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Build your own PC, part I

The best way to get the PC you really want – and to learn about its workings into the bargain – is to build one yourself. It might sound daunting but, armed with this component primer and Gordon Laing's guidance, you'll be able to create a budget system or a high-end PC that will make you the envy of all

Today's PCs have never been cheaper or easier to buy, so why on earth would you want to build your own? Because buying a new PC is not always about trying to squeeze everything including the kitchen sink into strict price points. Sure, preconfigured PCs may represent great value, but they don't necessarily deliver what you really want.

When you build your own PC you can choose precisely the components you're after and not put up with compromises or parts you don't need. You'll enjoy a unique customised system that's unavailable anywhere else and be the envy of your

friends and colleagues. Even better, you'll become an expert in essential PC maintenance in the process.

Building your own PC can be an extremely rewarding experience and easier than you think, but where do you start? That's where *PC Advisor* comes in: our three-part guide will help you design and build your dream system.

In part one this month, we'll list the components you'll need for a decent system and explain how we went about choosing them. The step-by-step boxouts show you to get started on the assembly of your system.

Be prepared

The first step when handling any kind of PC hardware, whether you're upgrading a single component or building a whole PC, is to ground yourself. This ensures there's no static electricity that could otherwise fry an unsuspecting PC part. Wear an antistatic wriststrap when handling components, available from specialist stores or computer fairs.

The second step is to read the manual that came with your motherboard very carefully, as this is your bible during the DIY or upgrading process. If you lose the manual, fear not, all the motherboard manufacturers store downloadable copies on their respective websites.

The third preparatory step applies to any kind of precision work: ensure you've got plenty of room and light as well as ample time, as it will take you around two hours just to physically screw your PC parts together. Speaking of which, don't forget your trusty Phillips head screwdriver (shown right); this is the one tool you'll be using to put your PC together.



To cater for all needs, we'll build two systems: one will cost £1,000 and will represent our budget system, while our high-end PC costs £2,000 including VAT. Remember, though, that if you reuse a monitor, case, drives or keyboard, you could save a fair amount on this total.

Next month we'll finish the assembly and, in the final part, we'll install the software and make sure everything works correctly. All suppliers are listed at the end of the feature (see page 188) and all prices are quoted excluding VAT. Note that while the prices were correct at the time of going to press, the costs of PC components continually fluctuate, especially those of processor and memory.

Processor

As the brains behind your PC, the processor is the single most important and usually most expensive component on the DIY shopping list, but which one should you buy? The key to buying processors is realising there's a disproportionately large premium to be paid for the fastest one. The second- and third-fastest chips are normally only fractionally slower, but considerably cheaper. The trick is therefore to check which is the fastest chip available, then choose the model just below it.

For our high-end machine we've gone for an Intel Pentium 4 chip which, despite being expensive, delivers the ultimate

performance when coupled with the right memory. The fastest model at the time of writing was the 2.53GHz model, costing a whopping £528. Following our rules we've opted for the next model down, the 2.4GHz Pentium 4 which costs £331. Note that Intel produces two versions of this chip, labelled A or B, designed for 400 or 533MHz system buses respectively. We've chosen the latter in order to match it with the fastest memory available.

Incidentally, we decided not to go for a dual-processor system as these only offer a benefit to specialised users, such as those who use their PCs for performing scientific calculations or 3D graphics rendering. For the vast majority of people, a single fast chip is a far better choice.

Now to our lower-priced system. In terms of value, it's impossible to beat AMD's Athlon XP processor. It's a great performer, too, and is only beaten by the

P4 in expensive configurations. At the time of writing, the fastest model was the Athlon XP 2200+, which costs £179. Just below this were the 2100+ at £146 and the 2000+ at £102. Admittedly there's much less between their prices than the top P4s, but the budget is tight on our low-end system, so we've opted for the Athlon XP 2000+.

Heatsinks

Desktop processors have long required heatsinks and fans to prevent them from overheating. Many processors are sold with heatsinks, but they're often very basic. It's best to visit a specialist online supplier, such as Overclockers UK (www.overclockers.co.uk), when purchasing a heatsink. We've opted for an Akasa AK-821 2Q Silent Cooler for our Athlon XP budget PC and a whopping Alpha PAL8942T with a Sanyo-Denki 80mm fan for our Pentium 4 high-end system.

The Akasa and Sanyo Denki fans are fairly inaudible for high-performance coolers, but there are even quieter alternatives. Log on to the appropriately named QuietPC (www.quietpc.com) to find out more about the beautifully designed Zalman flower heatsinks that can reduce system noise yet further.

Memory

In terms of overall PC performance, the speed, quantity and type of memory make the next biggest impact after the processor so, unless you're working on an extremely tight budget, go for a minimum 256MB of RAM. If you use your PC for any kind of graphics, video editing or photo printing, then additional memory will work wonders. Today's memory market is dominated by DDR (double data rate) RAM, which is well matched by the Athlon XP

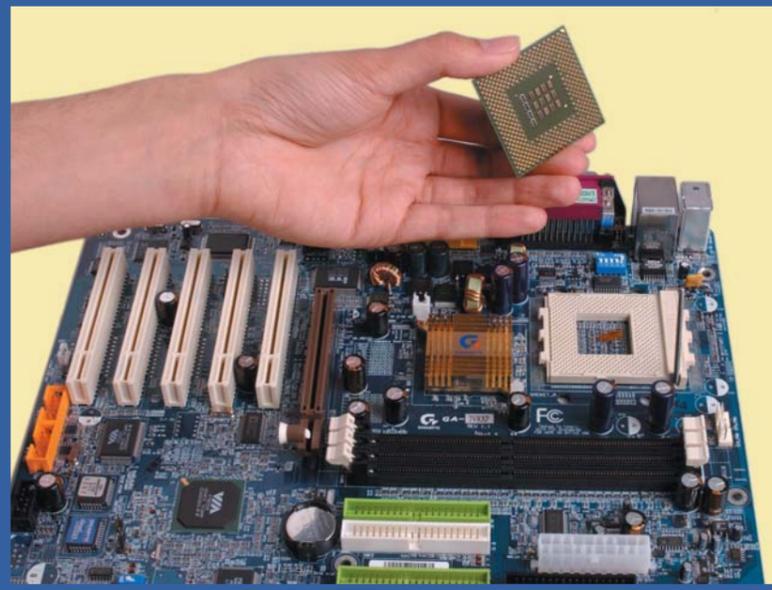
Essentials

- Tools Phillips head screwdriver, antistatic wriststrap.
- Benefits Building your own PC gives you the perfect specification at a reasonable price. It's also a great lesson in PC hardware and good fun, too.
- Cost £1,000 and £2,000 respectively including VAT for the configurations quoted.
- Time required Approx half a day for this part; approx one day for entire three-part process.
- Difficulty level Medium to high. Must be familiar with inside of PC.
- Tips The motherboard manual is your bible. Read it thoroughly.

Installing the processor

These days, installing a processor is very simple – just ensure the CPU is the right way round and that its pins are aligned with the holes in the socket. Fortunately the chip can only physically slot on to the motherboard one way round, as there are certain pins missing. On our Athlon XP budget system there's a pin missing in two of the corners, while on our Pentium 4 high-end PC two pins are missing on one of the corners.

Line up the missing pins with the matching absent holes in the socket. Once you've confirmed the processor orientation, lift the lever at the side of the socket and gently lower the CPU into place. Once it's pushed all the way in on every side, lower the lever at the side of the socket back down again to lock it in place.



processors. The most common type of DDR RAM runs at 266MHz and is known as PC2100; we've selected 333MHz DDR memory for our Athlon system, also known as PC2700.

At June's Computex show in Taiwan there was much gossip about 400MHz DDR memory, which should be available to purchase by the time you read this. It's too late for our project, but you may want to consider it with an appropriate motherboard for your own system.

A word of warning, though: DDR motherboards can be very fussy, so always check the websites of suppliers such as Crucial (www.crucial.com/uk) and Kingston (www.kingston.com/uk) to find out which memory chips are guaranteed to work. Checking our selected low-end system's Athlon motherboard (see the next section) on Crucial's website, we've plumped for a single 256MB PC2700

Dimm costing £50. Note this motherboard only supports two PC2700 Dimms.

While you can also build a Pentium 4 system with DDR memory, we've gone for the ultra-speedy RDRAM on our high-end PC. This is more expensive than DDR RAM, but is the only memory technology that currently keeps up with the Pentium 4's fast system bus.

There were many demonstrations at Computex of the latest PC1066 RDRAM, but the one that caught our eye was the even newer PC4200 RDRAM. This memory may run at the same speed as the PC1066 version but, in the long term, we believe it will be more popular and possibly cheaper, too. Consequently, this is the RDRAM we're going to use in our high-end system.

There's one slight problem with such cutting-edge components, though: finding a supplier. At the time of writing, Asus

(www.asus.com) was the only motherboard manufacturer to support PC4200 RDRAM memory and, due to limited supplies, it was bundling its new motherboard with a 256MB PC4200 Samsung card (see next section).

We wanted 512MB of RAM for our system, though, so we've bought an additional 256MB PC4200 Samsung card from Overclockers UK. We didn't have a definite price at the time of writing, but it will set you back around £100. Note that this motherboard has only two memory slots, so choose your second card with the future in mind.

Motherboard

The type of processor and memory you're using ultimately dictates the choice of motherboard. For our cheaper system we considered a number of motherboards supporting Athlon XP processors and 333MHz DDR memory. The Gigabyte GA-7VXP came out best overall for performance and features, sporting onboard audio, Raid, USB 2.0 and network connectivity – a bargain for £76. Log on to www.gigabyte.com for more information.

Since we wanted to employ PC4200 RDRAM for our high-end system, we had only one choice: the Asus P4T533, which costs £170 with 256MB of Samsung PC4200 RDRAM thrown in. Fortunately it's a great motherboard and also features onboard audio, USB 2.0 and Raid support though, unusually, there is no ethernet network port. Never mind, we'll fit one of these later.

Raid allows multiple hard disks to work as one, to either improve performance, reliability or both. The Raid controllers on our motherboards also double-up as second IDE controllers, which means we can connect up to eight IDE devices in total. This gives us plenty of scope for adding extra disks or giving fussy CD writers their own IDE channel.

Graphics card

High-performance 3D gaming is almost entirely down to the graphics card so, if you're into the best detail and fastest frame rates, this is where you should spend your money. The only problem is that top-of-the-range 3D cards are extremely expensive and can often remain at the top of the market for as little as six months.

Luckily, the budget for our high-end system is sufficiently generous for us to get something based on nVidia's Ti 4600 chipset. There are plenty of manufacturers using this chipset, but Gainward's GeForce4 PowerPack Ultra/750XP particularly impressed us.

This 128MB card sports a pair of DVI (digital visual interface) outputs but comes with two VGA (video graphics array) adapters if you're using analogue displays. It also features a FireWire port for video editing. However, this state-of-the-art performance comes at a price – it will set you back a whopping £286.

If you're into video recording and editing, though, you'd be better off with the Hercules 3D Prophet All in Wonder

8500DV, which is also available at Komplett.co.uk. This £230 card has a TV tuner, FireWire socket, video-recording capabilities and also plays 3D games pretty well.

This price is clearly way over the top for our budget system, but in this fast-moving market you can actually get yourself a great graphics card for comparatively little outlay. We've decided to go for a Gainward once more and have chosen its 64MB GeForce4 PowerPack Pro/650TV, which set us back a mere £62. It features an nVidia GeForce4 MX 460 running at 310MHz, which is an extremely nippy clock speed for the price. We bought both Gainward cards from www.komplett.co.uk.

Drives

Hard drives are getting bigger, faster and cheaper every day, but there are still many to choose from. In terms of interface, you can't beat IDE for a combination of price and performance. The considerably more expensive SCSI interface can now only really be justified by high-end servers.

IDE does however come in several flavours. Today's fastest is called Ultra DMA 133, but is only supported by Maxtor hard disks and a handful of motherboards. In our tests, though, it has no benefit over Ultra DMA 100 unless you had four fast Ultra DMA 133 disks working simultaneously in a Raid array.

The Raid controllers on our motherboards may support Ultra DMA 133 disks, but we've opted for Seagate's Barracuda IV range of Ultra DMA 100 disks instead (visit www.seagate.com). These drives aren't just quick, they're also incredibly quiet. We've chosen Seagate's 80GB model at £75 for the higher-end system, but could only afford the 40GB version at £53 for the budget PC. Clearly this is one area where an additional £22 can make a difference if you can spare it.

There may not be many compelling PC titles on DVD, but it's still worth buying a DVD-ROM drive just so you have the option of playing movies. Pioneer's DVD-106S is already a desirable slot-loading unit, but Overclockers UK has made it even better by modifying its firmware to play movies from any region in the world. It's hard to resist for £37, so we've included one on both systems. Note that you may also need a software utility to play movies from all regions, but Overclockers UK can advise on this.

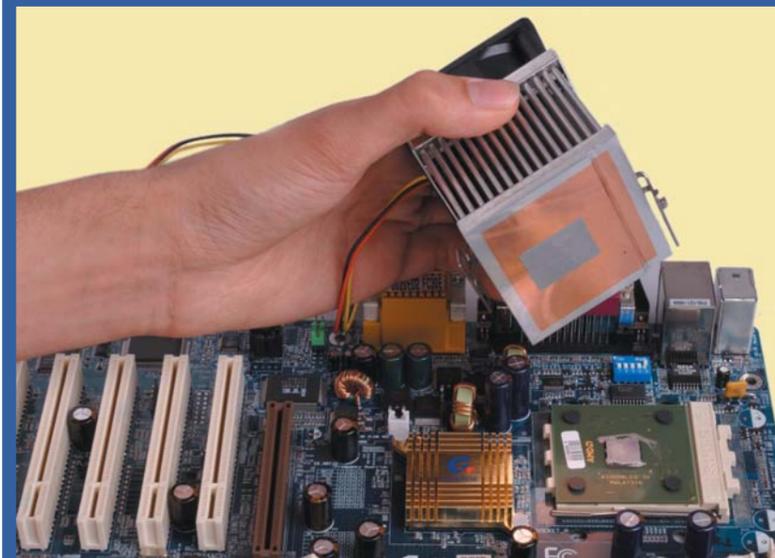
CD rewriters are also invaluable for backing up or distributing data, so we've fitted our more expensive system with a basic Ricoh MP7320A-DP 40-/32-/10-speed (read/write/rewrite) model for £50 from www.jungle.com. Sadly we couldn't afford one in the budget system.

Finally, despite being highly neglected these days, we'd still recommend having a floppy disk. Standard 1.44MB 3.5in models can be bought for as little as £9, so they hardly break the bank.

Expansion cards

This is where you can really start to customise your PC, but our motherboards

Fitting the heatsink



Most heatsinks sit on top of the processor and are held in place by a clip on either side of the socket. Again, they'll only work one way round so line up the indented strip on the bottom of the heatsink with the flat surface of the socket (this is to one side of the CPU). Some heatsinks require quite a firm pressure in order to clip on correctly.

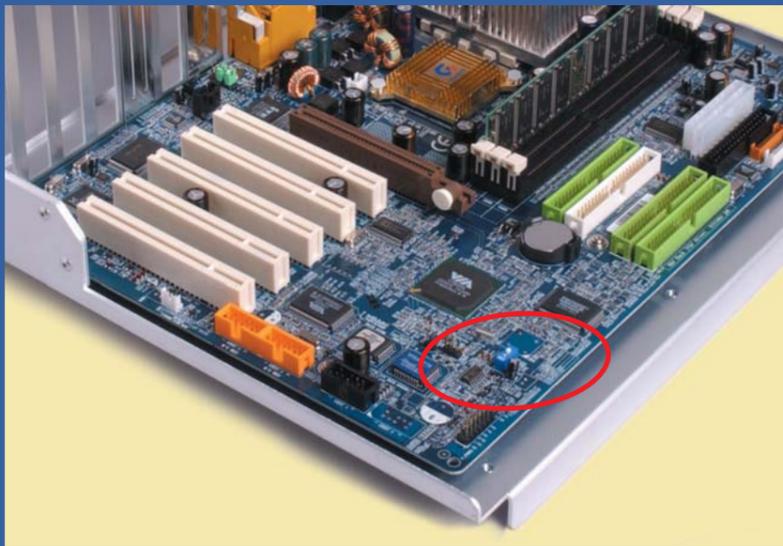
Many heatsinks feature a special square material pad underneath which helps transfer the heat better. If your heatsink didn't come with this, you may wish to use a fine scraping of thermal transfer paste, available from Overclockers UK (www.overclockers.co.uk). Finally, remember to connect the power cable for the fan to the appropriate plug on the motherboard – see its manual for details.

Our Alpha heatsink for the higher-end system, however, is so hefty that it requires its own mounting bolts and tensioned screws. These are supplied along with instructions on how to fit it to the motherboard. You'll also need to attach the 80mm cooling fan to this heatsink and, again, connect it to the fan power plug on the motherboard.

Adjusting the bus speeds

The speed at which the processor communicates with the motherboard and other components is slower than its internal clock speed (the one it's rated by) and is called the FSB (front side bus) speed. Our Athlon CPU has an FSB speed of 133MHz, though it bumps it up to 266MHz by using DDR (double data rate) technology. The actual bus speed (133MHz) must be set on the motherboard. To do this, switch SW1 to the off position.

The Pentium 4 processor has the same actual FSB speed, though it multiplies it to 533MHz with quadruple data rate. We can set the Asus motherboard to 133MHz from within the Bios menus when we first power the PC up.



already have most things we desire. Both have reasonable onboard audio capabilities, although those who want more impressive sound could fit a card from the Creative Labs SoundBlaster Audigy range (www.soundblaster.com), or maybe something geared even more towards musicians such as an Audiophile 2496 card from M-Audio. See www.midiman.net/products/m-audio/audiophile.php for more details.

Our cheaper system's motherboard features onboard ethernet for networking or connection to higher-end broadband equipment. We'd also like that facility on our high-end system, so we've fitted a plain Dabs Value 10/100 PCI ethernet card for just £5.50 (www.dabs.com).

Non-broadband users will need a 56Kbps (kilobits per second) modem to get online, so we've budgeted £10 for an internal 56K PCI card model from Dabs Value on each system.

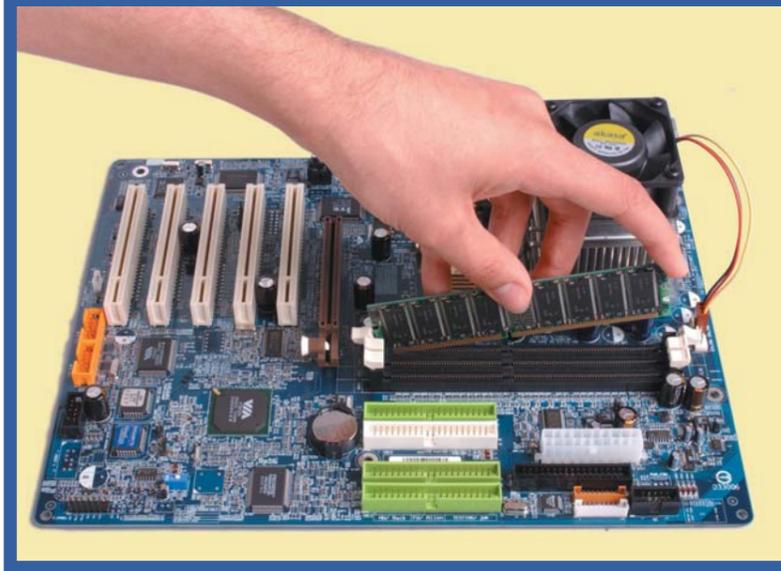
Monitor

In many respects, the monitor is the most important component of any PC, as it's the thing you'll be using all the time regardless of your application. Again, this is an area where many system builders skimp, but not us. We've chosen two decent CRT (cathode ray tube) monitors: a 17in Iiyama Vision Master Pro

Installing the memory

Our Gigabyte and Asus motherboards have three and two memory slots respectively, and memory cards must be inserted in order into slot one, then slot two and so on. The motherboards may employ different memory technologies, but installation is identical.

Pull the handles outwards on either side of the slot, line up the bump(s) inside the slot with the notch(es) in the bottom of the memory card, then push it firmly downwards. As you do this, the handles will be pushed inwards to lock the memory in place. Note the Asus board requires the supplied terminator card to be fitted in the second slot if only one memory module is being used.

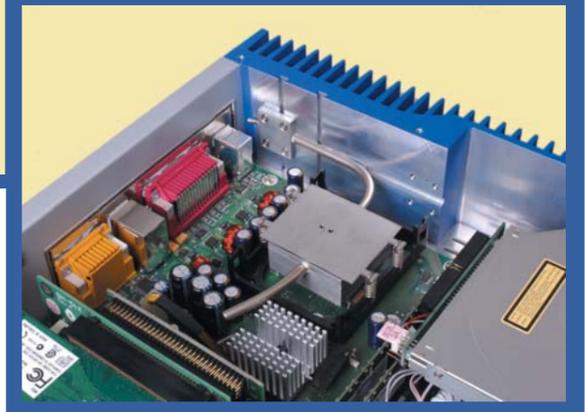


Fitting the motherboard



The motherboard would shortcircuit if it were placed directly into a PC case, so it's held just above the surface by a number of small plastic or metal spacers that are supplied with the case. Ensure these are clipped or screwed into the holes in the case so they line up with the holes in the motherboard's surface – ours need about eight to keep them firmly in position. Finally, lower the motherboard gently on to the spacers and screw it in place.

Our Coolermaster case actually lets you temporarily detach the side that the motherboard is screwed on to – this makes it much easier to mount the motherboard before slotting the entire side back on to the main case again.



1413 for £139 for our lower-priced system (www.iiyama.co.uk), and a 19in Sony CPD-E430 for £249 for our more expensive system (www.sony-cp.com). Display units are a personal choice, so try to view several models in the showroom before buying. You get what you pay for and you may decide it's worth spending more on a bigger or better quality monitor or even a flat-panel display. Obviously if you already have a decent model you can reuse it and save yourself some money.

Case and power supply

For many people, the system case is at the bottom of their shopping list, while power supplies rarely even get a second thought. Technically speaking, all we need is an ATX case with an ATX power supply but, since we're building PCs to be proud of, we're not going to bother with any old rubbish.

CoolerMaster is one of the most respected manufacturers of PC cases in the world. We've chosen one of its ATCS-201 aluminium models, which is easy to install, has plenty of room for expansion and looks great. It may cost £110 from Overclockers UK without a power supply, but it's already fitted with four internal cooling fans and convenient front-mounted USB ports which can connect to our motherboards. It's a no-brainer for our more expensive system, but we've juggled

the numbers to include it on the cheaper PC, too.

Of course, you may want something more distinctive. Many PC enthusiasts

have custom paint jobs on their cases or cut windows in the sides to show off components illuminated by small neon tubes. Check out www.coolcasemods.com.

Today's fast PC components are pretty greedy in terms of electricity and demand a decent power supply for reliability. While many PCs come with cheap supplies, we've gone for models that deliver the stability we desire, along with having plenty of juice remaining to power additional drives in the future.

Enermax is one of the leading power supply manufacturers and we've chosen its 350 and 431 Watt models for our two systems, which also feature adjustable fan speeds. For just £43 and £65 respectively from Overclockers UK, they're not bad for both peace of mind and peace and quiet.

Software

It's easy to get carried away with the hardware, but remember you'll also need an operating system for your new PC. The DIY approach gives you a great opportunity to try out something different like Linux,

but we're going to be conventional and stick with Microsoft for familiarity and compatibility. We've gone for a copy of Windows XP Home edition for both PCs. At £139 from Dabs.com it's quite a chunk of your budget but, unlike many prebuilt systems, at least you're getting a full retail copy with the original CD and manual.

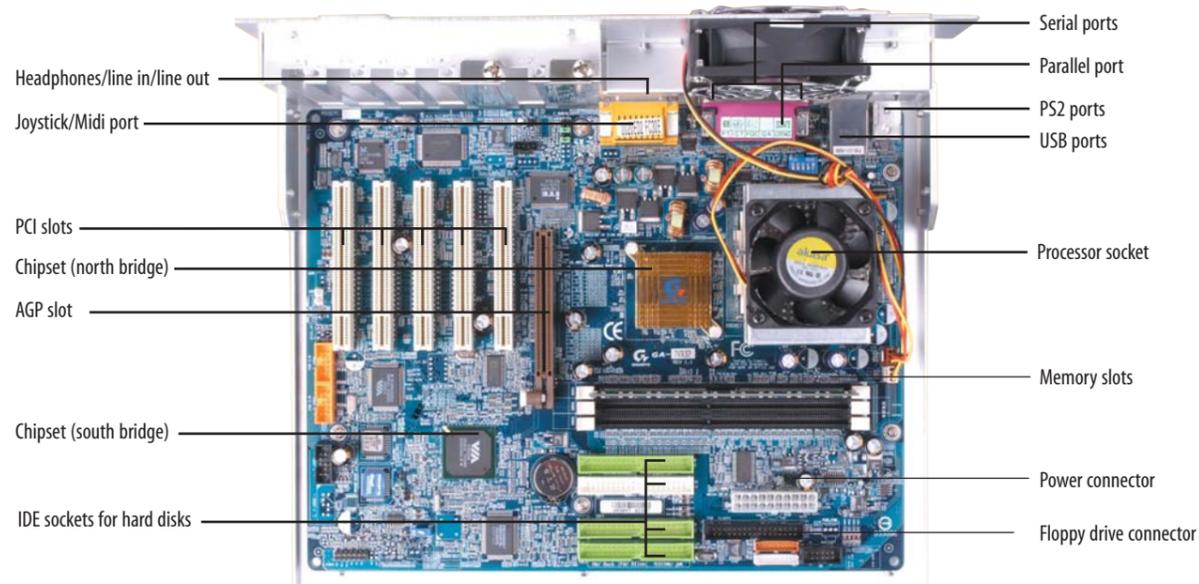
If you want to watch DVD movies, you'll also need a software DVD player. Most graphics cards come with one, but if yours doesn't or you fancy an upgrade we recommend MGI's SoftDVD Max at £12.99 or Cyberlink's more sophisticated Power DVD XP for £35.99 from Dabs.com.

And finally...

In all the excitement it's easy to forget life's boring necessities – a keyboard and mouse. Money's tight as we reach the end of the budget for our cheaper system, so we're going for a basic Microsoft combination at £20. For our high-end PC, we're adding another £20 to get a more desirable Logitech bundle. ■

→ Turn over for our Spec-for-spec boxout

Your motherboard



Spec for spec: high-end system

- Processor
Intel Pentium 4 2.4GHz;
www.dabs.com; **£331.**
- Heatsink and fan
Alpha PAL892T;
www.overclockers.co.uk;
01782 339 600; £34.65.
Sanyo-Denki 80mm fan;
www.overclockers.co.uk;
01782 339 600; £9.80.
- Memory card
256MB PC4200 Samsung;
www.overclockers.co.uk;
01782 339 600; £100.
- Motherboard
**Asus P4T533 with 256MB
of PC4200 RDRAM;**
www.dabs.com; **£170.**
- Graphics card
**Gainward 128MB GeForce4
PowerPack Ultra/750XP;**
www.komplett.co.uk; **£286.**
- Hard drive
**Seagate Barracuda IV
Ultra DMA 100 80GB;**
www.dabs.com; **£75.**
- DVD-ROM drive
Pioneer DVD-106S;
www.overclockers.co.uk;
01782 339 600; £37.
- CD-RW drive
Ricoh MP7320A-DP; www.jungle.com; **£50.**
- Floppy disk
Teac 3.5in 1.44MB;
www.overclockers.co.uk;
01782 339 600; £8.40.
- Ethernet card
Dabs Value 10/100 PCI;
www.dabs.com; **£5.50.**
- PCI card
**Dabs Value internal 56K PCI
card;** www.dabs.com; **£10.**
- Monitor
Sony CPD-E430; www.sony-cp.com; **0870 5424 424; £249.**
- PC case
CoolerMaster ATCS-201;
www.overclockers.co.uk;
01782 339 600; £110.
- Power supply unit
Enermax 431 Watt;
www.overclockers.co.uk;
01782 339 600; £65.
- Operating system
Windows XP Home edition;
www.dabs.com; **£139.**
- Keyboard and mouse
Logitech Cordless Desktop;
www.dabs.com; **£39.**

budget system

- Processor
AMD Athlon XP 2000+;
www.dabs.com; **£102.**
- Heatsink
**Akasa AK-821 2Q
Silent Cooler;** www.overclockers.co.uk;
01782 339 600; £17.
- Memory card
256MB PC2700 Dimm;
www.dabs.com; **£50.**
- Motherboard
Gigabyte GA-7VRXP;
www.dabs.com; **£76.**
- Graphics card
**Gainward 64MB GeForce4
PowerPack Pro/650TV;**
www.komplett.co.uk; **£62.**
- Hard drive
**Seagate Barracuda IV
Ultra DMA 100 40GB;**
www.dabs.com; **£53.**
- DVD-ROM drive
Pioneer DVD-106S;
www.overclockers.co.uk;
01782 339 600; £37.
- Floppy disk
Teac 3.5in 1.44MB;
www.overclockers.co.uk;
01782 339 600; £8.40.
- PCI card
**Dabs Value internal
56K PCI card;**
www.dabs.com; **£10.**
- Monitor
**Iiyama Vision Master Pro
1413;** www.iiyama.co.uk;
01438 745 482; £139.
- PC case
CoolerMaster ATCS-201;
www.overclockers.co.uk;
01782 339 600; £110.
- Power supply unit
Enermax 350 Watt;
www.overclockers.co.uk;
01782 339 600; £43.
- Operating system
Windows XP Home edition;
www.dabs.com; **£139.**
- Keyboard and mouse
**Microsoft internet
Keyboard PS/2;**
www.dabs.com; **£12.**
**Microsoft Internet
Trekker Wheel Mouse;**
www.dabs.com; **£12.**