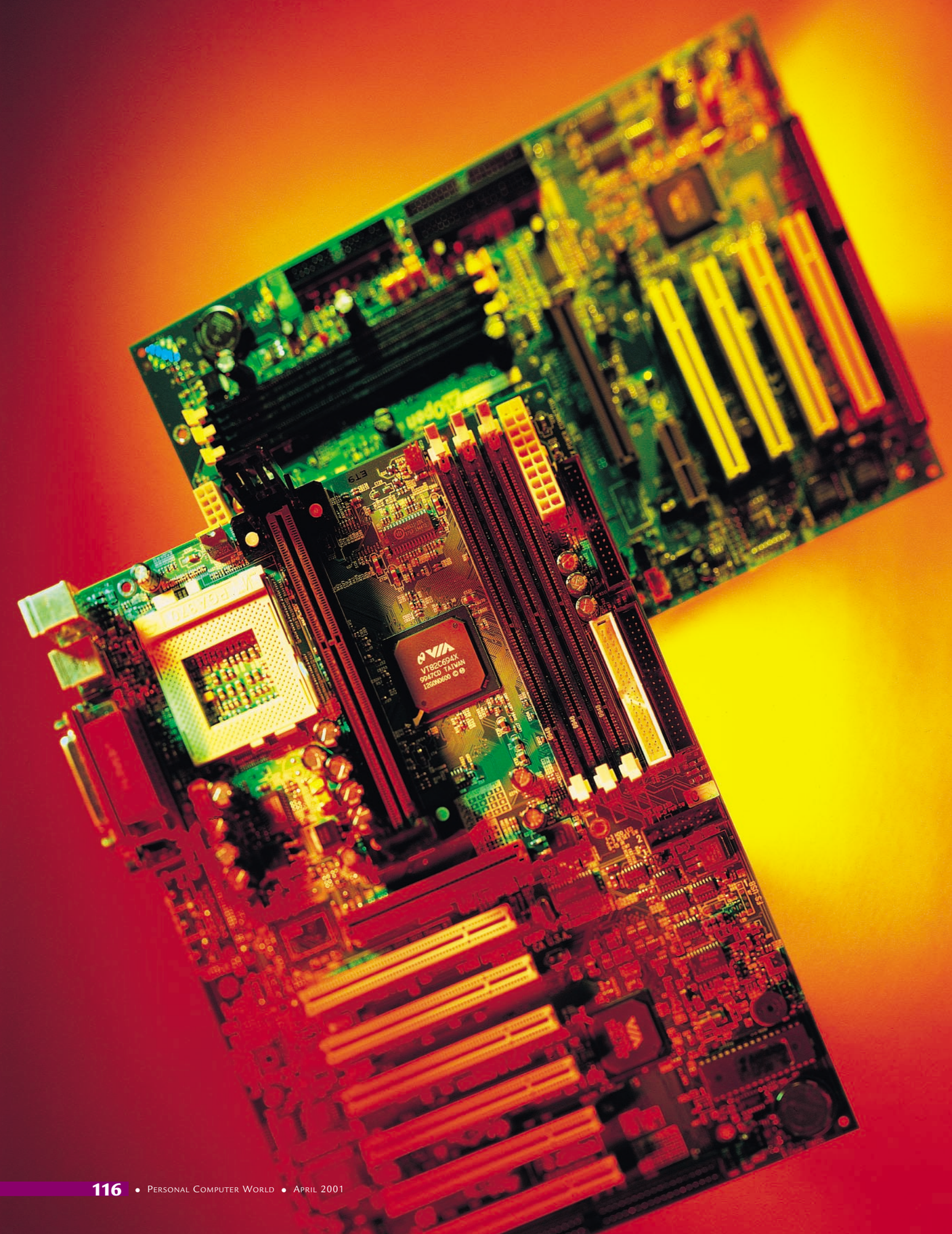


Magic motherboards

THEY SAY YOU CAN'T CHOOSE YOUR PARENTS... BUT YOU CAN UPGRADE YOUR MOTHERBOARD. GORDON LAING GIVES YOU THE HOWS, WHYS AND WHENS IN OUR STEP-BY-STEP GUIDE

The most important component in your PC is not the hard disk, graphics card or even the processor – it's the motherboard, to which everything connects. As the backbone of a PC system, the motherboard is responsible not just for connecting components, but providing the means by which they can talk to each other.

Since PC components come in a variety of speeds, shapes and sizes, it's crucial to choose the right kind of motherboard to house them. While a motherboard upgrade is unlikely to make your system any quicker by itself, its support for newer, faster components could see your PC's potential performance improve by leaps and bounds.

However, upgrading a motherboard is a much bigger task than just swapping a graphics card or popping in some additional memory. It involves removing all the components before actually unscrewing and lifting out the board itself. It involves considering which of your existing components can be re-used on a new board, and buying replacements for those that can't.

Then it's the whole process again in reverse, as the new motherboard is mounted in the system case, before the reinsertion of the components and cables. Like most new devices, there will even be some software drivers to install the first time you start up your operating system.

There's no need to panic though. Over the following pages we'll explain precisely what's involved in easy step-by-step stages, along with outlining and solving the various problems that could otherwise trip you up.

To complete the picture and help you choose the most suitable motherboard, we've also compared the features of the most popular chipsets today, along with a look into the future of motherboards with support for the latest Double Data Rate (DDR) memory and Intel's new Pentium 4 processor.

PHOTOGRAPHY JULIAN HAWKINS

Chipsets

The most important component on a motherboard is the chipset, as it literally defines the capabilities of the entire system. Most chipsets are divided into two actual physical chips on the motherboard called the northbridge and the southbridge.

The northbridge takes care of all data transfers between the CPU, main system memory and the Accelerated Graphics Port (AGP). The southbridge looks after the system's I/O capabilities, including support for USB, serial,

Pentium 4 motherboards

The Intel Pentium 4 is a completely different type of processor to the Pentium III and Celeron chips, and hence requires a special motherboard and chipset. Today, the only chipset that supports the Pentium 4 is Intel's own 850.

The 850 chipset will only talk to RDRAM, which means until any alternative chipsets arrive, all Pentium 4 systems are limited to using this currently expensive memory. The 850 handles up to 2GB of PC600 or PC800 RDRAM and supports AGP 4x; dual-CPU solutions are not currently offered. The accompanying ICH2 chip supports UltraDMA100 drives and two USB controllers.

Competitors to Intel are currently working on Pentium 4 chipsets – expect one from VIA first, supporting SDRAM memory for cheaper configurations. VIA will undoubtedly also be working on a DDR Pentium 4 chipset.

Leaked Intel roadmaps suggest that an SDRAM P4 chipset will become available before the end of 2001, but a DDR may not arrive until 2002.

parallel and keyboard ports, along with the EIDE and floppy drive controllers.

Clearly the capabilities of the chipset are crucial for supporting various devices. The latest northbridge might support DDR memory and AGP 4x transfers, whereas an older one may be limited to talking to normal SDRAM and slower AGP 2x transfers. Another problem may be that the northbridge may only support expensive RDRAM memory.

The situation is equally important on the southbridge, where the latest versions could support UltraDMA100 hard disks compared to, say, UltraDMA66 or 33 on older models. As USB continues to dominate, a more modern southbridge could contain support for not just one, but two USB controllers, providing four ports on the PC itself. In future chipsets, we can look forward to support for USB 2.0 controllers, which will provide a dramatic increase in bandwidth.

In all but Intel's 800-series chipsets, the northbridge and southbridge chips communicate with each other across the PCI bus, which runs at 133Mbytes/sec. On its 800-series chipsets, Intel has dumped the northbridge and southbridge names, instead referring to the former as the Graphics and Memory Controller Hub (GMCH), and the latter as the I/O Controller Hub (ICH). Intel has, however, doubled the data rates between the GMCH and ICH to 266Mbytes/sec.

The most important thing to remember is that the chipset is permanently soldered to the motherboard and therefore cannot be upgraded. While you could extend the capabilities of an old motherboard by fitting, say, a PCI card with a USB 2.0 or an UltraDMA100 hard disk controller, it's not possible to change the core support for AGP or a certain type of memory. Consequently, when choosing a new motherboard, ensure the chipset provides support for all desired devices and components.

Major players

Intel and AMD both make chipsets exclusively supporting their own processors. Taiwanese company VIA produces different chipsets for both Intel and AMD processors. While these three dominate the chipset market, other players include SiS and ALi (Acer Labs Inc). The latter in particular could again become a major player by being the first to market with a chipset supporting new DDR SDRAM memory.

All DDR chipsets will in theory talk to either DDR or conventional Single Data Rate (SDR) memory, although since their DIMMs are physically incompatible, the actual memory support is tied to the type of slots fitted on the motherboard itself. They will therefore tend to support one type of memory or the other. Theoretically there could be boards with both types of slots, although there would be no support for mixing.

AMD CPU chipsets

If you have an AMD Athlon or Duron in the latest Socket A form factor, then you've currently got to choose between VIA's Apollo KT133A chipset and a handful of motherboards with AMD's original 750.

The VIA KT133A is essentially the same as the earlier KX133, except with specific support for the new Socket A form factor. The KT133A also supports CPU front-side buses (FSBs) of 200 or 266MHz, compared to the older KT133, which only supports a 200MHz FSB – the 266MHz setting is essential to support the fastest AMD chips.

Most Socket A motherboards use VIA's chipsets. The latest KT133A supports AGP 4x and up to 1.5GB of SDRAM at either 100 or 133MHz – compared to the AGP 2x and 100MHz memory support of the aging AMD 750 chipset.

The first KT133A chipsets included the VT82C686A southbridge, with support for one USB and an UltraDMA66 controller. The newer VT82C686B southbridge supports two USB controllers and UltraDMA100 drives. Since the southbridge is not upgradable, it's worth choosing a motherboard with the latter version, if onboard support for UltraDMA100 is important to you.

The variety of decent chipsets for AMD Socket A CPUs is, however, about to expand significantly. Chipsets with support for new DDR SDRAM should be available early this year from AMD, VIA and ALi, to name but three.

ALi's MAGiK 1 chipset supports up to 3GB of SDRAM, be it conventional or DDR. It also supports AGP 4x and UltraDMA100.

AMD's new 760 chipset supports up to 4GB of conventional or DDR memory, AGP 4x, UltraDMA100 and two USB controllers. VIA's forthcoming Apollo KT266 chipset should also share the same specification as AMD's 760. However, if you're into multiprocessor systems, then the only chipset for AMD CPUs is the forthcoming 760MP.

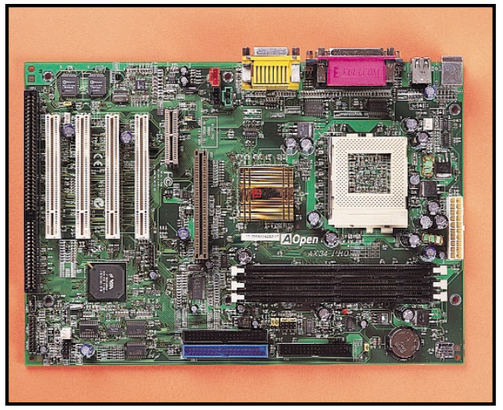
Intel CPU chipsets

While AMD's CPU chipsets are currently dominated by VIA, the choice for Intel CPUs is much broader – we'll leave aside the recently released Pentium 4 for now (see box on previous page) and concentrate on chipsets that support the Pentium III and Celeron CPUs.

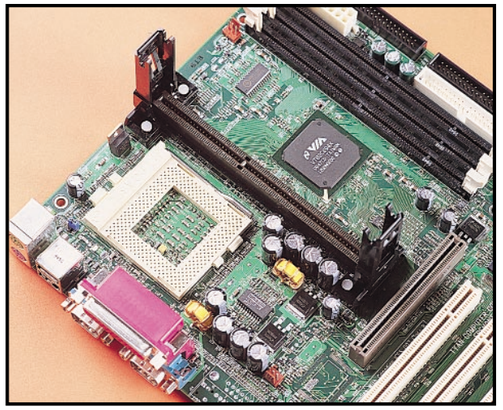
From VIA comes the venerable Apollo Pro 133A, which supports AGP 4x and up to 2GB of SDRAM running at 100 or 133MHz. It's also worth noting that there's a 66MHz FSB setting to support Celerons.

Coupled with the latest VIA southbridge, you'll also get two USB controllers and support

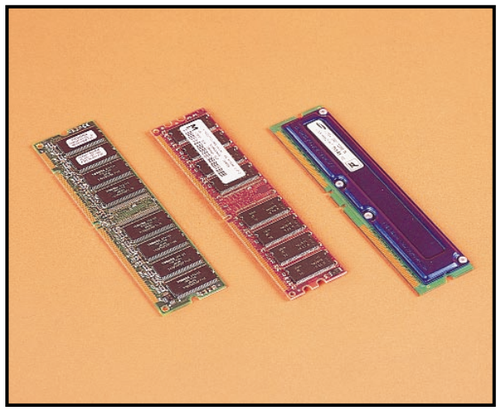
Your plan of action: think recycling!



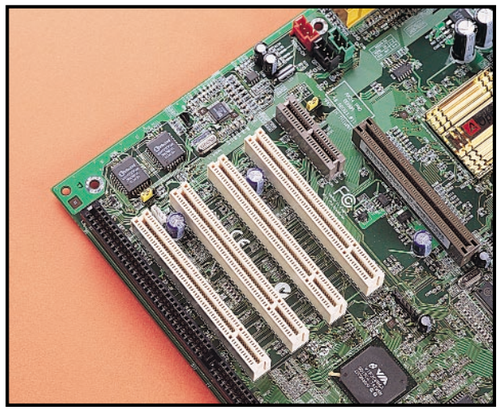
1 The key to upgrading is deciding which existing components can be recycled. First, ensure a new motherboard will actually fit in your existing case. Virtually all new motherboards use the ATX form factor, requiring an ATX case and power supply. If your case is pre-ATX, other existing components could also be dated, and you'd be better off buying a new PC instead.



2 If you want to re-use your CPU, obviously buy a motherboard that supports it. Remember Intel CPUs won't work on AMD motherboards and vice versa. If you have an older slotted CPU, your choice will be limited, as most new models only accept socketed CPUs. Intel still makes slotted versions of its Pentium III CPUs – there are a few new Slot 1 motherboards – but maybe it's time to switch to sockets.



3 Recycling memory can be tricky. Most modern motherboard and CPU combinations require SDRAM DIMMs running at a specific speed, and unless yours match the specification, you can't re-use them. Also, DDR SDRAM and RDRAM motherboards require their own type of memory that's not compatible with conventional SDRAM. If you want new memory, go for a faster DDR motherboard.

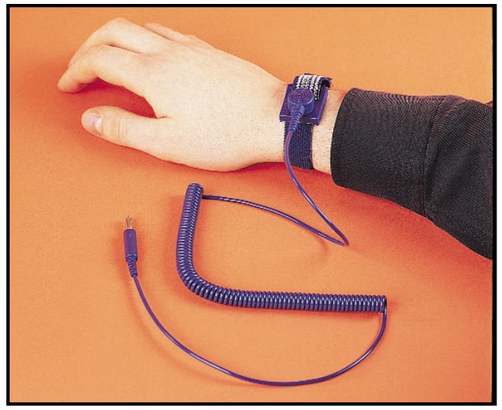


4 Almost all motherboards will have the same plugs as your old one, letting you recycle your input devices – although ancient AT keyboards may not work. The PCI standard hasn't changed, so any existing cards should also work. There are unlikely to be any ISA slots, and PCI graphics cards are best upgraded to AGP. UltraDMA33 drives will work on newer UltraDMA66 and 100 interfaces.

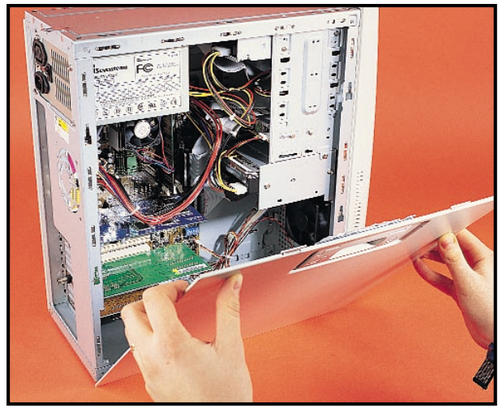
QUICK TIP

Before upgrading, figure out which parts can be recycled. All new motherboards are based on the ATX form factor, requiring an ATX case and power supply. If yours is pre-ATX then your PC is too old for an upgrade.

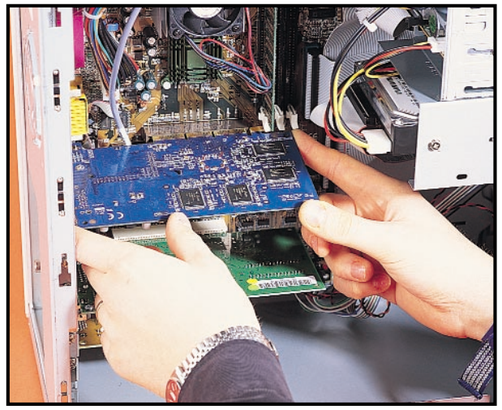
Removing the components



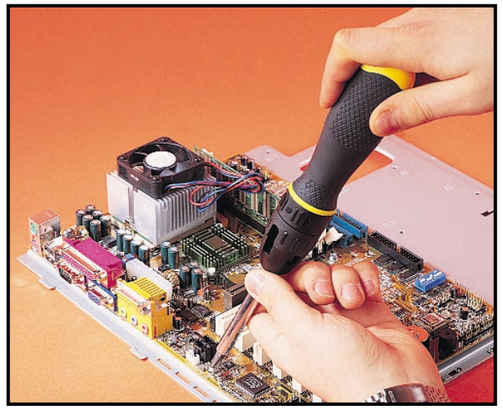
1 Once you've decided what to recycle, open your PC case and remove components. Be careful: static electricity can destroy sensitive PC components, so ensure you're grounded. Some people touch the metal casing of the internal power supply to do this, more cautious upgraders should invest in an anti-static wrist strap and avoid nylon clothing. Also remove all plugs from the back of your PC.



2 Every PC case opens differently, but your goal is to remove the left-hand side panel with the PC facing you. This could involve removing several screws and/or unlocking a latch. Once opened, you should lay the PC on its closed side, providing easy access to the insides. A well-lit work surface with plenty of static-free room to lay out components is an advantage – your carpet is not a good surface.



3 Once inside the PC, remove all cables and cards connected to the motherboard. Start by unscrewing the card's retainers and firmly pulling them out one by one. Next disconnect all the cables from the motherboard, including the flat ribbon drive cables, the multicoloured power connection, and the thin wires that make the lights and buttons on your PC's front panel work.



4 Unscrew the motherboard. Take out memory cards by pulling back the levers at each end to release them. The entire cartridge of a slotted CPU is removed by pulling outwards on the tall clips on either side, and lifting. A socketed CPU must have its heatsink unclipped before pulling up the lever on the side, allowing the CPU to be lifted out. Remember to unplug the CPU fan's power cable.

QUICK TIP

A motherboard upgrade involves reinserting every component, card and cable, and it's easy to make mistakes. Until you're 100 per cent certain everything is connected correctly leave the case open for last-minute changes.

for UltraDMA100. The Pro 133A also supports dual-processor systems.

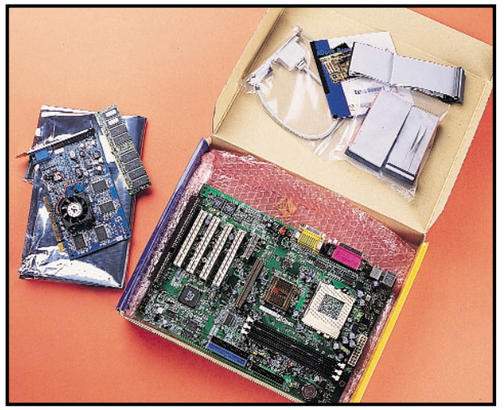
VIA is also about to launch a DDR chipset for Intel CPUs, unsurprisingly called the Apollo Pro 266, which is due out in early 2001. It will support AGP 4x and up to 4GB of conventional or DDR SDRAM. The accompanying southbridge should support two USB controllers and UltraDMA100. Motherboards have been previewed supporting dual CPUs and DDR.

ALi's Aladdin Pro 5 is another DDR chipset, supporting AGP 4x, UltraDMA100 and up to 3GB of DDR or conventional SDRAM.

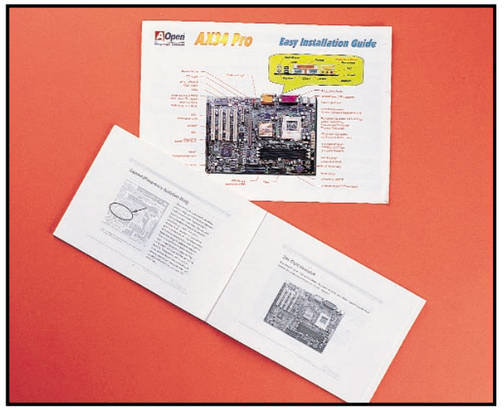
Intel has the largest range of chipsets in current use for its CPUs. The hub-based 800-series consists of the 810 (for Celeron), 815 (for mobile Celeron and PIII) 820 and 840 (for Pentium III), and the 850 (for Pentium 4) chipsets. For reference, we'll also throw in comparisons with the oldie-but-goldie Intel BX chipset.

All 800-series chipsets support AGP 4x, while

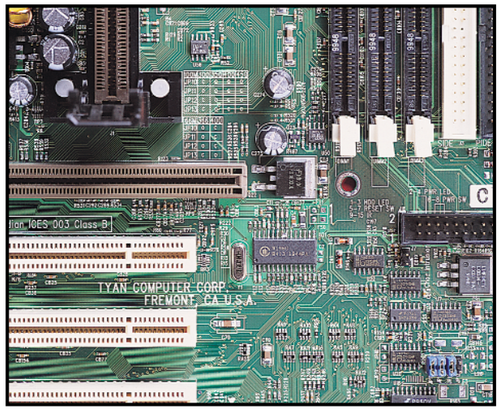
Essential preparation



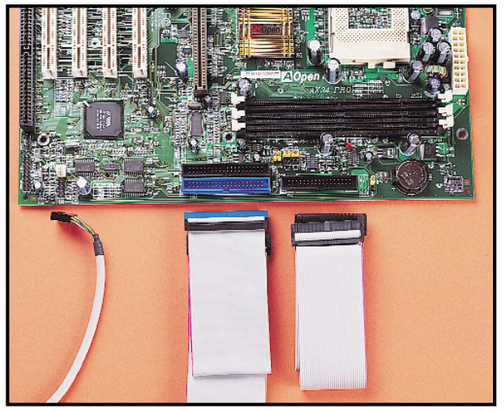
1 Before fitting your new motherboard, familiarise yourself with it and all the components you're going to insert. Ensure you've got plenty of room to work with, and safe places to store components while they're outside of the PC – the silver anti-static bags that new cards and motherboards are supplied in are ideal. Make sure you're grounded, as static electricity can instantly destroy PC components.



2 If you only read one manual in your entire life, make sure it's the one that comes with your motherboard. Even the most experienced hardware enthusiasts will need to refer to it. The manual will explain the motherboard's capabilities and compatibilities, then list every single connector, before going over BIOS configuration and installation of drivers. It is the ultimate reference guide.



3 Before screwing in your new motherboard, familiarise yourself with it. It may look pretty similar to your old one, but many of the connectors may need their cables inserting the other way round. Most motherboards also have information or tables printed on them explaining which jumpers do what. These may be even more detailed than the manual. A torch and magnifying glass may prove useful.



4 Make sure you have all the components you require to build a completely operational PC. New memory or a CPU may be top of your list, but they'll be useless if you're missing an essential system cable. Most motherboards will come with an EIDE cable to connect to a hard disk, and suitable retention clips if it's a slotted CPU model, but ensure they're compatible with your components.

QUICK TIP

No-one likes reading manuals, but in the case of a motherboard upgrade, it's absolutely essential. Many motherboards have their connectors the opposite way around to others, so don't get caught out. Let the manual lead you.

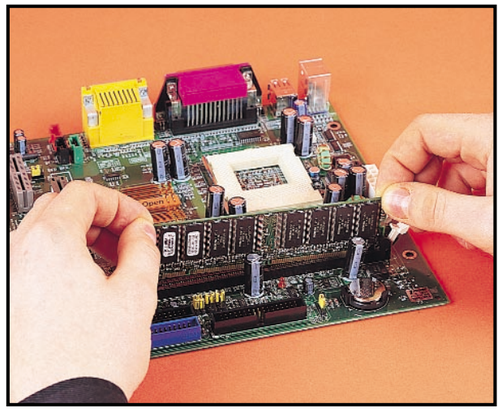
the BX is left at 2x. To enable cheaper systems, the 810 chipset features modest integrated 3D graphics, without an upgrade slot. The 815 also features integrated graphics, but thanks to the additional support for an AGP slot, it can at least be upgraded.

In terms of memory, the BX, 810 and 815 chipsets employ conventional SDRAM at up to 133MHz for the 810 and 815, or (officially) just 100MHz on the BX. The BX supports up to 2GB of memory compared to just 512MB on the 810 and 815; the BX will also talk to two CPUs if desired.

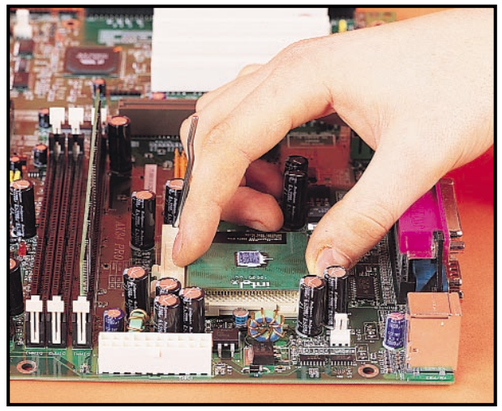
The 810, 815 and BX have one USB controller, although while the BX only supports Ultra-DMA33, the 810 and 815 support UltraDMA66 drives. Note the updated 815E and 815EP chipsets feature Intel's newer ICH2 hub, supporting two USB controllers and UltraDMA100.

On the Pentium III front, the 820 and 840 chipsets support AGP 4x and dual CPUs, but will only talk to expensive RDRAM memory – an

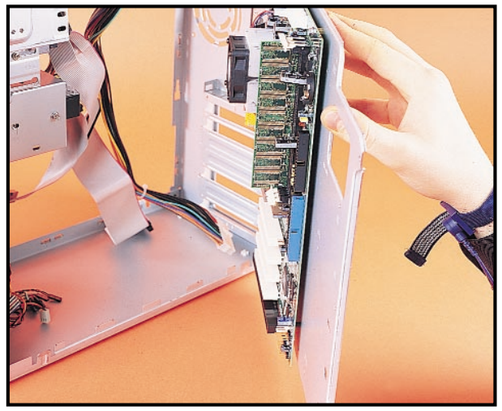
Installing the new board



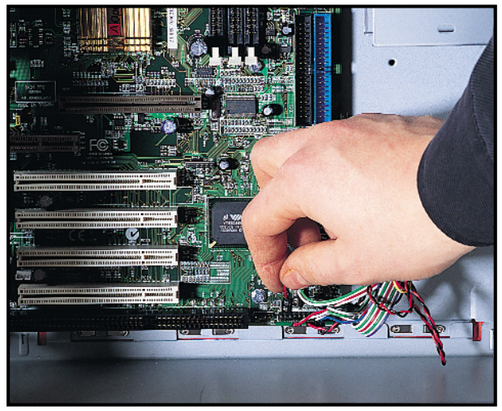
1 Now that you're fully prepared, it's time to fit the new motherboard in your case and reconnect all the cables. As with the removal stage, you may find it easier to fit the CPU and memory onto the board before screwing it into the case – this is the order in which we'll do it, but there's nothing stopping you first screwing the board in the case then reaching inside to fit the required components.



2 To fit a slotted CPU, insert the vertical retention clips into the motherboard, then slide the CPU cartridge into its slot. To fit a socketed CPU, lift the lever on the side of the socket and drop in the processor, align the pins then push down. Clip on the heatsink, and connect the fan's power cable. To fit memory, pull back levers at each end of the slot, push the card in, then lock levers into card's notches.



3 Now you must fit the board in the case, although you can do this before step two if desired. You can either lower the motherboard into the case, or remove the case's right-hand panel for direct access. The motherboard itself is held in by several screws around its edge and a couple in the middle – these align it with the holes in the case and prevent it from lifting when cards are pulled out.



4 Reattach the right-hand case panel, insert all the cables, including the power connector, the flat-drive ribbon cables and the wires for the front-panel lights and buttons. Refer to the manual to connect them correctly. Ribbon cables have one coloured wire, which should be aligned with the side of the socket with a number 1 next to it. Finally insert the cards and screw them in securely.

QUICK TIP

Static electricity can kill sensitive PC components, so make sure you're properly grounded before handling them. Anti-static wrist-straps are the order of the day, and always avoid nylon clothing and working on the carpet.

SDRAM translator chip was used by some early motherboards, but later withdrawn after encountering some problems.

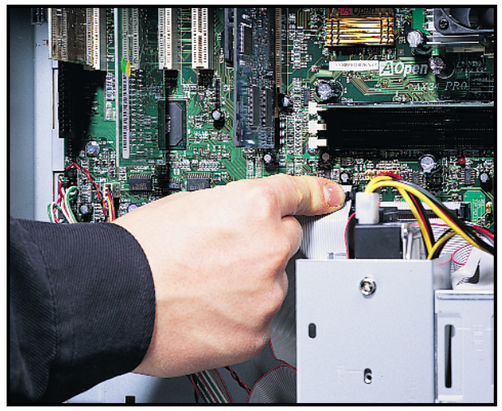
The 820 addresses 1GB of memory, compared to 4GB across two channels on the 840. Both chipsets have the original ICH, supporting one USB controller and UltraDMA66. Like the 815E, an updated 820E chipset features the newer ICH2, supporting UltraDMA100 and two USB controllers.

Intel is rumoured to be planning DDR chipsets, but these could be a long way off, and may only be for the Pentium 4 – VIA and ALi look like offering the only DDR Pentium III chipsets in the near future.

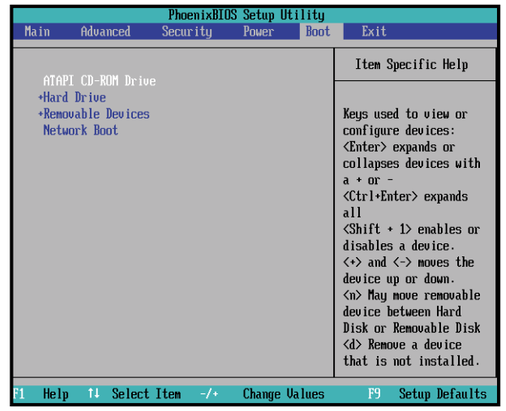
Onboard peripherals

Many motherboards feature greater device support than just the 'freebies' included in their chipsets. Several also have audio, Ethernet, SCSI and/or FireWire controllers onboard, saving you from buying and fitting additional PCI cards.

Switching on

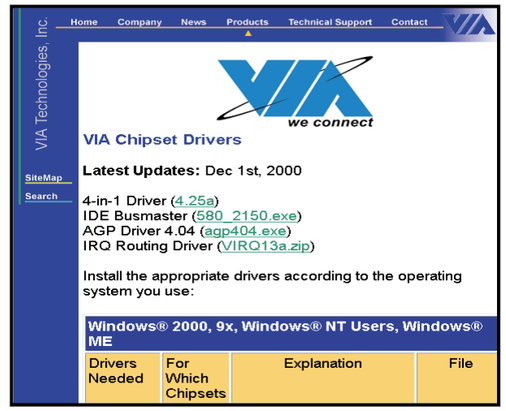


1 With all components, cards and cables correctly inserted and verified: connect all the external cables and switch the power on. If nothing happens, switch off and check the cables are the right way round. Ensure the CPU, memory and cards are fully inserted – a gap will stop it powering up. If your system beeps, count the number and cross-reference it with the troubleshooting guide in the manual.



2 The motherboard's BIOS has information about your system configuration, and your drives and onboard devices. You may have to modify a setting here, so press Del when starting up, and use the manual to find the sections to change. Ensure the BIOS knows what drives you have, and which to boot from first. If you're using EIDE drives, ensure the onboard EIDE controller is activated.

3 Now start up your operating system. A motherboard requires the right drivers to make it work. Windows will detect new devices and install the software for them. It's also essential to install the drivers that came with the motherboard for best performance. Owners of motherboards with VIA chipsets should check VIA's website (www.via.com.tw) and download the latest 4-in-1 driver.



4 Your motherboard should now be operational. However, it's worth maintaining it properly. New cards or operating systems may require support from the BIOS, which could need updating – check the motherboard manufacturer's website for updates on the BIOS. There may be newer drivers for the chipset, too, so check its manufacturer's website – VIA often updates its 4-in-1 chipset driver.

Several motherboards on the market today also extend the capabilities of their chipsets with additional onboard controllers. When the old Intel BX chipset briefly came back in fashion, new motherboards using it often featured a separate UltraDMA66 or 100 controller, so it could stand up in features against newer chipsets. As USB 2.0 finally arrives, expect to see early motherboards supporting it with a separate chip, before it's integrated into new southbridges.

While there's no difference in performance between an onboard controller such as those mentioned above, and one that's on a card, graphics are a different matter altogether. Intel's 810 chipset featured relatively slow onboard 3D graphics, which could not be upgraded with a new AGP card. If you're into gaming, then avoid motherboards with onboard graphics that cannot be upgraded – fortunately the newer 815's onboard graphics can be disabled in favour of an AGP card.

QUICK TIP

If your system won't power up, or beeps several times, then something is not connected properly. Check the cables are the right way round, and that cards, memory and even the CPU itself are fully inserted.