address second side of diskette
F2	Step error—cannot find track
F3	Data not written due to disk change
F4	Cannot write to disk until logged
F5	Wrong diskette type
F6	Cannot start disk operation

Code	Meaning
F7	Illegal track number
F8	Illegal drive number
F9	Illegal disk operation
FA	Door open
FB	Drive motor not up to speed
FC	Write-protected diskette
FD	Bad track on diskette
FE	Cannot complete disk operation
FF	Bad or unformatted diskette

Viruses

A virus is a program that infiltrates itself into another, and executes when that program is executed, so only executable file are affected by viruses, those with **.com .exe .bat** or **.sys** as extensions. Sometimes overlay or system files can be affected; these will have **.ovl** and **.ovi** extensions, or Word and Excel macros. They can either linger in memory, or occupy the boot sector of a disk. The least harmful ones merely duplicate themselves, just finding a new home from time to time; you might just get a message on the screen. At the other extreme, they may damage program code or data, and even self destruct when they have finished. They are difficult to track because they are often so small.

A virus can be transmitted in any way a normal program can, and can either go to work straight away, or wait for a trigger, such as a Friday 13th. If people have permission to modify files, so has any virus brought in by them; Supervisor privileges (e.g. the ability to do *anything*) will also be transferred

Often, what's thought of as a virus is something else, such as:

- **Worms**, which replicate, but do not infect other programs.
- **Trojan Horses**, destructive programs disguised as something else, or hidden inside a program, which do not replicate. A demo program that people are tempted to try makes an ideal Trojan Horse.
- **Logic Bombs**. Similar to Trojan Horses, but timed to go off at a certain time.

- **Droppers**, programs designed to avoid virus detection. Their function is transport and install viruses at the instigation of a trigger.

Technically, all a virus needs to do is replicate itself to be worthy of the name. There are several types of virus, including those that affect the boot sector of a drive, and those that infect files, Polymorphic, Stealth and Multi-partite. Remember that a virus is a program, and therefore needs to be launched. If you get one with an email message, it is harmless until you activate it.

Boot sector

They replace the boot code with their own, and move the original somewhere else, marking that location as bad, so DOS doesn't use it. Thus, the virus has full control of the computer as it loads before DOS. Then it becomes memory resident and infects everything in sight. There is a subtype that affects the Master Boot Record. The only way you get hit is by using an infected floppy.

File Infecting

Some replace the "program load" instructions in a file and move the original code elsewhere in the file, which makes them bigger and easier to detect. Some may even rename files and replace them completely, with .COM files. They wait around in memory and infect every subsequent program that is loaded.

Polymorphic

Change their appearance with each infection, so assume many disguises. They use encryption to change characteristics with each infection to avoid detection by comparison with known viruses. Decryption changes it back so it can execute.

Stealth

Hide from OS and software, by remaining in memory and intercepting all calls to the Operating System, so it hides by changing file sizes, etc and giving out the old information concerning a file rather than the new. Detected by less memory available, but must be detected and disabled while in memory.

Multi-partite

Infect boot sectors and executables, so combines boot sector with file infection. Can combine many techniques from all the above, so they load before the OS (like Boot Sector) and alter partition sectors, etc, and can spread through files.

Email

Binary files are turned into text to travel over the internet, as the equipment is so basic, and reconverted at the destination. Viruses may well get through this way, as virus checkers only check executable files!

Macro

Use the programming capabilities of application programs, that help you automate tasks. They become part of the document structure.

Glossary

Glossary

802.12

Official name for 100VG-AnyLAN.

802.3

The official name for Ethernet or, more precisely, CSMA/CD.

802.4

Official name for a Token passing system on a bus coax network.

802.5

The official name for 4 and 16 Mb Token-Ring.

802.6

The official name for a Metropolitan Area Network.

802.9

A standard for networking over UTP, supporting voice and data, and using hubs.

802.11

A standard for networking over wireless LANs.

10Base2

802.3 specification similar to Ethernet, using coax at 10 Mbps.

10Base5

Thick Ethernet; also something to do with StarLAN

10BaseT

Part of 802.3 defining UTP cabling for 10 Mbps Ethernet.

10Broad36

802.3 Broadband specification, using thick coax at 10 Mbps.

100BaseT

As above, but faster.

100VG-AnyLAN

Alternative to the above, using demand priority instead of CSMA.A&B bit signalling. Where T1 subchannels devote one bit of every sixth frame to supervisory information.

AAA

Any Advice Appreciated

AAL

ATM Adaptation Layer, which converts data packets into ATM cells for transmission across an ATM network, and converts them back at the other end.

AARP

Appletalk Address Resolution Protocol

AARP Probe Packets

Packets that check if a node ID is already being used in an Appletalk network, before that ID is used by a sending node.

ABM

Asynchronous Balanced Mode. An HDLC communication mode supporting peer comms between stations.

ABR

Available Bit Rate.

Access

Link up to a computer system or network.

Access Method

The way network devices use a network.

Access Protocol (or Access Method)

The traffic rules that devices on a network abide by when sending signals over the lines (such as CSMA or token passing). Whatever is used, they must ensure that only one station transmits at a time, and, if not, that data is not corrupted or lost.

Access Provider

A company providing internet connections. See also ISP.

Access Server

One that connects asynchronous devices to a network with terminal emulation software.

Account

Information about the user of a system, such as name, password and access permissions.

ACCUNET

AT&T Packet Service.

ACD

Automatic Call Distribution.

ACF

Advanced Communication Function. SNA products that allow distributed processing and resource sharing.

ACK

A non-printing character used to indicate that a block has been received. A control code (06h) sent to a sending station or computer by the receiving unit to acknowledge either that the receiver is ready to accept transmissions or that transmitted data arrived without error.

The ability to receive and send acknowledgement signals is built into the hardware and software. For example, the serial ports send and receive ACK commands. See also: NAK.

ACSE

Association Control Service Element. An OSI method of establishing, maintaining and terminating connections between applications.

Active Hub

As opposed to a passive hub, a powered device that amplifies and rebroadcasts network signals.

Active Monitor

A device that manages a Token Ring Network; typically a PC with the highest MAC address. Its responsibilities include making sure that tokens are not lost or that frames do not circulate endlessly.

ACU

Automatic Calling Unit.

Adaptive Routing

As opposed to *Alternative Routing*, where a network management system keeps track of the state of traffic on every line and decides at the time of transmission which route should be used.

ADC

Analog-to-Digital Converter.

ADCCP

Advanced Data Communication Control Protocol. An ANSI standard bit-oriented data link control protocol.

Address

The identifying characters or data structure used to identify a network terminal or other entity; a pattern of characters identifying a unique storage location, or part of a data block which identifies its destination. Every memory location is numbered consecutively. This number is the address of the memory location. An address can be a label, number, or name that identifies a register, memory location, or a location on a disk drive or external device accessed via an I/O port.

Address Bus

One or more lines (conductors) that carry address codes from the microprocessor to other parts of the system, such as a Memory Address Bus. The data requested is sent back to the CPU along a related data bus.

Address Mask

A combination of bits which describes what portion of an address refers to the network or subnet, and which part refers to the host.

Address Resolution

A way of resolving differences between computer addressing schemes.

Address Resolution Protocol

See ARP.

ADGR

All Donations Gratefully Received.

ADP

Automated Data Processing.

ADPCM

Adaptive Differential Pulse Code Modulation. Used for encoding analogue voice
samples into high quality digital signals.

ADSI

Analogue Display Services Interface. A way of viewing voice mail on a PC, or on a telephone screen.

ADSL

Asymmetric Digital Subscriber Line. High Speed digital connections over two pairs of copper wire. Downloading is quicker than uploading, hence asymmetric.

ADSU

ATM DSU. Used to access an ATM network via an HSSI.

AEB

Analogue Expansion Bus. A way of spanning voice cards across the AT bus.

AEP

AppleTalk Echo Protocol.

AFAIAA

As Far As I Am Aware.

AFAICR

As Far As I Can Recall.

AFAICS

As Far As I Can See.

AFAICT

As Far As I Can Tell.

AFAIK

As Far As I Know.

AFAIR

As Far As I Recall.

AFAIUI

As Far As I Understand It.

AFI

Authority Frame Identifier.

AFOAL

A Hell of a Lot.

AFP

AppleTalk Filing Protocol. Apple's network file access protocol, similar to NetWare's Core protocols.

AIS

Alarm Indication Signal, used on T1 lines, consisting of all 1s, transmitted instead of the normal signal to maintain continuity and to tell the receiving terminal of a transmission fault upstream from the transmitter.

AIT

Advanced Intelligent Tape. A tape backup format developed by Sony using 8mm cassettes with built-in memory chips.

AIUI

As I Understand It.

A-law

ITU-T standard used to convert between analogue and digital
signals in PCM systems, used mainly in Europe. Similar to mu-law in North America.

AGAN

As Good As New.

Agent

Software that processes queries and returns replies on behalf of other software.

Alignment error

An error on an IEEE 802.3 (i.e. Ethernet) network that occurs when the total number of bits of a received frame do not divide by eight. Usually caused by collisions causing frame damage.

ALOHA

A method of satellite communications, first used between Hawaii and the USA, that allows multiple stations to transmit at the same time.

Alias

On a Bulletin Board, an assumed name under which you may post messages.

Alternative Routing

A system where information which normally follows one route between two nodes is made to take another if any part of the network is overloaded.

AM

Amplitude Modulation, used to modify a carrier wave so it can carry information, by varying the "loudness" of the signal (amplitude) as opposed to FM, or *Frequency Modulation*, which varies the frequency.

AMEOL

A Most Excellent Off Line reader (used with CIX).

Amplitude

The maximum value of an analogue or digital waveform.

Analogue Signal

A continuously variable signal, such as sound. The variations in the signal directly correspond to the information the signal contains; for example, a louder sound is represented by a higher voltage. In other words, it is *analogous* to it.

As the information is directly dependent on the signal, any change in the signal will change the information contained, so analogue signals are very susceptible to noise. Analogue transmission is used on the telephone system and is not compatible with computer signals (see *Digital Signals*).

ANI

Automatic Number Identification; a feature of telephone systems that passes a caller's number over the system to the receiver so the caller can be identified.

ANSI

American National Standards Institute. Defined standard for displaying very low level graphics on PCs. The ANSI standard is used on most Bulletin Boards.

Answer Mode

Used when a modem is set up to receive calls from an originating modem. Hosts are usually in answer mode.

Answer Modem

One which accepts a call from an originating modem.

Answer Tone

The tone (defined by V.25) given out by a modem before the carrier to indicate to the caller that a modem has answered.

APaRT

Automated Packet Recognition/Translation. Allows a server to be attached to CDDI or FDDI without reconfiguring application or network protocols.

APPC

Advanced Program-to-Program Communications. This is an IBM protocol analogous to the Session Layer in the OSI Model. It enables data to be sent around a network.

APPI

Advanced Peer-to-Peer Internetworking.

APPN

Advanced Peer-to-Peer Networking. IBM SNA facility providing distributed processing based on PU 2.1 and LU 6.2.

Appleshare

Apple Computer's network product, which requires a dedicated Macintosh as a server. It includes both server and workstation software and uses AppleTalk Filing Protocols (see next). Macintosh II servers can support up to 50 workstations, while a Plus or SE is limited to 32.

Appletalk

A set of communications protocols that define networking on an AppleShare network, based on OSI. Phase 1 has only one network number in one zone. Phase 2 supports multiple logical networks and allows them to be in more than one zone, on a single physical network.

Application

A program used for a specific purpose.

Application Layer

The highest level of the OSI Model which describes the way that programs interact.

Application Server

A server that 0provides access to client/server applications and their data.

ARA

Appletalk Remote Access.

ARCNET

Attached Resource Computer Network. A 2.5 Mbps networking architecture based on a bus topology which uses token passing, developed by Datapoint.

ARM

Asynchronous Response Mode. Used with HDLC.

ARP

Depends how old you are—it used to mean *Air Raid Precautions* during World War II, but now means *Address Resolution Protocol*. It is used to translate IP addresses to physical network ones.

ARPA

Advanced Research Projects Agency.

ARPANET

Advanced Research Projects Agency Network. A packet-switching network developed in the early 70s, and which evolved into the Internet.

ARQ

Automatic Request Repeat. A method of error checking, sometimes used as a synonym for MNP.

Artificial Intelligence

The ability of computers to seem intelligent (oh yeah?).

AS

Autonomous System. An independent network with its own protocols and ways of working.

ASAP

As Soon As Possible.

ASCII

Acronym for *American Standard Code for Information Interchange* (pronounced "ask-ee"). A standard code where characters are given numbers, and there are 128 characters defined. Sometimes used as a synonym for "plain text".

ASCII File

A file containing only ASCII characters.

ASIC

Application-Specific Integrated Circuit. A chip designed for a particular purpose.

Asymmetrical Duplex Transmission

That which takes place in both directions at the same time, but not at the same speed, e.g. 1200/75 bps. Sometimes known as *Pseudo Full Duplex*.

Asynchronous

A type of communication distinguished by the lack of a set timing arrangement (sometimes called "start-stop"). Extra signals are transmitted to inform the receiving device when a complete character begins and ends (start and stop bits), so the meaning of a bit depends on its position in relation to the start and stop bits rather than its correspondence with the computer's clock.

AT Command Set

An industry standard group of modem commands, each of which must be preceded by the letters AT to get the modem's attention (as used by Hayes).

ATDM

Asynchronous Time-Division Multiplexing. Resembles normal TDM, except that slots are allocated as required.

ATG

Address Translation Gateway.

ATM

At The Moment/Adobe Type Manager/Automated Teller Machine/Asynchronous Transfer Mode. Asynchronous Transfer Mode is a high speed method of packet switching that uses fixed length packets at speeds of up to 155 megabits/second. Also known as cell relay; ATM "cells" are 53 bytes in size, 5 for the address and 48 for the information.

Attachment Unit Interface.

See AUI.

Attenuation

The difference between transmission and reception due to losses through equipment, lines or other devices, or signal loss over distance.

ATP

Appletalk Transaction Protocol.

AUI

Attachment Unit Interface. A 15-pin socket used for Thick Ethernet connections, found on the NIC, or the cable.

AURP

Appletalk Update Routing Protocol.

Auto Answer

The ability for a modem to automatically answer the telephone when it rings. It detects the incoming ringing voltage and siezes the line, whereupon it sends a signal to its host computer to let it know what's going on. This enables systems to be left running without attention.

Autodial

Describes a modem capable of automatic initiation of calls, without the use of a handset, as in *Autodial Modem*.

Automatic Number Identification

See ANI.

Automatic Repeat reQuest (ARQ)

A method of error correction where the receiving terminal automatically requests a block of data to be resent if errors have been detected in the original transmission.

Automatic Send and receive (ASR)

A system which enables incoming messages to be stored and outgoing messages to be sent.

Auto-partitioning

A condition where a hub detects that a device connected to one of its ports has been involved in more than 30 consecutive collisions, or the port is automatically disabled, and frames will not be passed through it.

Auto Recall

A facility on some autodial modems which enables them to redial an engaged number repeatedly until it is available.

AVHBI

A Very Happy Bunny Indeed!

AWG

American Wire Gauge, a standard that defines wire thickness. The lower the number, the thicker the wire.

BABT

British Approvals Board for Telecommunications. An offshoot of the Department of Trade and Industry which ensures that equipment attached to the telephone system does not ruin it, by testing it thoroughly. Approval is signified by a white label that contains a green circle.

Backbone

A high speed, high capacity link between individual networks in a large organisation, used as a primary conduit. It will usually use Thick Ethernet or Fibreoptic cable.

Back Channel

One used to send data in the opposite direction of the primary, say for control signals.

Backplane

The bus which links individual networks in a hub.

Backward Channel

A supervisory channel, not used as a main channel of communication.

BACP

Bandwidth Allocation Control Protocol. An extension to Multilink PPP concerning dynamic reallocation of bandwidth.

Balun

Balanced, unbalanced. Device used for matching impedance between a balanced and an unbalanced line.

Bandwidth

The range of frequencies that a circuit can reliably carry or, more properly, the difference between the highest and lowest possible frequencies that are available for signalling on a given channel.

BARRNet

Bay Area Regional Research Network.

Baseband

Where a single unmodulated signal carries information, using the entire frequency range of the medium, as used in most Local Area Networks. Data is transmitted in its raw state, not being modulated in any way. Only one signal at a time can travel along the cable. Although potentially fast, the effective speed of baseband systems may be slower than the official rating. With only one channel available, you can't retransmit on another one if there's a bottleneck, but have to wait till there's a gap.

Baseband Coax

A single channel medium for carrying baseband transmissions.

Bash

A shell used in Linux to process commands.

Basic Rate Interface

ISDN service consisting of two 56/64 Kbps B channels that allow simultaneous voice and data and a D channel for call, and customer information at 16 Kbps.

Baudot Code

A 5-bit data code used in telegraphy, telex and RTTY. The code is named after J M E Baudot, a French telegraphy expert, whose name is also remembered in....

Baud Rate

A measurement of the rate of signal changes per second when communication takes place between separate devices. When used with reference to printers and similar devices, it is normally equal to bits-per-second, so the two terms can be used in place of each other as one bit is generally transmitted per signal change. However, with modems, it's not strictly correct above a certain speed, say 1200 baud, as the number of bits transmitted per second will not exactly equal signal changes because more bits are squeezed on to the tone.

However, the terms are still used loosely in place of each other. Dividing the Baud rate by 10 gives the approximate number of characters transmitted per second. Both transmitter and sender need the same Baud rate to communicate successfully.

BBDC

Big Boys Don't Cry.

BBS

See *Bulletin Board*.

B-Channel

ISDN component that carries data, voice and video at 64 or 56 Kbps, both ways, depending your side of the Atlantic.

BCNU

Be Seeing You.

Beacon

A signal from an IBM Token Ring device indicating a serious problem with the ring, such as a broken cable. Beacon frames contain the address of the station assumed to be down.

Bell

Standards used for communications over the USA telephone system.

BER

Bit Error Rate

BERT

Bit Error Rate Test(er).

Best Effort Delivery

A network system without sophisticated acknowledgement procedures to guarantee reliable delivery of information.

BFN

Bye For Now.

BGI

Bloody Good Idea.

BGP

Border Gateway Protocol. For internetworking autonomous systems, and designed to minimise unnecessary traffic.

BHOW

Bangs Head On Wall.

Big Endian

And *Little Endian*. The sequence in which a processor stores data. In big-endian structures, the most significant bytes are stored in the lowest memory address, and the least significant for the latter. The Internet is big-endian based, and Intel processors aren't.

BIIK

Blowed If I Know.

Binary

The native language of all computers. Numbers, letters, and instructions are represented in 1s and 0s (or Ons and Offs) inside the computer.

Binary File

As opposed to an ASCII file (or any other in a structured form), a file where the data is not in a recognisable pattern but where any bit may be either on or off. Examples are graphic and program files.

BIND

Berkeley Internet Name Domain. A public domain DNS server package for Unix.

Bindery

A NetWare database that keeps track of users and other information.

Biphase Coding

Bipolar coding scheme originally developed for Ethernet, where clocking information is embedded into and recovered from the synchronous data stream without needing separate clocking leads.

Bipolar

A circuit with negative and positive polarity, as opposed to unipolar.

BIR

Burst Information Rate.

B-ISDN

Broadband ISDN. Designed for video, using ATM technology over SONET-based transmission circuits.

Bisynchronous

An IBM-developed protocol for mainframe computers involving synchronous transmission which is controlled by a clocking signal.

Bit Mask

A pattern of binary values. See *Netmask*.

Bit-oriented protocol

Class of data-link layer protocols that can transmit frames regardless of their contents.

Bit Rate

The speed at which bits are transmitted, that is, the number of bits that can pass through a communications channel in one second. Not necessarily the same as Baud Rate (see above).

Bits per second

Another name for *Bit Rate*.

Bit Synchronisation

The same as synchronous transmission.

BIU

Basic Information Unit, or *Bus Interface Unit*.

Black Hole Router

One that does not return ICMP *Destination Unreachable* messages when it needs to fragment an IP datagram with its “Don’t Fragment” bit set, so TCP can’t perform PathMTU discovery properly. Enabling Black Hole detection in TCP increases the maximum number of transmissions performed for a given segment. If several go unacknowledged, TCP will take off the Don’t Fragment bit until they are, then it will reduce the MSS and reset the bit.

Block

A preset number of characters which are transmitted together as a separate unit.

BLT

Bacon, Lettuce and Tomato (sandwich).

BLU

Basic Link Unit.

BMAP

Bit-Mapped Alphanumeric Processor.

BMIC

Bus Master Interface Controller. A chip that arbitrates control of the bus in an EISA system.

BNC

British Naval Connector, as used for thin coax. Although it looks the same as those used for 75 ohm video, the pin sizes are different, and you could get connection errors if you mix cables and connectors.

BOND

Bandwidth On Demand. A way of increasing bandwidth when required by aggregating ISDN channels.

Boosting

Adding UPS power to line power to make it up to an acceptable level.

BOB

Break-Out Box.

BOC

Bell Operating Company (see *Bell*). Local telephone company that existed in a US region before deregulation.

BootP

A protocol for assigning IP addresses to workstations when they boot up, based on the address of the adapter card.

Boot PROM

A chip on a network interface card that allows the computer the card is in to obtain boot instructions from the network.

BOTS

Software that operates as an agent or simulates human activity.

BRI

See *Basic Rate Interface*.

Broadband

American for *Wideband*. A communications method using a large bandwidth with several channels multiplexed on to it. Broadband networks require special tuning and strict procedures to work properly, which implies trained support staff. Typically, stations using specialised modems transmit on one frequency to a *translation module* (referred to as the *head end transmitter*) at the end of the cable which amplifies the received signals and shifts them to a second group of frequencies, where they're sent back the way they came (assuming they haven't been picked up by any station on their way there). Thus retransmitting doesn't cause a traffic jam and there's plenty of flexibility.

Where two cables are used, each either transmits or receives, so the head end merely provides a passive path between cables.

In short, where telephony is concerned, any channel with a band width greater than voice grade (4 KHz). For LANs, a coax cable on which analogue signalling is used.

Broadcast

A packet sent to all network destinations.

Broadcast Address

A special address for sending broadcast messages to all stations.

Broadcast Service

A data service in which all users receive the same information, but only the addressee acts on it (such as with Ethernet).

Broadcast Storm

This occurs when a LAN device decides not to work properly and starts to flood the network with spurious packets. Control this with a local router, not a bridge, as the packet addresses refer to all stations on the network. Only a router can look at the address and contain the packet in a particular segment.

Brouter

A combination of a bridge and a router, which can route one or more protocols and bridge all others.

Brownout

Where line voltage drops by more than 10%.

Browse

A database command used for looking through data in a table.

BRS

Big Red Switch.

BSA

Burroughs Synchronous/Asynchronous.

BSC

Binary Synchronous Communication.

BSD

Berkeley Software Distribution.

BSF

But Seriously, Folks.

BSRF

Basic Synchronous Reference Frequency.

BTAN

Basic Telecommunication Access Method.

BTDT

Been There Done That.

BTDTGTTS

Been There Done That Got The T Shirt.

BTLZ

British Telecom Lempel-Ziv. Custom version of the compression algorithm incorporated in V.42 bis.

BTU

Basic Transmission Unit.

BTW

By The Way.

Bucking

Blocking line power through a UPS so it doesn't get too high.

Buffer

A small amount of memory which temporarily holds data until it can be transmitted or processed by another device, which compensates for different rates of data flow.

Buffered Repeater

A device that amplifies and regenerates signals so they can travel further along a cable. The buffer assists in controlling the flow of data.

Bulletin Board

A computer that is permanently switched on and connected to the telephone line, programmed to answer calls automatically. It's like an electronic noticeboard, where you can "pin up" notices that others who care to *log on* can read, or where you can have electronic conversations with them. Some companies use Bulletin Boards to handle orders or make information available to the public, but there are thousands of private ones run by enthusiasts, all free of charge, even though their use has been overshadowed by the Internet.

BUS

Broadcast and Unknown Server (something to do with ATM).

Bus Master

An expansion card with its own processor, capable of taking some of the load off the CPU by taking control of the bus, which means it can transfer data to other cards on the same bus as well as into memory directly.

Cable Amplifier

A device that boosts the signal strength of cable signals.

Cable Drop

The segment of cable running from the street to your home or office. They connect to the main cable at locations called *taps*.

Cable Modem

A PC device that receives cable signals, which includes router and hub circuitry, and running network management and diagnostic software.

CAD

Computer Aided Design – hardware and software that enable engineers and architects to design things, usually expensive.

Call Accept

In packet switching, the packet that confirms that the party is willing to proceed with the call.

Call Clearing

The disconnecting of a call.

Call Packet

A packet containing addressing and other information that is needed to establish an X.25 switched virtual circuit.

Call Redirection

In packet-switching, allowing the call to be automatically redirected from the original to another address.

Call Request

In packet switching, the packet sent to initiate a datacall.

Call setup time

The time needed to establish a switched call between DTE devices.

Caller ID

See ANI.

CANX

Cancelled

Capacitance

The ability of a non-conductive material to store electricity.

CAP

Carrierless Amplitude Modulation. A technique used by ADSL, using FM techniques up to 1.5 Mbps.

CAPI

A cryptography API from Microsoft, built into NT.

Carrier

The high-pitched, continuous tone on the phone line that indicates a modem is in operation or, more properly, a continuous frequency signal that can be modified to carry information, such as radio.

Carrier Detect

A means of sensing when a data call has been answered.

CAS

Column Address Strobe. RAM is organized in rows and columns and is accessed via signals (strobes) sent along lines to these rows and columns. The CAS is a signal line which clocks the column address into an internal address latch, and is measured in nanoseconds; the lower the value, the faster the RAM can be accessed. CAS also acts as output enable for a memory cell. When CAS is asserted, the tri-state driver on the data pin is enabled.

CASE

Common Application Service Element.

CATV

Cable Television, where multiple channels are broadcast over broadband coaxial cable.

CBDS

Connectionless Broadband Data Service. European high speed, packet-switched WAN technology.

CBR

Constant Bit Rate

CCH

Channel Check Handler.

CCITT

The initials of the name (in French) of the International Telegraph and Telephone Consultative Committee, now superseded by ITU-T. Famous for the Fax, V and X series of standards.

CCP

Communication Control Program.

CCS

Common Channel Signalling, used in telephone networks, where signalling information is separated from user data.

CD

Carrier Detect. A signal generated by a modem to indicate a call has connected.

CDDI

Copper Distributed Data Interface. FDDI over copper. Uses the same cabling as 100BaseT, but is broadcast rather than switched. Stable and fast, with a theoretical maximum of 95 Mbps.

CDPD

Cellular Digital Packet Data. A standard for data communications that uses the unused signal in the bandwidth reserved for cellular voice transmissions.

CDR

Call Detail Recording.

CDRM

Cross-Domain Resource Manager.

CDRSC

Cross-Domain Resource.

CD-XA

CD eXtended Architecture, a specification for CD ROMs that contain digital data and audio (or video) that need to be replayed simultaneously.

CEI

Comparably Efficient Interconnection.

Cell Relay

Network technology using small, fixed size packets, which allows high speed switching.

Centralised Administration

Controlling network access, setup and configuration from a single point.

Centralised Network

A network based around a central server which deals with all network tasks.

Centrex

A business telephone service offering call forwarding and intercom to business, amongst other benefits.

CEPT

Conference for European Post and Telephone.

Channel

A path along which signals carrying data can be sent.

CGI

Common Gateway Interface, a standard that allows Web servers to run external applications, such as search engines. Sometimes called *Scripts*, CGI programs are behind the forms on web pages.

Channel Encoding

Data reduction by methods that depend on the properties of the transmission medium.

Character

A single digit, letter, punctuation mark, or other symbol which the user can read or write. In most microcomputers or word processors, one character is stored or expressed in one byte.

Character Mode Terminal

One which communicates asynchronously. In packet switching, one which can only access via a PAD.

Check Bit

The same as the parity bit.

Child Servers

Slang for daughter processes spawned by a main server process.

Choke Packet

Packet sent to a transmitter to inform it of congestion and to slow down.

CICS

Customer Information Control System.

CIDR

Classless InterDomain Routing. A way of representing multiple IP addresses in one router table entry.

CIM

Computer Integrated Manufacturing. Industrial workflow automation.

Circuit

Like a channel, a path along which data-carrying signals are sent, but implying two-way communication.

CIR

Committed Information Rate, or the transport speed a frame relay network will maintain between service locations, decided by the customer on first installation. Excess traffic is considered discardable and the first thing to go when the network is busy.

Circuit Switching

A situation where communication takes place along a circuit established for the duration of the call, as used by the telephone system. Once the call has finished, the temporary circuit is broken up into its constituent parts.

CIS

Compuserve Information Service.

CIX

Compulink Information eXchange. Conferencing system (or multi-user Bulletin Board). European rival of Compuserve, with infinitely better software and conferencing.

Cladding

The outer layer of transparent material in an optical fibre, the refractive index of which is lower than the core so light can bounce further along the fibre.

Clear Packet

Performs the equivalent of hanging up the phone on an X.25 circuit.

CLI

Command Line Interface.

Client

A workstation on a network (as opposed to a stand-alone PC which is a high performance graphics workstation) that requests services from a server. Also known as a *Requester*.

Client/Server

Refers to a network in which several PCs (clients) are connected to one or more servers (i.e. *server-based*). With regard to databases (on a network), it's where the database runs on the server as well as the client, where it normally would all be. This arrangement is used to save traffic over the wires.

CLNP

Connectionless Network Protocol. An OSI network layer protocol that does not need a circuit to be established before data is transmitted.

Cluster Controller

A device that provides the connections for a cluster of terminals to a data link.

CMI

Coded Mark Inversion.

CMIP

Common Management Information Protocol.

CMIS

Common Management Information Services.

CMNS

Connection Mode Network Service.

Closed User Group

An area within a computer system which is only available to certain subscribers.

Cluster

When two or more terminals are connected to a data channel at a single point.

CODEC

Coder/Decoder and analogue-to-digital converter.

Collaboration Software

Network based applications that let participants share information.

Collision Domain

A segment or more joined by repeaters.

Collision Sense Multiple Access

A contention method of avoiding conflict between network stations. Each station transmits at will until a collision occurs between the two sets of transmitted data. The two stations back off for a random interval, then retransmit.

Concentrator

See *Hub*.

Command Specify Block

A data structure used in SCSI disk I/O operations.

Common Carrier

A telecommunications resource providing facilities to the public (more to do with the USA where private companies run the telephone system).

Compile

To turn source code into an executable program.

Compuserve

Compuserve Information Service (CIS). On-line data service based in USA. Sometimes known as CI$, due to its relative expense.

Conferencing

Where groups of people can communicate on various topics without being hampered by considerations such as time or geography. First thought of by Richard Nixon, to enhance the productivity of the White House.

Congestion

The condition of a communications system beyond the traffic it can handle properly.

Connect Time

The length of time connected to a remote computer, often used as the measure of payment.

Connection Oriented

Data transfer that requires a virtual circuit (i.e. a complete path).

Contention

Competition between parts of a system for use of a common resource, such as between terminals for a network path.

Control Character

A character in an alphabet used for functional purposes rather than text, possibly causing a particular procedure to be started, finished or changed.

Cookie

A text file placed on your machine by a server on the web, so it can use the information in it next time you log on, which saves space on the server. Possibly a security threat, so the ability to receive them can be turned off in your browser.

Core

The inside cable of an optical fibre.

COS

Corporation for Open Systems.

CPE

Customer Premise Equipment (in telephone systems).

CPS

Characters Per Second.

CRC

Cyclic Redundancy Check. A bit-oriented type of error-checking that uses checksums. Before data is transmitted, a value is calculated, based on the contents of the data. If the receiver calculates the same, the data is assumed to have been transmitted error-free.

Crosstalk

Not what you get from the Bank Manager, but interference created when magnetic fields interrupt electrical currents, commonly from one cable to another. Eliminated by shielding and/or twisting one wire round another.

Crossover Cable

One where transmit and receive data pairs are crossed over, so the transmit from one machine is the input to another.

CRT

Cathode Ray Tube; used to mean a terminal, monitor, or display using a TV-like tube for primary output.

CSMA

Collision Sense Multiple Access. The method used on Ethernet to see if other systems are transmitting before sending.

CSU

Channel Service Unit.

CTI

Computer Telephony Integration. Mixing telephones and computers.

CTS

Clear To Send; a signal from the modem to the computer which indicates that the modem is ready to transmit.

CUL

See You Later.

Cut-through switching

Where the switch begins transmission before the whole packet is received, i.e. once the addresses have been read.

Cyclic Redundancy Check

An error detection method. See CRC.

DAC

Digital-Analogue Converter. A device used in VGA hardware to convert commands and data when interfacing between digital computer hardware and an analogue monitor.

Daemon

A Unix term for a program that sleeps till a request comes in to wake it up.

DARPA

Defense Advanced Research Projects Agency.

DAS

Dual Attachment Station. A device attached to 2 FDDI rings, so if the primary ring fails the secondary can be used.

DAT

Digital Audio Tape. Used for high quality audio recording and data backup.

Data Compression

Reducing the volume of data for transmission purposes to reduce the time on line.

Data Bit Length

The number of bits carrying the actual character within a byte. The data bit length can be set to 5, 6, 7 or 8. Most services use either 7 or 8 data bits.

Data Circuit-terminating Equipment (DCE)

Equipment, such as a modem, used for passing information to a terminal. It can establish, maintain and terminate a connection and provides the signal conversion for communication between Data Terminal Equipment and the telephone line.

Datagram

Information sent as a unit over a network system without having a defined path (or virtual circuit) defined first. IP datagrams are used over the Internet.

Dataline

In packet switching, a dedicated line between a customer's terminal and a Packet Switching Exchange (PSE).

Data Link Layer

The second layer of the OSI model where protocols manage the flow of data between the stations so that it arrives safely.

Data Network

A digital communications network with the ability to provide multiple access paths between users.

Data Network Identity Code (DNIC)

Part of the user address on the Packet Switch Stream which identifies the country and type of service.

Data Packet

Transports full-duplex information on an X.25 switched or permanent virtual circuit. May contain up to 1024 bytes of data, but more commonly 128 bytes.

Data Set

American for modem, used in the same sense as "radio set".

Data Terminal Equipment

The equipment which acts as a terminal on a computer system or network.

DBMS

Data Base Management System.

DBX

Digital Branch Exchange.

DCA

Defense Communications Agency

DCC

Data Country Code. An ATM address format.

DCD

Data Carrier Detect. A signal sent by a modem to a computer.

D-Channel

One component of ISDN used for call control purposes.

DCE

See *Data Circuit-terminating Equipment*. Not to be confused with *Distributed Communication Environment*.

D Channel

Data Channel with ISDN.

DCS

Digital Cross-connect System, or *Digital Command Signal*. If the latter, the information sent between fax machines about the transmissions between them.

DDM

Distributed Data Management.

DDN

Defense Data Network.

DDP

Datagram Delivery Protocol, used over Appletalk Internetworks.

DDR

Dial-on-Demand Routing, where a router can automatically initiate and close a circuit-switched session.

DDS

Dataphone Digital Service.

Deadlock

Where two processes wait for a reaction from each other before resuming what they were doing.

DEC

Digital Equipment Corporation.

DECNet

Communications products developed by DEC.

Decryption

The reverse of encrypting.

Dedicated

Reserved for a single function or user, as in dedicated file server or dedicated line (which is not switched).

Delay

In communications, the time between initiation of a transaction and the first response.

Demand Multiplexing

A form of multiplexing in which the allocation of time to devices requiring to transmit is made according to whether they actually have data to send or not. That is, no time slot is given if there is no data to send.

Demodulation

The opposite of modulation-reconstituting data after it has been modulated.

DES

Data Encryption Standard.

Designated Bridge

The one that incurs the lowest path cost when forwarding a frame from a segment to the route bridge.

Device Sharing

Permitting several users to use peripherals such as printers, etc.

DGUTDJ

Don't Give Up The Day Job.

DHCP

Dynamic Host Configuration Protocol. Used to assign temporary IP numbers to computers on a network.

Dhrystone

As opposed to Whetstone, a system of benchmarking.

DIA

Document Interchange Architecture, use for transparent interchange of documents in an SNA network.

Dial-up System

A system which has its own line and an auto-answer modem. Callers will be allowed access to the system automatically.

DID

Direct Inward Dialling. Allows you to get to someone's extension directly without going through the touch tone system.

Differential Encoding

Where a binary value is denoted by a signal change rather than a level.

Differential Manchester Encoding

Where a mid-bit-time transition is used for clocking, and a transition at the beginning of each bit time denotes a zero. Used on Token Ring.

Digital Service Unit

See DSU.

Digital Signal

A type of signal in which information is coded as a series of pulses or signal transitions; for example, those in a computer that are coded in combinations of 0s and 1s to represent data, because they can assume a high or low voltage to correspond to the on or off states of the computer.

Because it's the pattern and not the strength of the signal that conveys the message, digital signals are relatively immune to noise compared to analogue.

Direct Connect

Attaching a station to the network without a multiplexer, usually through a *Network Interface Card*.

Directory Server

With reference to NT, a domain controller.

Distortion Delay

This results from non-uniform transmission of parts of a signal through a particular medium.

Distributed File Systems

These allow one computer on a network to use the files and peripherals of another as if they were locally available.

Distributed Network

Another name for peer-to-peer network, where there is no central server and each workstation takes some of the workload.

Distribution

The name for a particular make of software, as in a Linux Distribution.

DLC

Data Link Control.

DLCI

Data Link Connection Identifier.

DLE

Data Link Escape.

DLSw

Data Link Switching. Used for integrating SNA and NETBIOS over TCP/IP.

DLT

Digital Linear Tape. Tape technology developed by DEC, now sold by Quantum.

DMT

Discrete Multitone. Newer and faster modulation technique (than CAP) used with ADSL, up to 6 Mbps.

DNA

Digital Network Architecture.

DNIS

Dialled Number Identification Service. A way of telling which number a caller has dialled when you have many to choose from. Typically used with freephone and premium lines.

DNS

Domain Name Service. A database spread over several name servers for translating Internet named addresses to their numeric (dotted) equivalents.

DOD

Department of Defense (USA).

Domain

A collection of servers and clients controlled by a single server. In the Internet, part of the naming system.

Domain Controller

On an NT network, a directory server that allows access to users, accounts, groups, computers and other network resources.

Door

A program that allows access to files and programs not built in to a Bulletin Board, and allowing them to be run on-line.

Downlink

A path from a satellite to a ground station.

Downloading

Transferring data from a host to your computer.

DPSK

Differential Phase Shift Keying.

DQDB

Distributed Queue Dual Bus.

DQM

Don't Quote Me.

DQMOT

Don't Quote Me On That/This.

Drive Mappings

The allocation of drive letters to disk drives and/or directories; for example, the drive letter D: on your machine could be allocated to drive C: on another machine in a network.

Drop

A point on a multipoint channel where a connection is made to a network device.

DS-0

A 64Kbps channel of a DS-1 facility.

DS-1

Digital Signal Level 1. Refers to the 1.44 Mbps (USA) or 2.108 Mbps (Europe) digital signal on a T1 facility.

DS-1/DT1

DS-1 Domestic Trunk Interface, used for DS-1 applications with 24 trunks.

DS-3

Digital Signal Level 3. Refers to the 44.736 Mbps digital signal on a T3 facility.

DS-4

Digital Signal Level 4. A 274.176 Mbps signal.

DS9

Deep Space Nine.

DSP

Digital Signal Processor. A device that processes electrical signals very quickly, and used in modems, sound cards, video cards and the like when this is needed.

DSR

Data Set Ready, a signal sent by a modem to a computer indicating that it is ready for work. "Data Set", used in the same sense as "Radio Set" means the modem.

Device Service Routine. A type of BIOS routine providing a specific set of functions for a peripheral device. The Int 10h video service is a DSR.

DSU

Digital (Data) Service Unit (e.g. a digital modem). A synchronous serial data interface that buffers and controls the flow of data between a network entrance point, such as a bridge or router, and the channel service unit. Used on leased lines.

DSVD

Digital Simultaneous Voice and Data.

DTE

Data Terminal Equipment. A device that requires its standard 25- pin RS232 port to be wired in a certain way in order to plug directly into DCE equipment (see above) and work straight away (pin 2 will transmit data and pin 3 will receive it).

Again, if you wish to connect DTE to DTE you will have to cross some of the wiring in the cable to get the signals where they are expected.

DTD

Drop To DOS.

DTE/DCE addressing

Needed for X.25, when confusion may arise about what to connect to what. A simple way is to remember that T=terminal, and C=Clock, so the DCE provides the timing for the circuit. The X.25 is generally configured as DTE and the modem or Network Terminal Unit (NTU) as DCE.

DTLOI

Due To Lack Of Interest.

DTMF

Dial Tone MultiFrequency.

DTR

Data Terminal Ready. A signal sent by a computer to a modem to indicate readiness to accept transmissions.

DTU

Digital Terminal Unit.

Dumb Terminal

One which can only send and receive data. It has no "intelligent" features and thus is unable to store or process it.

Duplex

A method of operating a communications circuit between two devices. Full-duplex allows both units to send and receive simultaneously. Half-duplex allows only one unit to send information at one time, although the link may be capable of two-way transmission.

Duplexing

The use of duplicated system components in a backup system.

DWIM

Do What I Mean.

DWIS

Do What I Say.

E1

A digital facility for transmitting data over a telephone network at 2048 Mbps.

EARN

European Academic Research Network.

Earth Station

A station which can transmit and/or receive radio signals to or from a communications satellite.

EBCDIC

Extended Binary Coded Decimal Interchange Code. IBM's alternative to ASCII.

ECC

Error Correcting Code. Used in hard drives and memory, a system of checking data integrity, where single bit errors are corrected and two-bit errors are corrected.

E Channel

Echo channel, used with ISDN.

Echo

An effect on long comms lines caused by successive amplifications of the signal—

echo-suppressors can be used to combat this. Can also mean the duplication on screen of characters sent along the wire.

Echoplex

One way of checking accuracy by echoing back the information that was sent and displaying it on the originating terminal's screen—if it isn't the same as what was sent, then it's re-transmitted. Not to be confused with Half-Duplex.

ECMA

European Computer Manufacturer's Association.

EDI

Electronic Data Interchange.

EGP

Exterior Gateway Protocol. A generic name for communication protocols used between Autonomous Systems.

EIA

Electronic Industries Association.

ELAN

Emulated Local Area Network.

EMA

Enterprise Management Architecture. By DEC, based on OSI.

Email

Short for *Electronic Mail*. A system that allows people to send messages over cables rather than on paper.

EMI

Electromagnetic Interference. Can cause reduced data integrity and increased error rates.

EMP

Electromagnetic Pulse. Caused by lightning, etc.

Encapsulation

Wrapping data in a protocol header.

Encoder

A device that modifies information into a transmission format.

Encryption

Encoding messages in order to make them unreadable; PCs can do this very well by themselves, you might say, but this is for security purposes so that only the intended recipient can read them.

End Boss

The final monster in most games.

EOT

End of Transmission.

Equalisation

A technique that compensates for communication channel distortions.

Error Checking Protocol

A scheme designed to detect errors in blocks of data transmitted through digital systems. Each block is made up of a number of bytes (not necessarily a whole message) which are summed and an extra byte representing the value of the sum is transmitted along with it. The process is repeated at the other end and the results compared. If they are the same, then no error is assumed. The more rigorous the checking, the slower the whole operation, and the same protocol must be used at each end. There are many protocols, from Xmodem (the original) to MNP (Microcom Network Protocol) or Kermit.

Error Correcting Code

A code with intelligence and the ability to add enough information to a data stream so that it can be reconstructed if errors are detected.

ESD

Electro Static Discharge.

ESF

Extended Superframe Format.

Ethertalk

Appletalk packets encapsulated so that they can run on Ethernet cables.

ETSI

European Telecommunications Standards Institute.

Equalisation

A method of compensation for distortion over long communications channels.

Ethernet

A network cable and access protocol scheme, using baseband coax in a bus topology with a 10 or 100 Mbps data transfer rate.

ETX

End of Transmission.

Exchange

A switching point in a telephone or telegraph network.

Explorer Frame

Frame sent out by a networked device to find the optimum route to another one.

Facsimile Transmission

A system for transmitting documents in binary format over the telephone lines.

FAX

Short for *Facsimile Transmission.*

Fax On Demand

A system of receiving requests and faxing back information automatically.

Fail-over

Where other servers in a clustered server system take over when one fails.

FCC

Federal Communications Communications.

FCS

Frame Check Sequence (CRC or checksum).

FDDI

Fibre Distributed Data Interface. A standard for using fibreoptic cables in a ring configuration at 100 Mbps. Uses hubs. Not everything will necessarily conform to it.

FDL

Facility Data Link.

FDM

Frequency Division Multiplexing.

FDX

Full duplex.

FECN

Forward Explicit Congestion Notification.

FEIYD

For Ever In Your Debt.

FEP

Front End Processor.

FGS

For God's Sake.

Fibre Channel

Signalling specifications and data handling techniques for fibreoptics (see below) at speeds up to 1 Gb/sec.

Fibreoptics

A data transmission method that uses light pulses over glass cables to represent data.

FIFO

First In First Out.

File Lock

See *Locking*.

File Server

A computer dedicated to managing the files for a network. Sometimes it can't be used for anything else, and Murphy's Law dictates it will be the best machine available (it may need to be high performance). See also *Server*.

FILO

First In Last Out.

Finger

A Unix utility which obtains information about someone with an email address.

Firewall

A PC on a network whose job is to protect the network from outside interference by restricting traffic where necessary, acting as a barrier between two networks or, more simply, the inside and the outside world. Like a bridge, it examines packets going either way and lets them pass or not, as the case may be. Unlike a bridge, the filtering techniques are a bit more sophisticated.

FITMR

Fixed In The Maintenance Release (Oh Yeah?)

FITNR

fixed In The Next Release.

Flag

In HDLC, the special sequence of 8 bits (01111110) used to determine the opening and closing of a frame.

Flash Hook

The switch that disconnects the telephone line when you replace the handset.

Flow Control

The control of data flow between systems to prevent overspilling of queues or buffers, or loss of data because the destination cannot accept it. Typically, **Ctrl-S** (XON) will pause everything and **Ctrl-Q** (XOFF) will restart it.

FM

Frequency Modulation.

FNC

Federal Networking Council.

FOAF

Friend Of A Friend.

FOC

Free Of Charge.

FOCL

Falls Off Chair Laughing.

Footprint

The area of the Earth in effective line-of-sight communication with a satellite, or within a satellite's transmission area.

FOTP

Fresh Off The Press.

FOTS

For Old Times Sake.

Four Wire Circuit

A circuit consisting of a combination of two standard pairs of cable, used for speech.

FPPL

Full Period Private Line.

Fragment

Part of a larger packet that has been split up.

Fragment-free switching

Where transmission only begins after the first 64 bytes of a packet are received, to make sure that smaller ones don't clog up the system. Runts, as the smaller ones are known, arise from collisions. Packets bigger than 1518 bytes are Giants.

Frame

In Time Division Multiplexing, a frame is one complete cycle of events. It will usually consist of a sequence of time slots with extra bits for framing, alarms and so forth. The word is also used for a group of data bits, with a flag at each end to indicate its beginning and ending, and on videotext systems to describe one screenful of information, and is always a predetermined number of characters, e.g. 716 on Prestel.

Frame Bandwidth Allocation

The sum of the CIRs associated with all the permanent virtual circuits (notional leased lines, in other words) for a customer.

Frame Buffer

The memory used to store the pixels that create the screen display, mostly found on a separate graphics card, but sometimes sharing system memory under UMA.

Frame Relay

A simplified form of X.25 packet switching that is faster because it uses less overheads, like error checking, which is left to the equipment at each end.

Framing

The method by which individual frames are recognised so that slots can be identified correctly.

Frequency Division Multiplexing

A form of multiplexing for analogue signals which allows more than one signal to be transmitted on one channel by using different frequencies.

Front End Processor

A computer acting as an interface between the main computer system and a network. It looks after all the communications and does not take part in any of the data processing.

FSK

Frequency Shift Keying. A simple modulation method used by slow modems. It works by varying the frequency of a carrier tone.

FST

Fast Sequenced Transport. A connectionless, sequenced protocol that runs over IP.

FTAM

File Transfer, Access and Management protocol.

FTP

File Transfer Protocol. A protocol, part of TCP/IP, that allows files to be transferred between hosts, especially on the Internet.

FTR

For The Record.

FU

Fouled Up.

FUBAR

Fouled Up Beyond All Recognition.

FUD

Fear, Uncertainty And Doubt.

Full Duplex

Simultaneous transmission of data in two directions at the same time.

FWIR

From What I Recall.

FWIW

For What It's Worth.

FX

Effects (e.g. stage directions).

FY

Faithfully Yours.

FYI

For Your Information.

Gateway

The junction between two networks, which may look to each network like one of its own nodes, as the gateway emulates the required software at each end. Used typically between a Local Area Network and a Wide Area Network, or a mainframe with different protocols. A good example is linking a LAN to an X.25 system through an X.25 gateway.

GBS

Get Better Soon.

GGP

Gateway-Gateway Protocol.

GFI

Go For It.

GNU

A free software system upwardly compatible with Unix.

Gopher

A text-based service used to navigate the Internet, now superseded by the web.

GOSIP

Government OSI Profile. A standard laid down by the government (the word "standard" is used loosely here, as all GOSIPs aren't the same).

GR&D

Grinning, Running & Ducking.

Group

A collection of user accounts treated as one entity for administration purposes. They will typically have something in common, such as all being members of the sales department, for example.

GSNW

Gateway Service for NetWare.

GTBOS

Glad To Be Of Service.

GWS

Get Well Soon.

GZIP

A way of compressing and uncompressing Linux files.

H.261

ITU-T standard for video compression, allowing video over basic 64 k/bps ISDN.

Half Duplex

The use of a circuit in only one direction at a time, although the circuit may be capable of transmission in two directions at once.

Handshaking

Agreed signals sent between two devices that ensure the process is carried out correctly. Both sides of the interface control the rate of operation.

Hayes Command Set

A standard group of commands relating to modems originally developed by Hayes, but which have now become an industry standard (see also *AT Command Set*).

Hayes Compatibility

The ability of a modem to conform to the standards laid down by Hayes, ranging from just recognising the basic command set to full emulation.

HDLC

A set of protocols defined by ISO for carrying data over a link with error checking and flow control. Not a "high level" protocol, despite its full name of *High Level Data Link Control.*

HDX

Short for *Half Duplex.*

Head End

Connects the cable network with dishes that receive satellite and broadcast TV signals, and connect with cable modems for the Internet. More technically, the end of a broadband network, from where transmissions are made towards destinations.

Header

Control information added in front of data, typically used with network packets (containing the identification of the sender and receiver) or Postscript print files.

Header Files

In C, these define basic functions, such as printing to the screen and writing to disk. This saves work by allowing you to use the headers rather than writing the stuff out all over again.

Helical Scan

A tape-recording method using spinning read/write heads and and diagonal tracks, as used in VCRs and tape backup systems.

HEMS

High-level Entity Management System, or *Helicopter Emergency Medical Service.*

HELLO

IGP used on early Internet backbones. Now out of date.

Hertz

Cycles per second.

Heterogeneous Network

One consisting of dissimilar devices running dissimilar protocols and supporting dissimilar applications.

Hierarchical Routing

Based on a hierarchical addressing system; IP addresses, for example, network numbers, host numbers and subnet numbers.

HI

Her Indoors.

HIPPI

High Performance Parallel Interface.

High Level Protocol

A protocol which allows network users to carry out functions at a higher level than merely transporting data.

Hop

The passage of a packet through a router.

Host Computer

Any computer which serves others. It may also provide a network service, and is therefore equivalent to a server.

In SCSI terms, the computer in which a host adapter is installed. The host uses software to request the host adapter services in transferring information to and from the peripheral devices attached to the SCSI bus connector of the host adapter.
On the Internet, a computer with an IP address you contact to get on to the net.

Host Adapter

An adapter card providing a SCSI bus connection, allowing SCSI devices to be connected to the system bus.

Host Number

The part of an Internet address that designates which node is being addressed.

Hot Plugging

The ability to add and remove devices to and from a PC while it is running, with automatic configuration controlled by software; mostly for PCMCIA and RAID.

Hot Swapping

See above.

HPFS

High Performance File System, used by OS/2, an improvement on FAT, in that it can handle hard disks of any size, and long filenames.

HSCI

High Speed Communications Interface.

HSM

Hierarchical Storage Management. A system that moves little used files from hard disks to slower tape or optical systems and retrieves them when necessary.

HSRP

Hot Standby Router Protocol.

HSSI

High Speed Serial Interface.

HTF

How the Hell.

HTH

Hope This Helps.

HTML

Hypertext Markup Language. ASCII, text-based scripting language used for creating hypertext documents, typically used for Web pages.

HTTP

Hypertext Transport Protocol. Used to access web pages or, more properly, to negotiate their delivery to a browser from a server.

Hub

A central device that repeats or regenerates network signals; a form of amplifier, or repeater, that makes sure every machine gets every signal. Used with 10baseT, Ethernet, FDDI or ARCNet.

HWISTKT

How Was I Supposed To Know That?

HWSTWH

He Would Say That, Wouldn't He?

Hybrid Network

An internetwork consisting or more than one technology.

Hypertext

A method of presenting information that used hotlinks to proceed from one document to another. In a Web document, the link is a URL pointing to another Web page or resource.

IAB

Internet Activities Board.

IAC

In Any Case.

IAE

In Any Event.

IAH

In All Honesty.

IANAL

I Am Not A Lawyer.

IBM

Its Being Mended/Its Better Manually/I Believe in Magic.

ICD

International Code Designator. One of 2 ATM address formats.

ICMP

Internet Control Message Protocol. Error and other messages used by routers and hosts to pass status information between themselves regarding IP datagram transmissions.

ICYDK

In Case You Didn't Know.

ID

Identity.

IDI

Initial Domain Identifier.

IDP

Initial Domain Part.

IDPR

InterDomain Policy Routing.

IDRP

InterDomain Routing Protocol. Based on BGP, but using OSI addresses. An OSI protocol that specifies how routers communicate with routers in different domains.

IEEE

Institute of Electrical and Electronic Engineers, a US body responsible for 802.x frames, etc.

IEC

International Electrotechnical Commission.

IETF

Internet Engineering Task Force. Technical body responsible for Internet protocols.

IFIP

International Federation for Information Processing.

IGMP

Internet Group Management Protocol. TCP/IP protocol that allows Internet hosts to take part in IP multicasting, which is a way of broadcasting messages to groups of computers.

IGP

Interior Gateway Protocol. Generic name for routing protocols used in an autonomous system.

IGRP

Interior Gateway Routing Protocol.

IHAG

I'd Hazard A Guess.

IIABDFI

If It Aint Broke, Dont Fix It.

IIDKB

If I Didn't Know Better.

IIR

If I Recall/Remember.

IIRC

If I Recall/Remember Correctly.

IIUC

If I Understand Correctly.

IIUYC

If I Understand You Correctly.

IIWY

If I Were You.

IKWYM

I Know What You Mean

ILMI

Interim Link Management Interface.

IMail

Abbreviation of Internet Mail, otherwise known as E-Mail.

IMCO

In My Considered Opinion.

IME

In My Estimation/Experience.

IMHA

In My Humble Analysis.

IMHE

In My Humble Estimation/Experience.

IMHO

In My Humble Opinion/In My Honest Opinion.

IMNSHO

In My Not So Humble Opinion.

IMO

In My Opinion.

IMP

Interface Message Processor. Old name for Internet Packet Switches.

Impedance

The amount of opposition to an electrical current, which will cause it to weaken. Roughly equivalent to friction.

IMVHO

In My Very Humble Opinion.

Information Superhighway

The idea that every home and office will be connected in some way to a giant network of information providers, consisting of a central backbone of cable running across the country, and tapped by its users.

Industry Standard Architecture

See *ISA*.

INOC

Internet Network Operations Centre.

INTAP

Interoperability Technology Association for Information Processing. A technical organisation that develops Japanese OSI profiles.

Intelligent Terminal

As opposed to a Dumb Terminal, one which can actually store and/or process the information received rather than just transfer it.

Interexchange Carrier

See IXC.

Internetwork

A network of networks, not involving a third party in its operation, hence not a WAN, but bigger than a LAN.

InterNIC

Internet Network Information Center. The organisation that allocates domain names and distributes RFCs, amongst other duties.

Interoperability

The ability of different computer equipment to communicate over a network.

Interphobe

Someone with a fear of the Internet.

Interprocess Communication

A facility that gives two programs the ability to share information. Said to be Local if they are running on the same machine and Remote if otherwise.

Intranet

A private network that behaves like the Internet.

INTSAT

I'm Not Totally Sure About This.

Inverse ARP

Inverse Address Resolution Protocol.

IOTTMCO

Its Obvious To The Most Casual Observer.

IOW

In Other Words.

IP

Internet Protocol. Connectionless part of TCP/IP, which relays messages between destinations.

IP Address

A 32-bit binary number identifying precisely the position of a computer on the Internet.

IPCONFIG

DOS command that tells you your computer's IP address.

IP Routing

The process of receiving an IP packet addressed to one network and sending it to another.

IPX

Internetwork Packet eXchange. A NetWare protocol for moving information across a network. *NWLink* is Microsoft's implementation.

IrDA

Infra Red Data Association. A standard for the use of infra red to exchange data between devices.

IRMC

I Rest My Case.

IRN

Intermediate Routing Node.

IRQ

Interrupt ReQuest. See Interrupt.

IRTF

Internet Research Task Force.

IS

Intermediate System.

ISAPI

Internet Server API. A programming interface for Web-Server applications.

ISC

I Stand Corrected.

IS-IS

Intermediate System-Intermediate System protocol.

ISO

International Standards Organisation. Based in Paris, it developed the Open Systems Interconnection (OSI) model.

ISO 9000

Quality Control System. Mostly boring and a waste of time, but required for trading with certain companies and government departments.

Isochronous Data

Data delivered at a consistent rate, such as video, typically transmitted on a high speed bus.

ISP

Internet Service Provider. See *Access Provider*

ISSI

Inter Switching System Interface.

ISTM

It Seems To Me.

ISTMT

It Seems to Me That.

ISTR

I Seem To Recall/Remember.

ISWYM

I See What You Mean.

ITNR

In The Next Release (oh, really?).

ITYR

I Think You're Right.

IVR

Interactive Voice Response. Getting a computer do things remotely with sounds, such as touch tones or voice.

IWBN

It Would Be Nice.

IWBNI

It Would Be Nice If.

IWFM

It Works For Me.

IWHAGT

I Would Hazard A Guess That.

IWW

I Wonder Why.

IXC

Interexchange Carrier. A telephone company! One which uses several transmission methods to transport a message, though.

IYDMMA

If You Don't Mind Me Asking.

IYKWIM

If You Know What I Mean.

IYSWIM

If You See What I Mean.

Jabbering

In 802.3, a condition where a device is transmitting a frame longer than its maximum length. Otherwise, an error condition where a network device continually transmits garbage.

JAFO

Just Another Flamin' Observer (from the film, Blue Thunder).

JAM

Just A Minute...

Jamming Signal

A signal generated by a Network Interface Card on Ethernet to signify that a packet collision has taken place.

JANet

Joint Academic Network. Network joining together most UK colleges of further education, based around X.25.

JAT

Just A Tick...

Java

A programming language originally developed by a division of Sun in 1991, for handheld machines and consumer electronics.

The code is compact, and a web browser called hotjava was developed in 1994, later included in Netscape, hence its popularity on the Internet, where it's now used for small animated 3D objects in web pages. It's a bit like C++, and therefore is known as C-, as it less functional. Microsoft's ActiveX does a similar job.

JBOD

Just a Bunch Of Disks, as found in the average PC, where data is written to one drive. A term used in relation to RAID.

JFTR

Just For The Record.

Jitter

Distortion of an analogue signal by variation of its reference timing.

JPEG

Joint Photographic Expert Group. An image file format that compresses bitmapped images to save space, typically by 10% or more, devised by the aforementioned body. It filters out high frequency information before compressing what's left.

JTFM

Just The Facts, Ma'am/Man.

JUNET

Japan Unix Network.

KDE

Windows-like graphical desktop for Linux.

Kernel

The basic core of any operating system, handling memory management, multi-tasking, I/O operations, etc.

KFC

Kan't Find Chicken.

Kilostream

A British Telecom 64K-bit leased line.

LAN

Local Area Network.

LANE

Local Area Network Emulation.

LAPB

Link Access Procedures (Balanced). The most common protocol used to interface X.25 DTEs with X.25 DCEs. Full Duplex, point-to- point and bit synchronous. The unit of transmission is a frame, which may contain one or more packets.

LAPD

Los Angeles Police Department? Maybe *Link Access Protocol D*! Used with ISDN for something.

LAN

A network that provides communication between computers and associated devices in a defined area, typically a building or a floor in that building.

Laser

Light Amplification by Stimulated Emission of Radiation. Analogue transmission device where some material is excited from outside to provide an narrow beam of concentrated light that can be modulated to carry data.

Latency

The time between a device requesting access to a network and actually being allowed to transmit. Where chips are concerned the time taken to switch from one state to another, so that the more latency, the less the performance.

LATM

Local ATM = on-premise ATM.

LDM

Limited Distance Modem.

Leased Line

A private telephone line used for data transmission. Generally of a higher specification than dial-up lines, but not cheap.

LEC

Local Exchange Carrier. A local telephone company; i.e. one that only uses one method of transmission.

Also *LAN Emulation Client*, with ATM.

LECS

LAN Emulation Configuration Server.

LES

LAN Emulation Server.

LGM

Little Green Men.

LIFO

Last In First Out.

LILO

Last In Last Out. Also *LInux LOader*, bootmanager.

Line

A physical connection between two devices or points.

Line Conditioning

Where line power is filtered before it gets to a computer, so spikes, surges, etc don't get through.

Line of sight

Where there are no obstacles between transmitting and receiving stations.

Link

A circuit or transmission path between sender and a receiver.

Link Beat

A signal which informs a 10BaseT hub of a device connected to it, and of the link integrity. If the link beat signal is not received at a port, the hub will not transmit packets out of it, even if a cable is attached.

LLC

Logical Link Control.

LMI

Local Management Interface. A specification for frame relay products that defines ways of exchanging status information between devices.

Load balancing

The ability of a router to distribute traffic over all its network ports which are the same distance from the destination address.

Local Area Network

See *LAN*.

Local Loop

A connection between a customer and the telephone exchange.

Local Mode

Where computers carry out localised processing; not connected to a host system.

Locally Attached Device

A device attached directly to a computer, as opposed to one only available over the network.

LocalTalk

Shielded twisted pair network used by Apple, formerly called AppleTalk Personal Network Cable.

Logical Channel

The term used to describe each complete transmission in a multiplexed system. "Logical" means "pretend" or "apparent" in this context as, to the user, there seems to be a channel for use, even though there isn't.

Logical Unit

A physical or virtual device accessed through a target; it is part of a SCSI address that identifies a particular device. Each logical unit of a device has a logical unit number (LUN) by which it is addressed.

Logon

The act of gaining access to a system, which may involve using an ID and password.

LOL

Lots Of Luck/Laughing Out Loud.

Loopback Test

Where signals are sent and directed back to the source, to see if signals are being sent in the first place.

Lossy

Describes a network that loses packets when highly loaded.

LSB

Least Significant Bit.

LU 6.2

Logical Unit 6.2—an IBM protocol for terminals connected to its *System Network Architecture* (SNA). LUs are intended to be the interface between the product and the end user (which may be a program).

MAC

Media Access Control.

Mail Gateway

A computer that translates mail between different systems.

Makefile

A file containing the commands needed to compile source code into executable form.

MAN

Metropolitan Area Network; one operating over the area of a city, or within 50km, with fibreoptics at 100 Mbps, or other WAN technologies. Nodes are connected over 2 km distances.

Also a Unix command to display help files.

Manchester Encoding

The 802.3 coding scheme, where a transition occurs in every bit to provide clocking.

MAP

Manufacturing Automation Protocol. A token-passing bus LAN designed by General Motors. Also a method of assigning drive letters, and a NetWare command.

MAPI

Messaging Application Programming Interface. An API for messaging systems.

MAU

Multistation (Media) Access Unit. Used in Token Ring as a concentrator.

Mark

One of the two conditions on a data comms line, the other being Space. Mark indicates "idle" and is used as a stop bit.

MDBTYD

My Dad's Bigger Than Your Dad.

Media

The cabling or wiring (but it may be radio) used to carry signals, typically twisted pair, coax or fibreoptics. Can also mean the material used to store data.

Media Filter

A device for converting the output of an adapter board to work with another type of wiring, to save laying yet more cable. Typically used with Token Ring.

Megahertz

1 million cycles per second.

MEGO

My Eyes Glaze Over.

Message

A block of text or data transported as a whole.

Message Switching

A method of operating a communications network where whole messages are moved from node to node, and stored if necessary until a forwarding path is available.

Metropolitan Area Network

See *MAN*.

MFT dialling

Multi-Frequency Tone Dialling, where different tones represent digits.

MHOTY

My Hat's Off To You.

MHS

Message Handling Service. A Novell standard for connectivity, supporting LAN and WAN E-mail connections in store-and-forward fashion.

MIB

Management Information Base.

Micron

1/25,000 of an inch. used to specify the core diameter of fibreoptic cable. If you buy the cable before the equipment, get the 62.5 micron size.

Microwave

Electromagnetic waves in the range 1-30GHz.

Middleware

Software that sits between a client and a server to make communications between databases easier.

MILNET

Military Network.

MIME

Multipurpose Internet Mail Extensions. A protocol for sending non-ASCII data over the Internet as text.

MJU

Multi Junction Unit.

MMBTY

My Mum's Bigger Than You.

MMS

My Mother Said.

MNP

Microcom Networking Protocols. Proprietary standards for error checking and data compression invented by Microcom (or Tricom in the UK). For example, MNP4 error checking means that no spurious characters should appear on the screen during a session with an On-Line Service. The ITU-T equivalent is V.42. MNP 5 includes data compression on the fly, but this has been superseded by V.42bis, which can autodetect compressed files and not expand them again, as MNP 5 is prone to do.

Mode

A method of operation, or a phase of program operation.

Module

Software that can be loaded and unloaded by a running operating system as required.

Modulation

Varying some characteristic of a carrier wave in accordance with the data to be transmitted; converting digital signals to analogue signals.

MOM

Message Oriented Middleware.

MOP

Maintenance Operation Protocol, designed by DEC.

MPEG

Motion Picture Experts Group. Responsible for standards concerning video on computers, particularly dealing with compression.

MPOA

Multi Protocol Over ATM.

MRDA

Mandy Rice Davies Applies ("Well He Would, Wouldn't He?”).

MSB

Most Significant Bit.

MS-NET

Microsoft's DOS-based contribution to network operating systems, officially known as Microsoft Networks.

MT

Empty.

MTIA

Many Thanks In Anticipation.

MTU

Maximum Transmission Unit. The biggest packet that can be passed over a link without it becoming fragmented.

Multilink PPP

A way of aggregating ISDN channels with synchronous PPP framing.

Multiple Access

Where multiple users can open the same file at the same time.

Multiplexer

Equipment that takes a number of transmission channels and combines them into one.

Multiplexing

The process of transmitting more than one signal over a single line.

MUX

Multiplexer

MVIP

MultiVendor Integration Protocol. A protocol used to daisy-chain voice or fax cards across a PC Bus.

MYOB

Mind Your Own Business.

NACSIS

National Centre for Science Information Systems. Japanese network.

NAFAIAC

Not As Far As I Am Concerned.

NAFAIC

Not As Far As I'm Concerned.

NAFAIK

Not As Far As I Know.

NAK

Negative Acknowledgement. A control code (15h) transmitted to a sending station or a computer by a receiving unit as a signal that the transmitted information has not arrived, or is incorrect. It usually triggers retransmission of the block concerned.

NAS

Network-Attached Storage. Standalone storage devices connected directly to a LAN.

NAU

Network Addressable Unit.

NAUN

Nearest Active Upstream Neighbour. In Token Ring, the closest upstream network device from the device acting as reference point.

NALOPKT

Not A Lot Of People Know That.

Nanosecond

A billionth of a second.

NBP

Name Binding Protocol. An Appletalk data transport protocol.

NBS

National Bureau of Standards.

NCP

Network Control Program. Used in SNA, a program that controls and routes the flow of data between a communications controller and other network resources.

Also *NetWare Core Protocol*, for Novell's client shells and redirectors.

NCTE

Network Circuit Terminating Equipment.

NDA

Non Disclosure Agreement.

NDIS

Network Driver Interface Specification. A device driver standard created by Microsoft and 3Com. Similar to ODI.

Negative Acknowledgement

See NAK.

NETBEUI

NetBIOS Extended User Interface. An IBM/Microsoft extension to NETBIOS, as used by Windows for Workgroups, etc. for transport services.

NETBIOS

Network Basic Input/Output System. A layer of programming originally developed by IBM and Sytek that sits between the Network Operating System and the hardware concerned, usually the network card. It can also open communications between workstations at the session level. As it is somewhat of an industry standard in its own right, many third-party manufacturers either emulate NETBIOS or provide their own compatible version. On the other hand, many don't.

Netmask

A 32-bit mask showing how an Internet address is to be divided into *network*, *subnet* and *host* parts.

Netscape Navigator

A widely used Internet Browser.

Network

A system which provides links between users in different places. It provides interconnectivity between varying types of equipment.

Network Administrator

Someone who looks after a network; adding users, machines, etc, as required.

Network Analyzer

Hardware/software used for network troubleshooting.

Network Interface Card

See *NIC*.

Network Layer

The third level of the OSI model which contains the logic and rules that determine the path to be taken by data flowing through a network. Sometimes ignored in smaller systems.

Network User Address

A number which identifies each subscriber to a network service (e.g. PSS, where it's a 10-digit number) so they can get the money off you. It also provides a means for others to get in touch with you. In PSS, it's issued to each terminal (not a character terminal, as they use PADs).

Network User Identity

An identity code given to subscribers to a network service which enables them to access it.

Newsgroup

Discussion group using the Internet as a means of transmission. To start a new one is easiest in **alt**, so post a proposal for discussion into **alt.config**. There is, naturally, an FAQ that covers all this. Others require a Request For Discussion, followed by a Call For Voting. Start by emailing **group-mentors@acpub.duke.edu**.

NEXT

Near End Cross Talk. Interference on wires caused by proximity to others. Reduced by twisting.

NFS

Network File System. One of many file system protocols that allow computers on a network to use the files and peripherals of another one as if they were available locally. Developed by Sun Microsystems and adopted by other manufacturers.

NFW

No Flamin' Way.

NIC

A circuit board inside a computer that permits direct connection to a network. The board has some intelligence, sometimes has memory (for buffers) and is used to make up packets for transmission

NIH

Not Invented Here.

NIMBY

Not In My Back Yard.

NIOED

Not In the Oxford English Dictionary.

N-ISDN

Narrowband ISDN.

NMI

Non-Maskable Interrupt (INT 02h). A hardware interrupt (or request for service) that cannot usually be turned off, or worked around, and it takes precedence over software and other hardware interrupts. An NMI is only issued under severe circumstances, such as a serious memory, power or I/O problem.

NNI

Network to Network Interface.

NNTP

Network News Transfer Protocol. A protocol used with Usenet newsgroups for posting and retrieving news articles.

Node

A junction of network lines. Often used loosely to mean a terminal.

Noise

Random signals which disturb transmission on lines and cause errors.

Non-Volatile

As opposed to volatile, a quality of memory where the contents are retained regardless of whether power is on or not. This also includes memory that is backed up by battery, like CMOS, but the A+ exam thinks otherwise.

NOS

Network Operating System. Software that allows computers to operate on a network, e.g. NT, NetWare, LANTastic!

NPD

No Problem, Dude.

NRN

No Reply Necessary.

NRZ

Non-Return-to Zero. NRZ signals maintain constant voltage levels with no signal transitions.

NRZI

Non-Return-to-Zero Inverted. As for NRZ, but interpreting the presence of data at the beginning of a bit interval as a signal transition, and the absence of data as no transition.

NSAP

Network Server Access Point

NSAPI

Netscape Server API. Programming specification for Netscape's Web servers. Also Network Service Access Point, with ATM.

NT-1

Network Terminator Type 1. Device that converts a 2-wire ISDN line, to a 4-wire.

NTFS

NT File System. Very advanced, native to Windows NT.

NTOOT

Nine Times Out Of Ten.

Null Modem Cable

A cable configured to resolve the differences between DCE and DTE equipment when connecting like to like (DCE-DCE or DTE-DTE), since each type expects signals on certain pins. As many of the purposes of the pins are crossed over (e.g. 2 and 3 and some handshaking pins), it's sometimes called a crossover cable. There are several types of null modem cable depending on the liberties that may have been taken with the RS232 port by the manufacturers of the equipment you propose to connect.

NVR

See *Non-Volatile Memory*.

NVRAM

Non-Volatile Random Access Memory.

NWLInk

Microsoft's implementation of IPX.

OCR

Optical Character Recognition. Converting printed matter into ASCII text files, typically using a scanner.

Octet

The name for a byte in packet switching.

ODBC

Open Data Base Connectivity. A system allowing multiple databases to be accessed in a standard way, regardless of file format. The drivers use a form of SQL.

ODI

Open Datalink Interface. A device driver standard from Novell allowing you to run multiple protocols over one network card.

OEM

Original Equipment Manufacturer.

Off Line

Not connected.

OIC

Oh I See.

OLR

Off Line Reader.

OMS

Over My Shoulder.

ONC

Open Network Computing.

On Line

Connected.

On Line Service

A service provided by an Electronic Mail service such as CIX or Compuserve that provides facilities for your use.

OOTB

Out Of The Box.

OOTD

One Of These Days.

OOTT

One Of Those Things.

Open Architecture

A system where third party developer can manufacture items that conform.

Open Circuit

A broken path along a transmission medium.

Open Source

A movement advocating that software should be proprietary.

Optical Fibre

Fine, high quality glass fibre, along which light can be transmitted.

Originate Modem

A modem which is only capable of calling a host system.

OS/2

A 32-bit multi-tasking, general purpose operating system for 80386 based computers.

OSI

Open Systems Interconnection, a model developed by ISO describing network communication processes and how hardware and software should interconnect if they are meant to work together in a communications system. There are different standards within each layer.

OSPF

Open Shortest Path First. An IGP that supersedes and is more efficient.

OTOH

On The Other Hand.

OTT

Over The Top.

Overwrite

To write data where other data is stored already. Overwrites occur in networking where two users attempt to write updates to data which is stored in the same place.

OVSN

Out Very Soon Now.

OWIL

Only When I Laugh.

PABX

Private Automatic Branch eXchange. Automatic private telephone switchboard that connects all your lines to the outside world.

Packet

A block of data handled by a packet-switched network in a format which contains a header (including the ending and receiving stations' identifications), error checking information and data. The terms datagram, frame, message and segment are loosely used to mean the same thing.

Packet Assembler and Disassembler (PAD)

A device in a packet-switched network which prepares data for transmission by converting from serial to packets, and vice versa. Thus, it allows ordinary terminals, or anything that cannot ordinarily assemble packets to connect to a packet-switched system.

Packet Burst

On a network, where only one acknowledgement is required for a series of packets.

Packet Interleaving

A form of multiplexing in which packets from various subchannels are interleaved on the line. X.25 is an example.

Packet Switching

A method of sending data in packets rather than as a continuous stream.

Packet Switching Exchange

A node on a packet-switching network that carries out all the switching operations, such as packet assembly/disassembly, the direction of data and so on.

Packet Terminal

A terminal capable of creating and disassembling packets.

PAD

See *Packet Assembler/Disassembler*.

PAD Profile

See PSS, NUI, NUA and Pad Profile.

Page

A block of information in a Viewdata system consisting of 26 frames (labelled A-Z). A block of memory.

PAM

Pulse Amplitude Modulation.

PAP

Printer Access Protocol, which is AppleTalk's print sharing protocol. Also *Password Authentication Protocol*, where a PPP session is started before the user name/password combination is transmitted.

Parallelism

Where multiple paths exist between two points in a network.

Parallel Transmission

Where bits are transmitted simultaneously over a number of channels.

Password

A means of identifying authorised system users consisting of a word or letters. You will be granted access according to whether your password is recognised.

PBX

Private Branch Exchange.

PCB

Printed Circuit Board.

PCM

Pulse Code Modulation.

PC-NET

IBM's DOS-based network operating system, officially known as the IBM PC LAN Program.

Peer-to-Peer Network

One that lets any station on a network double as a server while operating locally.

Perl

Interpreted scripting language, typically used in CGI scripts.

Peripheral Device

A device, like a printer, that can be shared over a network.

Permanent Virtual Circuit

A non-physical (i.e. notional) link established between two terminals on a packet switched network. That is, each terminal sees the data stream as if it were on a leased line, but it isn't. This is as opposed to an open-pipe link, which is a real connection.

PGA

Pin Grid Array; a way of mounting chips on a circuit board; PGA chips have pins coming out of the bottom, rather than from the side.

Phantom Voltage

A voltage differential of 5 volts between the transmit and receive wire pairs in a Token Ring system, which is enough to activate the relays in a MAU, so if a wire breaks, or shorts, the voltage disappears, the relay opens and the ring carries on.

Physical Layer

The first layer of the OSI model which covers such aspects as cabling.

PIC

Programmable Interrupt Controller. A chip used to sort out priorities for interrupts.

Picosecond

1 trillionth of a second.

PIM

Personal Information Manager.

PING

Packet Internet Groper. A TCP/IP application used to check whether other machines are on line and available. An ICMP echo request is sent and a reply awaited.

PITA

Pain In The Neck.

Pixel

Picture element. The smallest addressable point on a computer screen.

PLCC

Plastic Leaderless Chip Carrier.

PLP

Packet Level Procedures. These define protocols for transferring packets between an X.25 DTE and X.25 DCE. A full duplex protocol that supports data sequencing, flow control, accountability, error detection and recovery.

Plug and Play

See *PnP*.

PMFJI

Pardon Me For Jumping In.

PMJI

Pardon Me Jumping In.

P-NNI

Private Network to Network Interface.

Polling

Regularly inviting stations to transmit, commonly used with fax machines.

PoP

Point of Presence. A local bank of modems used to dial into the Internet.

Port

The connection which provides an input or output to a system.

Port Mirroring

A setting that lets a switch forward the traffic meant for one port out of another.

PoP

Point of Presence. Where an Internet Service Provider (ISP) has its equipment.

POP

Post Office Protocol. A text based protocol used for sending and retrieving Internet email messages. The two versions, POP2 and POP 3 are not compatible.

POS

Point Of Sale.

POV

Point Of View.

PPP

Point to Point Protocol. A serial protocol used to connect a PC directly to the Internet through a dialup connection. It features error correction, data compression and other elements that SLIP, an alternative, lacks, in particular the ability to encapsulate datagrams, allowing for better transportation across differing equipment.

PPPD

Point to Point Protocol Daemon.

PPTP

Point-to-Point Tunnelling Protocol. An enhanced form of PPP that encapsulates packets for one protocol inside packets used for another (tunnelling), so that TCP/IP data can be transmitted over non-TCP/IP networks. This means that you can join networks together over the Internet.

PQPF

Plastic Quad Flat Pack; a way of packaging ICs.

Presentation Layer

The sixth layer of the OSI model which formats data for screen presentation and translates incompatible file formats.

Privileged Mode

A mode of execution in protected mode in the ix86 architecture in which some programs can carry out restricted operations that manipulate critical system components (memory and I/O ports). The kernel of the operating system and device drivers are usually the only type of software that can use instructions that operate in privileged mode.

PRA

ISDN *Primary Rate Access*.

Prestel

Viewdata service combining low level text and graphics.

PRI

ISDN *Primary Rate Interface*, consisting of 23 or 30 B Channels, depending on your side of the Atlantic.

Print Server

A computer on a network that makes one or more printers attached to it available to other users.

PROM

Programmable Read Only Memory.

Protocol

Rules for the passing of information back and forth between computers. Protocols allow several different types of machinery to communicate on the same system.

Protocol Converter

A translator of one transmission code to another.

Proxy

Something that stands in for something else.

Proxy Server

A machine on a network that passes data to and from the other machines from your ISP. In other words, it checks a packet's destination and passes it over the dialup link if appropriate, so it's a gateway using a dialup link.

Pseudo Full Duplex

Transmitting at high speed while receiving at a low one. With fast turnaround, it's possible to simulate Full Duplex. Also known as Asymmetrical, an example of which is HST, used by some US Robotics modems.

PSK

Phase Shift Keying. A modulation method used mainly by V.22 modems.

PSS, NUI, NUA and PAD Profile

These relate to the Packet Switch Stream (PSS) network, which is now part of BT's Global Network Services (GNS). Each service is allocated a Network User Identity (NUI) and Network User Address (NUA) to enable you to gain access to it. You will be asked to enter the NUI and NUA when you sign on to the service. The Pad Profile is a two-character code included within each of them which identifies the terminal type, Teletype being A7.

PSTN

Public Switched Telephone Network. The name for the standard telephone system.

PTT

Post Telephone and Telegraph.

Pulse Code Modulation

Representation of an analogue signal by sampling at a regular rate (typically 8000 times a second) and converting each sample to a binary number.

Public Domain

Software released into the Public Domain is free, although the author retains the copyright. These usually consist of nifty bits of code developed for a particular purpose and released in case anyone else would find it useful. Not the same as shareware.

Pulse Dialling

A method of dialling on older exchanges where electrical pulses are generated and sent down the line, as opposed to tones.

PVC

Permanent Virtual Circuit.

QAM

Quadrature Amplitude Modulation.

QIC

Quarter Inch Cartridge. Cheap tape storage method.

QPSK

Quadrature Phase Shift Keying.

Queue

A waiting line where jobs are stored for execution, such as a print queue. Technically, a means of bridging speed gaps between different parts of the computer.

RAID

Redundant Array of Inexpensive Disks.

RARP

Reverse ARP. Finds IP addresses based on physical (MAC) addresses, useful for diskless workstations.

RAUBM

Replies As Usual By Mail.

RBHC

Regional Bell Holding Company—crosses state lines.

RBOC

Regional Bell Operating Company—exists in one state.

Read-only

A file designation that permits a user to open a file but not modify it.

Read-Write

A file designation that permits a user to open and/or modify it.

Record Locking

See *Locking.*

Redirector

In a network, a software module loaded into every workstation. It captures requests from an application program for file and print sharing resources and routes them to where they should be.

Redundancy

Parts of a stream of information that can be eliminated without losing the essential information in the stream.

Redundancy Checking

The insertion of data (in addition to the information bits) which is used to check the accuracy of data to be transmitted. See also Parity.

Register

A temporary storage unit (i.e. memory) for digital information. Found in modems.

Remote Access

Connecting to a network over the telephone lines, usually from home but can be anywhere. You can either control a PC directly, or join as a node through a PC.

Remote Computer

Any computer or terminal with which a communications link has been established.

Repeater

A device which amplifies or regenerates signals to compensate for losses in the system so they can travel further down the cable.

Replication

Synchronising data on two computers.

Requester

See *Client*.

Request/Response

How the client/server relationship works. A request from a client leads to a response from a server.

Reset Packet

Clears error conditions on an X.25 Switched or Permanent Virtual Circuit. Does not clear the session.

Response Time

The interval needed before a user request is answered.

Resource Sharing

The ability of computers to share and/or use their facilities around a network.

Restart Packet

Notifies X.25 DTEs that an irrecoverable error exists within the network. These clear all existing Switched Virtual Circuits and resynchronise all existing Permanent Virtual Circuits between an X.25 DTE and X.25 DCE.

RFC

Request For Comment. Online Internet documents inviting discussion, often adopted as standards in their own right.

RFI

Radio Frequency Interference. Emitted by unshielded cabling which can interfere with network communications.

RFS

Remote File Service. One of the many distributed file system network protocols that allow one computer to use the facilities of others as if they were available locally.

It is developed by AT&T and adopted as a part of UNIX V.

RHIA

Rubs Hands In Anticipation.

Ring Latency

The time a signal takes to go once round a Token Ring system.

RISC

Reduced Instruction Set Computing. A type of microprocessor instruction set focussing on rapid and efficient processing of a relatively small and simple set of instructions that can be executed in a minimum number of instruction cycles, usually one or less.

RIP

Routing Information Protocol. Standard IGP inter-router communications protocol.

RLOGIN

Terminal emulation program, similar to **telnet**, found in most versions of Unix.

RO(T)FL

Roll On (The) Floor, Laughing.

ROFLWTSDMF

Rolls On Floor Laughing With Tears Streaming Down My Face.

ROLC

Routing Over Large Clouds (ATM).

ROM

Read Only Memory. Devices used to store code and data that cannot be changed, as used for BIOSes.

ROUS

Rodents Of Unusual Size (from the film, *The Princess Bride*).

Router

Software or hardware linking two or more networks using similar protocols (usually over a wide area), able to forward messages destined for a particular network. It can make routing decisions based on a packet's address, and can send packets to the right links. It stops computers finding out about each other.

RPC

Remote Procedure Calls. Used in Client-Server database products as a mechanism for distributing applications.

RPM

Red Hat Package Manager. Used for installing, uninstalling and updating software.

RS232C

One list of definitions originally for communicating on telephone lines, but also widely used to connect printers and plotters. Defined by IEEE, the US equivalent of V.24.

RSN

Real Soon Now.

RSVP

Resource Reservation Protocol.

RTC

Real Time Clock. Usually, the Motorola MC 146818A or compatible.

RTF

Rich Text Format

RTFM

Read The Flamin' Manual!

RTS

Request to Send.

Run Length Encoding

Used commonly in fax transmission, a system of error checking using a byte count instead of sending a stream of identical bytes.

Runt

A packet less than the minimum Ethernet packet size of 64 bytes, arising from collisions and, if not eliminated, can cause congestion.

RXD

Receive Data.

SAA

Systems Application Architecture. Specifications written by IBM, the same as the ISO model, that is, describing how users and programs join together with the intention of unifying its architecture. This philosophy of common design pro-vides a consistency across the

System/370, the System/3x and PS/2. Many (DOS) software menu systems conform to this.

Samba

Server/client software that allows Unix machines to work on a Windows network, which uses Server Message Blocks.

Sampling Rate

The number of times a second an analogue signal is measured and converted to binary numbers.

SAN

Storage Area Network. A pool of multiple servers used for centralised storage. Includes fibre channel and RAID devices.

SAP

System Access Point.

SAR

Search And Rescue.

SAS

Single Attachment Station/Special Air Service.

SCSA

Signal Computing System Architecture. A design for hardware and software communicating over telephone lines and networks, so you can do the same things over both.

Script

A way of automating complex sequences of instructions, similar to a batch file.

Scrolling

Adjusting the screen display upwards or downwards.

SDH

Synchronous Digital Hierarchy.

SDLC

Synchronous Data Link Control.

SDRAM

See *Synchronous DRAM*.

Security

The system that prevents unauthorised users from obtaining access to a network, using passwords and permissions, etc.

Server

A computer on a network that provides services for workstations. Often regarded as a "controlling computer", it can be dedicated (used as a server only) or non-dedicated (used as a workstation as well).

Server-based Network

One where a server provides services to clients, and “controls” the network.

Server Cluster

Multiple servers operating as if they were a single machine, with all servers active (a mirrored server is idle until required). The contents of the main server will be mirrored to the others.

Session Layer

The fifth layer of the OSI model which dictates the conditions under which individual nodes on a network can communicate with each other.

SFSG

So Far So Good.

SGML

Standard Generalised Markup Language. A text based language used to describe the contents of electronic documents. HTML has descended from this. You need a transformer to view a document created with

Sharing

How resources are made available to the network.

Shell

A user interface.

S-HTTP

Secure HTTP. An extension of HTTP used for authentication and data encryption between Web servers and browsers.

SIG

Special Interest Group. An ongoing discussion group in a Bulletin Board.

Signal

The process used to convey information, which could take the form of a voltage or a current waveform, a pulse of light or a radio wave. It could also mean a very short message, such as "Control Signal".

Signal to Noise Ratio

The proportion of noise within a signal.

Simplex

Either a circuit used in one direction only or one used in either direction but not at the same time, depending on whose definition you use. The latter is sometimes also called Half Duplex, again depending on the definition.

SIP

Single In-line Package.

SITD

Still In The Dark.

SLIP

Serial Line Internet Protocol. Used when directly connecting a computer to the Internet. A packet-framing protocol that defines how IP datagrams are packaged for transmission over serial lines. PPP has more facilities.

Slotted Ring

Where a network based on a ring topology is divided into slots that circulate continuously.

SMB

Server Message Block. Yet another network protocol used by many manufacturers that allows one computer to use the files and peripherals of another as if they were locally available. This one was developed by Microsoft.

SMDS

Switched Multimegabit Data Service.

SMP

Symmetric Multi-Processing. Using more than one CPU. You can use 4 Pentium/Pros and 2 Pentium IIs.

SMTP

Simple Mail Transfer Protocol, used with TCP/IP. Text based TCP/IP protocol used for exchanging mail messages.

SNA

System Network Architecture. IBM's idea of a communications system which forms part of SAA, in association with SDLC, commonly used for transmitting data between an IBM host computer and a 3274 or 3276 controller.

SNAFU

Situation Normal—All Fouled Up.

SNMP

Simple Network Management Protocol. A control and reporting scheme for managing devices on a network. It consists of *console software*, run by the network manager, and *agent software* that runs on a networked device and maintains a database of facts about the device.

Commands include **get**, which will retrieve information, and **set**, which will change it. **getnext** retrieves the next object without it needing to be specified, while **trap** is for messages initiated by the agent.

The Management Information Base (MIB) defines which aspects of a device can be controlled, and is different from system to system.

SOBOH

Slap On Back Of Head.

SOH

Start of Header.

Source Code

High level instructions used to write porograms.

Space

The alternative condition of a line to Mark.

SPID

Service Profile Identifier. The number assigned by an ISDN service identifying a B-Channel. It includes each B-Channel's phone number and other digits indicating the switch type.

SONET

Synchronous Optical NETwork.

SOTA

State Of The Art.

Spider

Spiders are *robot* programs, that is, automated, that jump from page to page over the web, to gather statistics for updating indexes. If you register your web site with a search engine, they will send a robot out to gather information about it. Over 2 million sites per day can be interrogated, so the indexes will be huge.

SPOOL

Simultaneous Peripheral Operation On Line, meaning the capability for two operations to happen at once. A spooler will take data addressed to the printer and store it until the printer is ready; then it will release it at a rate that is comfortable with the printer's speed (the same could apply with modems and communications).

This saves you hanging around if there's a queue for the printer and allows you to do something else at the same time.

SPX

Sequenced packet eXchange. IPX, but with guaranteed delivery.

SQL

Structured Query Language. An standard English-like language for querying relational databases.

SRAM

Static RAM. See *Memory*.

SSH

Secure Shell. A way of logging into another computer over a network.

SSL

Secure Sockets Layer. Procedures at transport level used for authentication and data encryption between Web servers and browsers. A browser will communicate with a Server using http, with the get command. The text for commands and files are sent and received through sockets, which allow two computers to talk to each other over the Internet. SSL is a variation on the basic theme, written by Netscape for their Navigator product, to ensure safety of data, since no encryption is done on the basic Internet. SSL encrypts **http** transmissions, using RC4, a block encryption algorithm invented by Ron Rivest. The encryption key is generated anew for every session; 40 bit outside the USA and 128 bits inside, with corresponding difficulty levels for the cracking thereof.

SSWL

Splits Sides With Laughter.

Standalone

A device, computer or application not attached to a network.

Star

A LAN topology where cables radiate from a central network processor. One workstation is attached to each cable.

StarLAN

A networking system developed by AT&T that uses CSMA protocols on twisted pair telephone wire.

Start Bit

In asynchronous transmissions, the bit sent before the first bit of a digital word. The start bit is always on. Its presence informs the receiving station of the coming data.

Start-Stop Transmission

Another name for asynchronous transmission.

STB

Simply The Best.

STM

Synchronous Transfer Mode.

STS

Synchronous Time Stamps.

STS-3c

Synchronous Transport System—Level 3 concatenated.

Stop Bit

A bit (or bits) placed at the end of a byte to indicate the end of transmitted data. There are sometimes more than one, such as 1.5 or 2.

Store and Forward

The handling of messages or packets in a network by accepting them completely into storage before sending them forward. Used as a method of concentrating lines without congestion.

Store and Forward Switching

Every packet is read completely before transmission, having been stored in a buffer during the process.

STP

Shielded Twisted Pair. UTP with shielding.

STX

Start of Transmission.

Subnet Boundary

A limit between two subnets.

SVC

Switched Virtual Circuit.

Switched 56

A digital leased line offering 56 kbps.

SWMBO

She Who Must Be Obeyed.

SWYM

See What You Mean.

SYN

Synchronisation.

Synchronous

A form of communication between devices where both ends of the transmission are locked in step from the beginning to the end of the session; a common time base is continually acted upon by the sender and receiver as the modems pulse in time with each other.

The devices operate at substantially the same frequency and are maintained in a correct relationship by constant monitoring and adjustment for circuit conditions. As the meaning of each bit is dependent on its time of arrival, framing and error checking bits are unnecessary, so the data throughput rate is faster than it would be with asynchronous.

SysOp

System Operator. The person in charge of running a Bulletin Board.

T1

A leased line consisting of 26 64 Kbps channels, plus another one of 8 for control. bandwidth is 1.544 Mbps.

T3

A leased line equal to 30 T1 lines (45 Mbps).

TAIISAT

Take An Interest In Sex And Travel. In other words, GO AWAY!

TANJ

There Aint No Justice.

TANSTAAFL

There Ain't No Such Thing As A Free Lunch.

TAPI

Telephony Application Programming Interface. An API that allows Windows to program telephone devices, like modems, which applications can use to do their job.

TAR, TARBALL

A method of compressing files.

TBW

That Blasted Woman.

TCP/IP

Transmission Control Protocol/Internet Protocol. A set of protocols originally developed by the Department of Defense in the USA to link computers across networks. *Transmission Control Protocol* establishes communications between stations, allowing reliable delivery by retransmitting lost and corrupted data packets, and ensuring that packets are received in the same order that they were sent and *IP* relays the messages.

TDM

Time Division Multiplexing. A multiplexing method in which the time on the channel is allocated in turn to different subchannels and the data packets are interleaved with one another. The allocation may be regular in a fixed cycle or frame, or varied according to the needs of the subchannels.

TDR

Time Domain Reflectometry. The technique used to detect cable faults by transmitting voltage pulses and timing the echoes.

Teletext

The transmission of coded digital information as part of a television signal (it uses the blank bits), which can be decoded and displayed as text and graphics on a special receiver.

Teletype

This term used loosely to describe keyboard/printer terminals. It's actually a trademark of Teletype Corporation, whose terminals were so successful that their specifications became a widely adopted standard.

When a computer acts as a terminal to a remote host, Teletype is one of the emulations available.

Telex Network

A switched public network with teleprinters as terminals.

Telnet

A system (with TCP/IP) that connects you to a remote computer and allows you to run a program on it.

Terminator

A resistor at both ends of an Ethernet cable to absorb signals so they do not reflect back along the cable and cause errors by being read more than once.

TFTP

Trivial File Transfer Protocol. A scaled down version of FTP that has no authentication, as it relies on UDP for data transport.

TFTR

Thanks For The Report.

TG

Thank God.

Thick Ethernet

A cabling system that uses large diameter coax to connect computers through transceivers.

Thin Ethernet

Sometimes known as Cheapernet, as for Thick Ethernet, but with thinner and more flexible coax, with transceivers on the NIC.

TIA

Telecommunications Industries Association/Thanks In Anticipation.

TIC

Tongue In Cheek.

Timeouts

Timeouts bring into operation a predetermined event if another expected event does not occur in a set period. For instance, a timeout set for 6 seconds will cause a modem to hang up if nothing is heard on the telephone for that time.

Timesharing

The sharing of a resource between several users by giving each of them access (a time slot) in succession.

TIU

Terminal Interface Unit.

TLA

Three-Letter Acronym.

TMAI

Tell Me About It.

TMRTB

That Man Reads The Beano.

TNG

The Next Generation.

Token Passing

An access protocol in which a special packet (or token) circulates around a network giving stations permission to transmit when the token is in their possession. Any station wishing to transmit captures the token by setting a bit on it. When the transmission is completed, the station releases the token (and its hold on the network) by resetting the bit to free status.

Token Ring

A network scheme where packets are relayed around a ring.

Tone Dialling

See *MFT Dialling*.

TOP

Technical Office Protocol. Usually found living with MAP and uses CSMA and X400 standards.

Topology

Of networks, the physical layout of the nodes, terminals and lines; in other words, the map. Strictly, the pattern of connection (i.e. star), but the word also includes distance and geography. Common topologies include Bus, Tree, Ring, Star and Mesh.

TOS

Type Of Service. Field within IP used by newer protocols within routers to decide on routing, based on the task.

T-Piece

Or T-connector, used to join two coaxial cables with a spur at right angles for the NIC.

TPTB

The Powers That Be.

Traffic

The volume of messages sent round a system. The term is often used as a rough measure of how much a system is used, such as light, medium or heavy.

Transceiver

A device capable of sending and receiving information. Commonly used externally on a Thick Ethernet network, but often incorporated on a network interface card for Thin Ethernet.

Transport Layer

The fourth layer of the OSI model which checks the integrity of and formats the data carried by the physical layer, managed by the data layer and routed by the network layer, if implemented.

Transport Protocol

The basic level of protocol concerned with the transport of messages.

Travan

Large capacity tape technology that came from QIC.

Trellis Coded Modulation

A form of coding that adds an extra bit to the data flow to create a predictable pattern. Receiving equipment is able to guess what should have been sent from the pattern changes. It doesn't correct errors but helps make data less susceptible to them. It's a standard feature of V.32bis.

TTBOMK

To The Best of My Knowledge.

TTFN

Ta Ta For Now.

TTFS

Try This For Size.

Time To Live

Field within IP used by protocols to kill packets trapped in routing loops.

TTY

TeleTYpe. The most basic kind of terminal there is.

TTYL

Talk To You Later.

TVM

Ta Very Much.

TVMIA

Ta Very Much In Advance.

TWMTBACT

That Was Meant To Be A Comment To...

TWSTBACT

That Was Supposed To Be A Comment To...

TXD

Transmit Data.

TYVM

Thank You Very Much.

UA

Unusual Abbreviation.

UART

Universal Asynchronous Receiver/Transmitter. The gadget that converts data transmission from parallel inside the computer to serial for the serial ports.
The 16550A is a pin-compatible replacement for the original 16450 used in the AT which contains twin 16- byte buffers that can hold data until the CPU is ready to process it (the original 16550 had a bug in it, hence the improved A version).

UBR

Unspecified Bit Rate.

UDP

User Datagram Protocol. A connectionless TCP/IP protocol that allows datagrams to be sent from one Internet application to another, which must supply their own reliability checking.

UNI

User Network Interface.

Unix

An operating system developed by AT&T Labs in 1969.

Uplink

A communications path from an Earth station to a satellite.

UPS

Uninterruptible Power Supply. Switched or In-line. The switched type detects a power failure and switches in; the other runs the PCs it protects all the time from batteries that are continually being recharged.

URL

Uniform Resource Locator. A character string in document that identifies a resource (e.g. a document) on the Internet, typically a web page, e.g. http://www.org.com

USRT

Universal Synchronous Receiver-Transmitter. A single IC that contains receiving and transmitting circuitry for synchronous serial communications.

UTCCH

Until The Cows Come Home.

UTP

Universal Twisted Pair.

UUencoding

A way of sending binary files across the Internet, which is ASCII-based. Programs are encoded at the start, and decoded at the destination.

UYMF

Up Yours, My Friend.

VBR

Variable Bit Rate.

VC

Virtual Channel. See also *Virtual Circuit.*

VCC

Virtual Channel Connection.

VCI

Virtual Channel Identifier.

VDSL

Very-high-data-rate Digital Subscriber Line. Delivers over 9 Mbps of data over copper wires.

VGI

Very Good Idea.

Viewdata

Teletext-based service for accessing services through the telephone network.

Virtual Circuit

A concept used in X.25 to describe a notional circuit that is only in effect for the duration of a call, as when you use a telephone. Switched VCs allow a connection on a per-call basis, so they don't always connect the same two DTEs. Permanent VCs always connect two particular DTEs.

VLAN

Virtual LAN.

Volatile

A quality of memory, in that once the power is turned off, the information stored in it is lost.

Volume

An area of a hard disk separated from other parts, typically used with NetWare.

VP

Virtual Path.

VPC

Virtual Path Connection.

VPI

Virtual Path Identifier.

VPL

Visible Panty Line.

VR

See *Virtual Reality*.

V-Series

Recommendations for data transmission using the telephone network, thus many of them deal with modems. The best known is V.24, which lists the interchange circuits between a modem and its Data Terminal Equipment. Others include V.21, which covers 300 baud full duplex communication between modems and V.22bis which deals with 2400 baud.

VTP

Virtual Terminal Protocol.

WAGI

What A Good Idea.

WAIDW

What Am I Doing Wrong.

WAIS

Wide Area Information Server. A way of searching huge distributed database servers over the Internet, but any network will do. Think of gopher as a table of contents, and WAIS as an index.

WAN

Wide Area Network. A network operating over long distances, with a third party involved in its operation, such as the telephone company. A network spread over a large campus, but operated internally
may be over a wide area, but is still technically a Local Area Network.

WASHITO

Wait And See How It Turns Out.

Wavelength Multiplexing

Used in fibre, where more than one wavelength of light is used to multiplex signal on to a fibre.

WFAC

Waiting For A Call.

WFMOB

Well Seduce My Ancient Footware.

WHYD

What Have You Done

WIBNI

Wouldn't It Be Nice If.

Wide Area Network

Combinations of equipment linked over a wide area, often by the telephone system.

Wideband

Communications channels having a wider bandwidth than that used for normal speech circuits, with very high speed transmission (typically 48 kbits/sec) which enables many high-speed data transfers to take place.

WIHIH

What in Hell is Happening?

WINE

Wine Is Not an Emulator, used to run 32-bit Windows programs under X.

Winsock

Sockets for Windows, in the shape of **winsock.dll**.

WIWAB

When I Was A Boy.

WIWAL

When I Were A Lad.

Workgroup

A subdivision of a larger network, formed for administrative convenience.

WOSA

Windows Open Services Architecture. A collection of APIs that allow applications to access databases, telephones, etc. it includes ODBC.

WPC

See *Write Precompensation*.

WRT

With Respect To.

WTBC

Wont That Be Confusing?

WTF

What The Hell.

WUASTC

Wake Up And Smell The Coffee.

WWFFC

Why Wait For Father Christmas

WWW

World Wide Web. Hypertext pages on computers around the world and accessible over the Internet. You need a browser to read them.

X-Series

CCITT recommendations for packet switching, such as X.25.

X.25

A standard that defines how data should be handled in a packet switched network.

X.400

CCITT standard dealing with electronic mail and message handling.

XModem

A simple send-and-wait protocol originally designed for transmitting data between computers using telephones.

XMS

*e**X**tended **M**emory **S**pecification*. As there was originally no operating system to take advantage of extended memory, developers accessed it in their own way, often at the same time. Lotus, Intel and Microsoft, together with AST, came up with an eXtended Memory Specification that allowed real-mode programs to get to extended memory without interfering with each other. The software that provides XMS facilities in DOS is **himem.sys**.

XNS

Distributed file system developed by Xerox.

XON/XOFF

A software handshaking system used for flow control.

X-Windows

GUI for Unix-like systems.

YFST

Yawns For Some Time.

YHBM

You Have BinMail.

YHM

You Have Mail.

YHSM

You Have Snail Mail (i.e. normal post).

YKWIM

You Know What I Mean.

YGWYPF

You Get What You Pay For.

YSBIB

You Should Be In Bed.

Useful Numbers

American Megatrends (AMI)

6145-F North Belt Parkway
Norcross GA 30071
Tel: (770) 246 8600
Fax: (770) 246 8790
Tech Support: (770) 246 8645
www.megatrends.com

AMI (UK) Ltd

01342 410410

Award Software

777 East Middlefield Road
Mountain View CA 94043
Tel: (800) 800 BIOS
Fax: (415) 968 0274
www.unicore.com

Chips & Technologies

2950 Zanker Road
San Jose CA 95134
Tel: (408) 434 0600
www.chips.com

Chips & Technologies (UK)

01734 880237
01734 884874 (F)

DTK

(818) 810 0098
(818) 333 6548 BBS

Epson UK

01442 227478
01442 227479

Epson

(310) 787 6300
(310) 782 5350 (F)
(408) 782 4531 BBS

Eurosoft (UK) Ltd

3 St Stephens Road
Bournemouth
Dorset BH2 6JL UK
Tel: 44 (0)1202 297315
Fax: 44 (0)1202 297280
www.eurosoft-uk.com

General Software

320-108th Avenue NE, Suite 400
Bellevue WA 98004
Tel: (206) 454 5755
Fax: (206) 454 5744

IBM

3039 Cornwallis Road
Research Triangle Park NC 27709
Tel: (919) 543 4328
Fax: (919) 543 3518
www.ibm.com

Intel

5200 NE Elam Young Parkway
Hillsboro OR 97124
Tel: (503) 696 8080
Fax: (503) 645 8181
www.intel.com

Komputerwerk

(412) 782 0384

Micro Firmware

3330 West Gray Street, Suite 170
Norman, OK 73069
Tel: (405) 321 8333
Fax: (405) 321 8342
www.firmware.com

Microid Research

1538 Turnpike Street
North Andover MA 01845
Tel: (800) 800 BIOS
Fax: (508) 683 1630
www.unicore.com

Opti

(408) 980 8178

Phoenix

411 East Plumeria Drive
San Jose CA 95134
Tel: (408) 570 1000
www.ptltd.com

Silicon Pacific

44 1491 638275

SystemSoft

2 Vision Drive
Natick MA 01760-2059
Tel: (508) 651 0088
www.systemsoft.com

Unicore

1538 Turnpike Street
North Andover, MA 01845
Tel: (800) 800 BIOS
www.unicore.com

Upgrades Etc

(800) 541 1943

Xetal Systems

Makers of the POSTmortem™ card
Box 32602
9665 Bayview Avenue
Richmond Hill
ON L4C 0A2 Canada
Tel: (416) 410-3883
ulf@problem.tantech.com