Pop parts

Get better performance and extend the life of your PC by popping in a new motherboard. We've tested 18 tasty numbers.

New cars depreciate at a frightening rate and PC technology moves at such a pace that one month's speed demon can look like a sluggard the next. Few would take the drastic measure of replacing their car's engine, but keeping your PC up to date is a little easier.

Replacing your motherboard is one of the most cost-effective options for extending the life of your system. If your PC seems slow in comparison to newer models, it's more likely to be caused by a combination of the slow bus systems which carry data from your components and main memory, rather than being entirely the fault of your processor. It is the bus system which is upgraded when replacing an old motherboard and drastic performance increases can sometimes result. If your budget is tight, you may need to carry on using some or all or your existing components, so you will need compatible slots. And, certain motherboard layouts may be more suited to your system than others.

Here, we've covered the main considerations such as on-board chips, BIOS software and new slot technologies. More experienced readers may want to look at how to push the safety limits with overclocking. And, we offer some essential advice on how to install your new motherboard. In case you want a closer look at all motherboards: we have put high-resolution pictures on this month's cover CD.
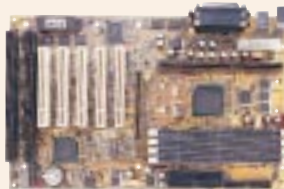
Ratings

★★★★★ **Highly recommended**
★★★★ **Great buy**
★★★ **Good buy**
★★ **Shop around**
★ **Not recommended**

Contents

◆ *Motherboards tested and reviewed by Ian Robson*

ABIT AB-LM6

Although this is a Slot 1 board, it only supports a maximum 66MHz front-side bus and has been included in this group test for comparison with the Socket 370 Celeron boards. Where it seems the Socket 370 alternatives have been designed from the base up as economical solutions, this is a fully-featured board with a full quota of bus and DIMM slots. The larger board layout affords enough room to avoid any cable tangles or obstructions to airflow around the Celeron, although this is at the loss of the baby ATX case option. The manual is littered with photographs and diagrams but just doesn't hit the mark in explaining sufficiently well the details that other manuals cover admirably.

Construction	★★★★★
Usability	★★★
Features	★★★★
Value for Money	★★★
Overall	★★★★

ASUS P2V

Providing a board that supports an overwhelming number of front-side bus configurations may prove tempting for the overclockers, and the fully supported hardware monitoring will come in handy, but the average user will generally stick with the recommended, fully supported 100MHz FSB and may see this as an unnecessary expense. It may have been a small premium to offer this substantial choice, but it's at the expense of a few minor considerations that needed attention elsewhere, such as a heat sink for the northbridge chip. The manual is tailored to the technically minded person who could nevertheless be a novice in motherboard installation.

Construction	★★★
Usability	★★★★
Features	★★★
Value for Money	★★★★
Overall	★★★

CHAINTECH CT-6BTA3

It is rare that a motherboard, once correctly connected to your system, will fail to power up as this one did, so some frustration ensued until a few simple chip checks were applied: sure enough, the BIOS chip wasn't completely housed. To Chaintech's credit, the rest of the construction was of high quality with an inspired layout and processor supports already expertly fixed. Ample bus slots haven't suffered through the adoption of on-board sound, and four DIMM slots provide extra housing for those smaller-capacity modules transferred from an older machine. The manual is pitched at an experienced user, but with use of the blank memo pages, a newcomer could muddle through.

Construction	★★★
Usability	★★★★
Features	★★★★
Value for Money	★★★★
Overall	★★★★

GIGABYTE GA-6BXE

EDITOR'S CHOICE PERSONAL COMPUTER WORLD ✓

Those with less than perfect sight will praise Gigabyte's colourful offering with its hefty orange mini-sink on the northbridge chip, a sky blue DIP switch, and brightly coloured jumpers scattered elsewhere. Without having to resort to maximum form-factor size, a very generous quota of DIMM and peripheral slots have been squeezed on, and the inspired layout hasn't resulted in the likelihood of criss-crossing of cables. The manual is not quite so colourful but holds something for other manuals to aspire to in its simplicity in explaining technical details. The quick-start section is just large schematic diagrams with little or no text, but pulls no punches in instructing the user.

Construction	★★★★★
Usability	★★★★★
Features	★★★★★
Value for Money	★★★★★
Overall	★★★★★

INTEL Rochester (RC440BX)
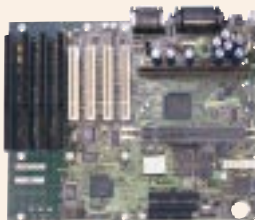
The Rochester incorporates not only on-board sound but also an excellent AGP graphics sub-system from nVidia. This does, of course, scupper any intentions for improving upon the primary display adapter, but it is nevertheless a powerful choice that will see a non-gamer through to their next whole system upgrade. Taking advantage of the full ATX form factor has allowed for a spacious layout with no likely cable tangles and a generous supply of bus slots. However, this should also have allowed for the front panel, floppy and EIDE connections to be placed in an area less susceptible to an overhanging system box structure.

Construction	★★★★
Usability	★★★★
Features	★★★★★
Value for Money	★★★★★
Overall	★★★★

MICRO-STAR MS-6163

Micro-Star has pulled out all the stops to produce possibly the most reliable and sturdy of constructions, with even the processor retention mechanism attached expertly for you. There are ample slots biased towards the preferred PCI option, and connection positioning reflects awareness of opening up system airflows. The northbridge chip heatsink has even been clipped down on the off-chance that glue may not retain its modest weight. The manual is not for the newcomer but nonetheless covers enough areas in sufficient detail to cope with your queries. If it could just be reformatted in a more user-friendly way, it could be in the running as a generic motherboard manual.

Construction	★★★★★
Usability	★★★★
Features	★★★★
Value for Money	★★★★★
Overall	★★★★★

SOYO **SY-6BA+**

SOYO boards should be used for tutorials on installing motherboards, as they set out to make light work of an otherwise daunting task with their no-nonsense quick-start guide. But the edge really becomes apparent from where others give up, in its quick BIOS setup. After completing four simple steps, including the Soyo Combo Setup for configuring your processor settings, you're away. A generous quota of bus and memory slots has not resulted in a compromised construction. Although it's a tight squeeze in some areas, the positioning of the connections has provided ample allowance for cable obtrusions to processor airflows.

Construction	★★★★
Usability	★★★★★
Features	★★★★
Value for Money	★★★★★
Overall	★★★★

ASUS **MEL-M**

ASUS obviously thought that cryptic model names were no longer desirable and opted for the sixth Spice Girl. This board may not match up to supergroup standards, but its excellent Yamaha XG on-board sound will provide good tunes. There is the obvious bus slot trade-off with an on-board peripheral but more so here than was really necessary, restricting upgrade options. The manual is a true enthusiast's dream, and good for newcomers, too. Every aspect and detail is described, with high-res pictures clearly labelled. There's even a comprehensive BIOS user guide to help you get the most out of your purchase.

Construction	★★★★
Usability	★★★★★
Features	★★★★
Value for Money	★★★
Overall	★★★★

SUPERMICRO **P6SBA**

Supplying a slightly thinner than average ATX board could have resulted in a compromised design. But not so. Some inspired re-shuffling has resulted in all cable connections being tucked tidily away from the bus slots, providing a clear access route. Also, it's quite encouraging to see thoroughly sturdy processor supports in an otherwise delicate product. Only one point of caution is that as the power plug is so close to some component circuitry, connecting is slightly restricted. The manual is not to everyone's taste as it is clearly written for those who wish to delve into the subject matter in more detail. Although there is no quick-start offering, the BIOS guide is excellent.

Construction	★★★★
Usability	★★★★
Features	★★★★
Value for Money	★★★★
Overall	★★★★

INTEL **FIJI**

By incorporating basic sound and graphics on-board, Intel has pitched this motherboard at the same intended market as the Celeron itself. If you're after a cheaper, no-fuss alternative to separate peripheral cards plus motherboard, then the trade-off is a drastic reduction in bus slots. As the board is designed for lower-profile system boxes you may find that if you want to use it in a standard tower ATX case, the wide layout puts your front panel, floppy and EIDE connections under the 3.5in device bays. You can, of course, make all connections prior to screwing the board down, but for future alterations this can be very awkward.

Construction	★★★★
Usability	★★★★
Features	★★★★★
Value for Money	★★★★
Overall	★★★★

TMC **MB-TI6NBS+**

Incredibly, within the tempting asking price, TMC has managed to incorporate 64Mb of PC100 system memory onto the motherboard. It's quite a triumph of design to squeeze this onto a board which is already generous with its bus slots. There has been no skimping on other areas of design either, particularly with careful consideration being given to airflows when placing connections. The manual is a bit stark and charts are favoured over diagrams for most of its contents. This leaves much of the explanations to lengthy text that is clearly laid out and detailed, but is no replacement for a good schematic picture.

Construction	★★★★★
Usability	★★★
Features	★★★★★
Value for Money	★★★★
Overall	★★★★

SOYO **SY-6VZA**

EDITOR'S CHOICE
PERSONAL COMPUTER WORLD

Soyo's quick-start guide does just what it says on the cover and provides the first-timer with an open-arm approach. It focuses on exactly what is required for elaborate system configurations so that the user is quickly up and running and can then revert to the excellent comprehensive manual on the CD-ROM. The board is very slim and expertly designed to ensure that no cables will become tangled or restrict airflow across the processor. There is also on-board sound which is an ideal design consideration for this board's intended marketplace, still leaving ample slots for upgrading.

Construction	★★★★★
Usability	★★★★★
Features	★★★★★
Value for Money	★★★★★
Overall	★★★★★

ASUS P5A (Rev.1.04)

Where others have supplied a quick-start guide, here the summary details are printed on the board itself. Other vendors may have offered similar configuration charts, but only ASUS has managed to overcome the difficulties in printing coherent information within the integrated circuitry. For the experienced, this can be enough to get the system up and running without spending too long with the manual. Constructed with expertise, the layout seems almost spacious with no device connections likely to intertwine with one another. The processor may seem lonely in this configuration but it does benefit from unrestricted airflows.

Construction	★★★★★
Usability	★★★★
Features	★★★★★
Value for Money	★★★★★
Overall	★★★★★

CHAINTECH 5RSA2

Chaintech has managed to squeeze on-board sound onto an already cluttered micro-ATX motherboard, but this may have been at the expense of a couple of much-needed PCI slots. A more serious victim of the space-saving form factor is the positioning of the ATX power plug between the two memory slots and the floppy connector. With both EIDE connectors also in such close proximity, only the most nimble fingered person will feel confident enough to tackle any maintenance. Only a photocopied quick-start guide is supplied for initial installation, with a truly detailed software manual via Acrobat. But this isn't much good if you do get stuck and require more detailed instructions.

Construction	★★★
Usability	★★★★
Features	★★★★
Value for Money	★★★★★
Overall	★★★★

GIGABYTE GA-5AX

Design consideration has been applied to the positioning of component connections: no cables need cross over the processor, allowing for maximum airflow. Not so much consideration has been applied to simple memory upgrading. You are forced to remove the graphics adapter from the AGP slot, as the clips which house the modules spring right back over the slot. The manual too reflects some mixed ideas, containing as it does a full graphical quick installation guide, with a bare minimum of text proving difficult to follow. The more detailed section is hardly much larger and is far easier to comprehend.

Construction	★★★
Usability	★★★★
Features	★★★★
Value for Money	★★★★
Overall	★★★★

MICRO-STAR MS-5169 v3 AL9

Micro-Star's offering is a no-nonsense affair designed from extensive experience, ensuring that all component connections are placed where convenient for the user. One of the more practical implications of this is that the denser cables such as the floppy, EIDE and ATX power can be kept clear of the airflow required by the CPU and its heatsink/fan combo. Labelling on the board and the approach taken by the user manual does suggest a degree of computer literacy is required. A great improvement over previous manuals is that a detailed BIOS user guide provides enough guidance for the inexperienced while offering more advanced users some useful insights.

Construction	★★★★★
Usability	★★★★
Features	★★★★
Value for Money	★★★★★
Overall	★★★★

SOYO SY-5EMA+

Soyo provides a refreshing handheld approach with its quick-start guide. Experienced users will still find their requisite information, but for the first-timer upgrading, it may be a less traumatic experience than you had anticipated. The board itself is firmly constructed, and has been designed with the shortest route connections for all cables without causing an obstruction. Whereas some vendors have opted for a small heatsink for their northbridge chip, which can only be of benefit, Soyo has omitted this little luxury. Only time will tell if this is an economical decision too far.

Construction	★★★★
Usability	★★★★★
Features	★★★★
Value for Money	★★★★
Overall	★★★★

TMC T15VG+

TMC does offer this model of board with a subdued 66MHz FSB, but for a minimal premium you can opt for the one tested here which fully supports 100MHz FSB. Although there are no on-board peripherals, the board is littered with additional features such as two 72-pin SIMMs for transferring memory from an older system. Squeezed elsewhere are connectors for IrDA and Wake-on-LAN with manual bus settings modulated by the less fiddly DIP switches. An extra feature is a full 1Mb of on-board L2 cache, although it has to be stated that if your processor is already running an L2 cache it will make very little use of this unless it's a K6-III!

Construction	★★★
Usability	★★★★
Features	★★★★★
Value for Money	★★★★
Overall	★★★★

Anatomy of a motherboard

1 **Socket 370.** Socket for Intel's 370-pin Plastic Pin Grid Array (PPGA) Celeron processor. Distinguishable from Socket 7 by its extra row of pinholes and a second cut-off corner.

2 **Socket 7.** Zero Insertion Force (ZIF) socket for 321-pin fifth generation processors including the Intel classic Pentium, Intel Pentium MMX, AMD K5/K6-2/K6-III, IDT C6, and Cyrix 6x86/6x86L/6x86MX.

3 **Slot 1.** Slot for Pentium II/III Single Edge Cartridge Connector (SECC/SECC2) or Celeron Single Edge Processor Package (SEPP).

4 **Three Dual Inline Memory Module (DIMM) sockets.** For synchronous DRAM (SDRAM) memory and, in some cases, EDO memory.

5 **Northbridge chip.** An integrated chip essentially co-ordinating the northbridge architecture components with control circuitry which includes the memory and the CPU, AGP and PCI interfaces. Together with the southbridge chip it makes up the system chipset, the core logic of the board. (*For more on chipsets, see p170.*)

6 **Southbridge chip.** An integrated chip essentially co-ordinating the southbridge architecture components with control circuitry that includes the PCI to ISA bridge, IDE devices and, in some cases, the hardware monitor, advanced power management, USB controller and real-time clock.

7, 8 **Primary and secondary EIDE channels /floppy diskette channel**

9 **1 or 2Mit bit flashable BIOS EEPROM chip.** The motherboard's system BIOS provides the Power-On Self Test (POST), the BIOS setup program and the PCI and IDE auto-configuration utilities. (*For more on BIOS software, see p172.*)

10 **Real-time clock battery.** Also provides a sustained power supply for user configuration data for the system hardware that is required prior to the operating system stored in the Complementary Metal-Oxide SemiConductor (CMOS).

11 **ATX power supply connector.** In very rare instances a board may also feature the older AT-style power connector. Be sure your current system box can supply power to the right connector for your new motherboard.

12 **Jumpers.** When set over two pins, shorts the connection, sending a configuration signal to the core logic. A combination of jumper settings may be required to configure bus frequencies and voltages. DIP switches are an alternative configuration device. Where there are no devices (i.e. a jumperless board), settings will either be configured automatically or via the BIOS software.

13 **Industry Standard Architecture (ISA) bus slots.** 16-bit bandwidth with a clock frequency of 8MHz.

14 **Peripheral Component Interface (PCI) bus slots.** 32-bit bandwidth with a clock frequency of 33MHz.

15 **Accelerated Graphics Port (AGP).** The new standard 2X specification has a 64-bit bandwidth with a standard clock frequency of 66MHz, although other frequencies are possible depending on the motherboard.

16 **Ports.** Two Universal Serial Bus (USB) ports, two serial ports, one parallel port, one PS/2 mouse connector and one PS/2 keyboard connector. Whereas a PS/2 will have six pinholes, the older-style keyboard connector will have five, hence the name '5-pin DIN', and will be almost twice the size.

17 **Hardware monitor.** Separate from the southbridge chip for this board. Monitors fan speeds, critical voltages and temperatures. If critical levels are reached, settings via the BIOS software will kick-in safety precautions such as slowing the CPU clock. In extreme circumstances it will shut down the system to protect it from permanent failure. Requires a small amount of system resource (a memory address) to perform its actions.

18 **Fan connectors.** One each for processor, power supply and chassis.
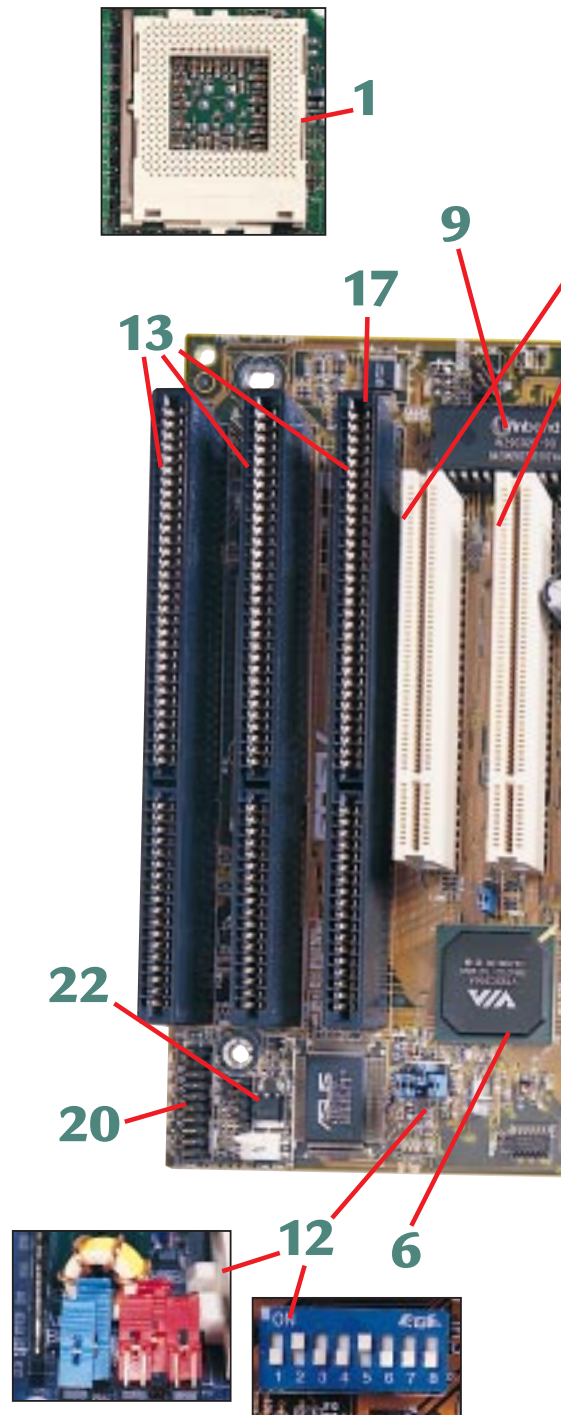
They are preferable to direct power supply-connected fans as these on-board connections support rotational signal fans for monitoring purposes.

19 **Thermal sensor connector.** Some motherboards require manual installation of optional temperature sensors for critical areas of the boards.

20 **Front panel connectors.** For ATX-powered machines the vital power-on connector is located in this array, as are the connections for the reset switch and the system speaker. Other common connectors located here are for front panel LEDs, such as IDE activity and power-on, and occasionally for

2

14

21 **15** **23**

26 **19**

16

11

24

3

5 **18**

4

10

25 **8** **7**
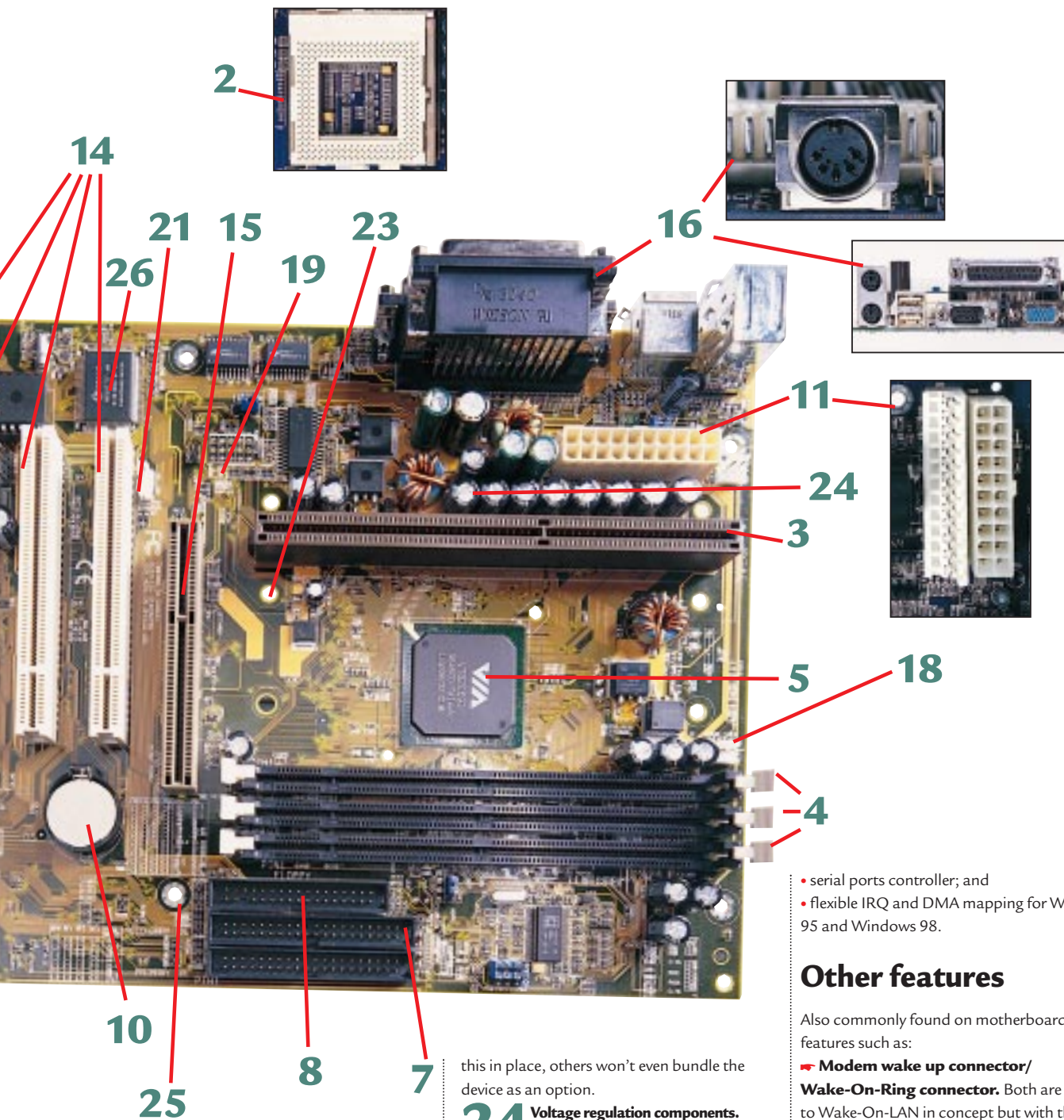
a keyboard lock switch for connecting to a case-mounted switch which prevents the keyboard from responding to keystrokes.

21 **Wake-On-LAN connector.** This feature supports a system power-up when a wake-up packet or signal is received from a network through a compatible LAN card.

22 **IrDA-compliant infra-red module connector.** Support for a wireless-data transmitting and receiving infra-red module. Configuration of the device is also required through the BIOS software to switch the use of the UART2 resources from COM2 to IrDA. The module is rarely shipped with motherboards.

23 **Universal retention mechanism holes.** Two either end of a Slot 1 will house the retention device for physical processor support. Some motherboards will already have

this in place, others won't even bundle the device as an option.

24 **Voltage regulation components.** A collection of coils and capacitors for smoothing the various voltages received from the mains supply.

25 **Mounting holes.** Scattered across the board and close to the corners for fully supporting the motherboard via mounting screws.

26 **Multi I/O controller.** Separate from the southbridge chip for this board. Handles the exchange of information between the processor and external devices. Common features include:
• integrated keyboard and mouse controller;
• industry standard diskette drive controller;
• one multimode bi-directional parallel port controller for standard Centronics-compatible operation and, in high-speed mode, support for Extended Capabilities Port (ECP) and Enhanced Parallel Port (EPP);

• serial ports controller; and
• flexible IRQ and DMA mapping for Windows 95 and Windows 98.

Other features

Also commonly found on motherboards are features such as:

☞ **Modem wake up connector/ Wake-On-Ring connector.** Both are similar to Wake-On-LAN in concept but with the obvious difference in the choice of hardware.

☞ **On-board peripherals.** In the case of on-board sound an extra connector, the SB-Link, may feature which enables support for modem voice transfers to the sound processor. (*For more about on-board chips, see p170.*)

☞ **L2 cache.** Socket 7 boards can feature second-level cache memory in an array of chips on the motherboard, commonly ranging in size from 512Kb to 2Mb. Constrained to the speed of the front-side bus clock, this synchronous pipelined burst static RAM (PBSRAM) is optimised for cacheing functions and will improve performance in systems running processors without a second-level cache. Tri-Level cacheing functionality is supported by AMD's K6-III and will adopt any on-board second-level cache for this purpose.
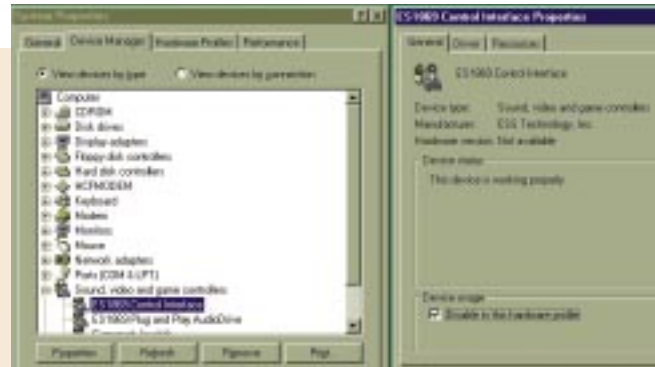
ON-BOARD CHIPS

Peripherals designed as integrated chips placed directly onto the motherboard are becoming more diverse and popular, including not just audio and video chips but also SCSI, LAN and even RAID controllers. But apart from a subsequent reduction in the number of bus slots provided, there can be major limitations imposed by some on-board devices.

An on-board AGP graphics solution may be a fraction of the cost of the slot card alternative, but you'll be stuck with no upgrade path to take advantage of better alternatives a year into the life of your motherboard. At present there is no vendor supplying a motherboard with an option to disable on-board AGP graphics and plug a card into a vacant AGP slot. Sound, LAN, IrDA and even SCSI controllers can usually be disabled by means of repositioning a jumper or DIP switch. This method will speed up your boot time as the motherboard omits the devices from its POST (Power-On Self Test) and frees-up BIOS-allocated resources. A modern OS will also give the user this option and, apart from AGP graphics, the following example for disabling on-board sound can be applied equally to other devices.

☞ **Pictured here** is the System Properties box from Windows 9x. If you expand the Sound, Video and Game Controllers branch you will see a number of devices which refer to your sound chip, usually by its model name — in this case, the ES1869. Double-clicking each device brings up the dialogue on the right with a check box for disabling. Once checked, you can shut down your system and install your preferred audio device with all resources previously allocated to your on-board audio now available for your new device. Any on-board peripheral that was fully installed will have had its drivers installed, any other supporting software and possibly a permanent Registry entry. Uninstalling the supporting software is advisable but the other legacies shouldn't be a concern if the OS is doing its job properly. Just to be sure, make a note of the installed device driver details so that if you install a similar device at a later date, your OS won't be confused by its presence and you can steer the driver update browser to the correct location.

SYSTEM CHIPSETS

One of the most important components of your PC is the system chipset. It is vital that you choose the right type to gain optimum system performance with your current configuration and ensure a smooth future upgrade path. The chipset consists of northbridge and southbridge chips, controls the flow of instructions and data between the CPU, system memory and motherboard bus, and determines how fast and how efficiently these transfers happen. It also looks after power management features.

Intel divides its chipsets into two main segments: performance and basic. In the former there are the BX and the ZX chipsets, and in the latter are the EX, LX and ZX-66 units. They all support 1X and 2X AGP, and SMM and ACPI power management. Users of faster Slot 1 CPUs will most likely opt for the BX chipset. This supports front-side bus speeds of 66MHz or 100MHz, up to 1Gb of SDRAM memory and dual processors. It works with the Celeron, PII and, if you have an enhanced version, the Pentium III line of CPUs.

Intel recently released the ZX, a cut-down version of the BX. It only supports 256Mb of SDRAM and does not support parity checking. Nor does it support dual processors. It can be used with the PIII although for most PIII users, the BX will be the chipset of choice. The other version of the ZX chipset, the ZX-66, is intended for use with Celeron processors.

Of the three chipsets in the basic category, the LX has been around the longest. With a maximum rated front-side bus speed of 66MHz it supports both Celeron and PII CPUs, up to 512Mb of SDRAM or 1Gb of EDO system memory at front-side bus speeds of 66MHz, and error correction for memory.

Lastly, there is the EX chipset, a budget chipset for a budget processor. Like the LX, the EX can support a maximum front-side bus speed of only 66MHz and just 256Mb of either EDO or SDRAM memory. It does not support parity checking for memory.

Intel's Camino chipset for the PIII is scheduled to be released soon, with full support for a bus speed of 133MHz.

At present, users who wish to upgrade are better off with the BX chipset as it supports three of Intel's CPU ranges. Intel will be announcing new chipsets in the middle of this year. New CPUs from AMD and Cyrix use chipsets that support the Super 7 standard. Like Intel's BX chipsets, Super 7s support front-side bus speeds up to 100MHz and are AGP 2X compliant. Users of AMD's K6-2 CPUs have a relatively painless upgrade path to faster K6-III processors. Later this year, though, AMD will introduce the K7 processor which will use a completely different motherboard and chipset.

AJITH RAM

BIOS SOFTWARE

When you switch on your PC, before it accesses the disk drives and boots into your operating system, it must have been given certain parameters that describe the disk drives attached to it. These, along with other details of how your PC is configured, are entered by the user via the Basic Input-Output System (BIOS) software.

The BIOS software is usually reached by hitting a single access key immediately after the system memory check, most commonly the <Del> key but occasionally <F1> or even a combination of keys. Pictured here is of one of the more common styles of BIOS software with sections for configuring all I/O devices, peripheral resources

and settings, security options, power management setup, and auto-detection of IDE device settings. Jumperless boards will also contain a section for configuring your processor and bus speeds through software without the need for fiddling with your motherboard.

Detailed explanations of your specific motherboard's configuration entries are usually clearly explained in the supplied manual. Bear in mind that the best way to start is to trust the manufacturer's default settings and select 'auto' wherever possible. When you feel more confident, you will find that you're able to fine tune your system using the BIOS software to produce quite substantial

improvements in boot-up times and even performance. Future hardware releases inherently provide an unknown factor for BIOS designers and it may become necessary to upgrade your BIOS for updated support or software revisions. However, never update your BIOS if your system appears to work fine, as revisions mostly address specific problems and are not designed to offer all users any kind of performance improvements.

The days of levering out your BIOS ROM chip to update the BIOS software are long gone. These days

you can write to Electrically Erasable Programmable Read-Only Memory using floppy disk-based utilities which safeguard your return path by backing up your BIOS before replacing it. All the boards we reviewed for this group test had EEPROM BIOS ROM, but some manufacturers offered more extensive support for revisions than others.

CPU OVERCLOCKING

Overclocking is running your CPU at a clock or bus speed for which it has not been specified. Most PCs can benefit from mild overclocking. As long as you don't go mad, your PC will probably run fine, but CPU manufacturers don't like overclocking and discourage it. Nearly every sort of x86 processor can be over-clocked but the best results are often obtained from Intel silicon. AMD and Cyrix processors tend to run hot to start with, so overclocking makes them hotter still.

Heat is the main problem. Unless the CPU is properly cooled, overheating can cause the processor to misbehave and cause a kind of internal chip 'rot' called electromigration. Most chips can safely run at 80° C, but a cooling fan can drop this to 50° or less, so the degradation needn't be

a major threat. First, track down a decent heatsink plus cooling fan, preferably a decent-quality ball bearing motor fan. Use some silicon heatsink compound to bond the heatsink to the CPU top, which makes a big difference to the heat transmission.

■ **Step by step**
I must warn you that over-clocking your processor is not for the fainthearted and if you don't know what you're doing you could end up frying your processor or motherboard, or worse. Only attempt this if you're not worried about your warranty (which will probably be invalidated) or toasting your CPU.

☛ **If you have** a modern, 'jumperless' motherboard the changes required can be done via CMOS setup. The others will require you to

move some jumper sleeves or DIP switches, so you'll need your motherboard manual. Sometimes the jumpers are labelled on the motherboard but often they're not, so read the manual.
☛ **Two motherboard** settings need to be changed: the bus speed and the processor multiplier. To change the bus speed, look in your motherboard manual for something like 'CPU External (BUS) Frequency Selection' — these are the jumpers that need moving. At faster bus speeds, memory can get iffy and you really need good-quality RAM to run at these speeds.
☛ **Each CPU** uses a multiple of the bus speed, the so-called bus multiplier. For example, a P120 uses a X2 multiplier on a 60MHz bus, while a Celeron 300A

uses a X4.5 multiplier on a 66MHz bus. To change this setting, find something like 'CPU to BUS Frequency Ratio Selection' in your motherboard manual.
☛ **Another thing** that often needs changing is the power supply to the CPU because processors which run faster, draw more power. Do not be overly concerned about pumping too many volts into your processor as a Pentium has a relatively wide voltage safety margin.
☛ **Finally,** you should bear in mind that very often the best, most stable results are achieved by going up a notch in speed. If you overdo it, you will probably just wind up with a hung system or maybe worse, in which case, simply put the jumpers back the way they were.

ROGER GANN

Table of features
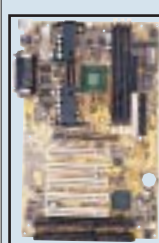
Manufacturer	ABIT	ASUS	CHAINTECH	GIGABYTE	INTEL	MICRO-STAR
Model Name	AB-LM6	P2V	CT-6BTA3	GA-6BXE	ROCHESTER (RC440BX)	MS-6163
Price (ex VAT)	£57	£73	£75	£78	£95	£73
Price (inc VAT)	£66.98	£85.78	£88.13	£91.65	£111.63	£85.78
URL	www.abit.com.tw	www.asus.com	www.chaintech.com.tw	www.gigabyte.com.tw	www.intel.com	www.msi.com.tw
UK supplier	Simply Computers	Dabs Direct	EveshamVale	Micro Direct	Intel Response Centre	Dabs Direct
UK supplier's telephone	0870 7274020	0800 558866	0800 496 0800	0161 248 4848	0870 607 2439	0800 558866
Form factor/size (l x w)	ATX / 305x191mm	ATX / 304 x 192mm	ATX / 304 x 205mm	ATX / 305 x 190mm	ATX / 305 x 244mm	ATX / 305 x 192mm
CPU						
Socket type	Slot 1	Slot 1	Slot 1	Slot 1	Slot 1	Slot 1
CPU vendors supported	Intel	Intel	Intel	Intel	Intel	Intel
CPU Bus freq mult mod [1]	Soft CPU via BIOS	jumpers	SeePu via BIOS	DIP switch	via BIOS	CPU P & P II via BIOS
CPU Bus freq mult options	x2.5 - x8 (0.5 integrals)	x2 - x8 (0.5 integrals)	x2 - x5.5 (0.5 integrals)	x3 - x5.5 (0.5 integrals)	Set proc speed in BIOS	x3 - x8 (0.5 integrals)
CPU Bus freq modulator	Soft CPU via BIOS	jumpers	SeePu via BIOS	DIP switch	via BIOS	CPU P & PlII via BIOS
CPU Bus freq options	66 - 83MHz (3 Set)	66.8 - 150MHz (14 set)	66 - 133MHz (7 set)	66 - 133MHz (7 set)	66MHz or 100MHz	66 - 153MHz (16 Set)
Core voltage modulator	n/a	n/a	n/a	n/a	n/a	n/a
Core voltage I/O options	n/a	n/a	n/a	n/a	n/a	n/a
Northbridge chipset	Intel 82443LX	VIA VT82C693	Intel 82443BX	Intel 82443BX	Intel 82443BX	Intel 82443BX
Southbridge chipset	Intel 82371AB	VIA VT82C596A	Intel 82371EB	Intel 82371EB	Intel 82371EB	Intel 82371EB
Bus and connections						
AGP/PCI/ISA/shared slots	1 / 4 / 1 / 1	1 / 3 / 2 / 1	1 / 3 / 1 / 1	1 / 4 / 1 / 1	0 / 3 / 3 / 1	1 / 4 / 1 / 0
USB/Ser/Par/PS2/DIN [2]	2 / 2 / 1 / 2 / 0	2 / 2 / 1 / 2 / 0	2 / 2 / 1 / 2 / 0	2 / 2 / 1 / 2 / 0	2 / 2 / 1 / 2 / 0	2 / 2 / 1 / 2 / 0
Parallel port support	Norm/EPP/ECP/ECP+EPP	Norm/EPP/ECP/ECP+EPP	Norm/EPP/ECP/ECP+EPP	Norm/EPP/ECP/ECP+EPP	Norm/EPP/ECP	Norm/EPP/ECP/ECP+EEP
IR port support	✓	✓	✓	✗	✗	✓
Memory						
168-pin DIMM slots	4	3	4	4	2	3
72-pin SIMM slots	0	0	0	0	0	0
Max system mem support	512Mb (1Gb EDO)	768Mb	512Mb	1Gb	256Mb	768Mb
On-b L2 cache/Upgr/Freq [3]	n/a	n/a	n/a	n/a	n/a	n/a
Power supply connectors	ATX	ATX	ATX	ATX	ATX	ATX
Fan Conn CPU/ps/chassis [4]	✓ / ✓ / ✓	✓ / ✓ / ✓	✓ / ✓ / ✓	✓ / ✓ / ✓	✓ / ✓ / ✓	✓ / ✓ / ✓
BIOS s/w supplier/version	Award v4.51PG	Award v4.51PG	Award v4.51PG (B)	Award v4.51PG	AMI 4R4CB0XA	Award V4.51PG
Antivirus/lang/auto EIDE [5]	✓ / ✗ / ✓	✓ / ✗ / ✓	✓ / ✗ / ✓	✓ / ✗ / ✓	✓ / ✓ / ✓	✓ / ✗ / ✓
On-board						
Sound manuf/model	n/a	n/a	Creative Labs/ES1373	n/a	Creative Labs/ES1373	n/a
Graphics manuf/model	n/a	n/a	n/a	n/a	Nvidia Riva 128ZX (8Mb)	n/a
EIDE / floppy channels	2/1	2/1	2/1	2/1	2/1	2/1
DMI	✓	✓	✓	✓	✓	✓
Fan speed/volt/temp	✓/✓/✓	✓/✓/✓	✓/✓/✓	✓/✓/✓	✗ / ✗ / ✗	✓/✓/✓
Wake-on LAN	✓	✓	✓	✓	✓	✓
Other supported features	-	-	SB-Link	SB-Link	Wake-on-Ring	SB-Link, modem wake
Extra supplies	EIDE/floppy cables	EIDE/floppy cables	EIDE/floppy cables	EIDE/floppy cables	EIDE/floppy cables	EIDE/floppy cables
	I/O shielding plate	spare jumpers	spacer		CPU retention mech	CPU retention mech
					I/O shield	CPU temp sensor
User Manual						
Installation instr (out of 5)	★★★★★	★★★★★	★★★	★★	★★★	★★★★
BIOS s/w overview (out of 5)	★★★★★	★★★★★	★★★★	★★★	★★★	★★★★

Key: [1] CPU Bus frequency multiplier modulator [2] USB/Serial/Parallel/PS2/5-pin DIN [3] On-board L2 cache/Upgradable/Frequency [4] Fan connections CPU/power supply/chassis [5] Antivirus/language options/auto EIDE
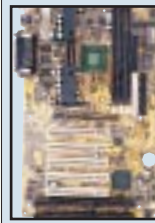
group test

Table of features

MANUFACTURER	SOYO	SUPERMICRO	TMC	ASUS	INTEL	SOYO
MODEL NAME	SY-6BA+	P6SBA (REV. 2.00)	MB-TI6NBS+	MEL-M	FIJI	SY-6VZA
Price (ex VAT)	£71.12	£79.00	£125	£72	£75	£58.65
Price (inc VAT)	£83.57	£92.83	£146.88	£84.60	£88.13	£68.91
URL	www.soyo-europe.com	www.supermicro.com	www.tmc-uk.com	www.asus.com	www.intel.com	www.soyo-europe.com
UK supplier	CCL	Boston	TMC Technology (UK)	Dabs Direct	Intel Response Centre	CCL
UK supplier's telephone	01274 664110	01923 699399	01438 842305	0800 558866	0870 6072439	01274 664110
Form factor/size (l x w)	ATX / 304 x 191mm	ATX / 304 x 178mm	ATX / 305 x 201mm	microATX / 244 x 216mm	microATX / 244 x 244mm	ATX / 304 x 170mm
CPU						
Socket type	Slot 1	Slot 1	Slot 1	Socket 370	Socket 370	Socket 370
CPU vendors supported	Intel	Intel	Intel	Intel	Intel	Intel
CPU Bus freq mult mod [1]	SOYO COMBO via BIOS	jumpers	via BIOS	DIP switch	Automatic	SOYO COMBO via BIOS
CPU Bus freq mult options	x2 to x5.5 (0.5 integrals)	x3.0 - x6.5 (0.5 integrals)	x3 - x6.5 (0.5 integrals)	x3 - x5.5 (0.5 integrals)	Automatic	Set process speed in BIOS
CPU Bus freq modulator	SOYO COMBO via BIOS	Jumper	via BIOS	DIP switch	Automatic	SOYO COMBO via BIOS
CPU Bus freq options	66 - 133MHz (7 settings)	66MHz, 100MHz, Auto	66 - 153MHz (15 Settings)	50 - 83 MHz (6 Settings)	Automatic	66 -133MHz (7 settings)
Core voltage modulator	n/a	n/a	n/a	n/a	n/a	n/a
Core voltage I/O options	n/a	n/a	n/a	n/a	n/a	n/a
Northbridge chipset	Intel 82443BX	Intel 82443BX	Intel 82443BX	Intel 82443LX	Intel 82443ZX	VIA VT82C693
Southbridge chipset	Intel 82371EB	Intel 82371EB	Intel 82371EB	Intel 82371EB	Intel 82371EB	VIA VT82C596
BUS AND CONNECTIONS						
AGP/PCI/ISA/shared slots	1 / 4 / 1 / 0	1 / 3 / 2 / 1	1 / 3 / 2 / 1	1 / 2 / 0 / 1	0 / 2 / 0 / 1	1 / 3 / 0 / 1
USB/Ser/Par/PS2/DIN [2]	2 / 2 / 1 / 2 / 0	2 / 2 / 1 / 2 / 0	2 / 2 / 1 / 2 / 0	2 / 2 / 1 / 2 / 0	2 / 2 / 1 / 2 / 0	2 / 2 / 1 / 2 / 0
Parallel port support	Norm/EPP/ECP	Norm/EPP/ECP	Norm/EPP/ECP	Norm/EPP/ECP/ECP+EEP	Norm/EPP/ECP	Norm/EPP/ECP
IR port support	✓	✓	✓	✓	✗	✓
MEMORY						
168-pin DIMM slots	4	3	3	3	2	3
72-pin SIMM slots	0	0	0	0	0	0
Max system mem support	1Gb	768Mb	448Mb	768Mb	256Mb	768Mb
On-b L2 cache/Upgr/Freq [3]	n/a	n/a	n/a	n/a	n/a	n/a
Power supply connectors	ATX	ATX	ATX	ATX	ATX	ATX
Fan Conn CPU/ps/chassis [4]	✓ / ✓ / ✓	✓ / ✓ / ✓	✓ /✓ /✓	✓ / ✓ / ✓	✓ / ✓ / ✓	✓ / ✓ / ✓
BIOS s/w supplier/version	Award v4.51PG	AMIBIOS P6SBAR1.4	Award v4.51 PG	Award v4.51 PG	AMI 4F4J20IA	Award v4.51PG
Antivirus/lang/auto EIDE [5]	✓ / ✗ / ✓	✓ / ✗ / ✓	✓ / ✗ / ✓	✓ / ✗ / ✓	✓ / ✓ / ✓	✓ / ✗ / ✓
ON-BOARD						
Sound manuf/model	n/a	n/a	n/a	Yamaha /XG YMF740C	Creative Labs/ES1373	Creative Labs/ES1373
Graphics manuf/model	n/a	n/a	n/a	n/a	ATI/Rage Pro Turbo AGP 8Mb	n/a
EIDE / floppy channels	2/1	2/1	2/1	2/1	2/1	2/1
DMI	✓	✓	✓	✓	✓	✓
Fan speed/volt/temp	✓/✓/✓	✓/✓/✓	✓/✓/✓	✓/✓/✓	✗/✗/✗	✓/✓/✓
Wake-on LAN	✓	✓	✓	✓	✓	✓
Other supported features	SB-Link, modem wake		SB-Link	Wake-on-Ring	Wake-on-Ring	SB-Link, modem wake
Extra supplies	EIDE/floppy cables,	EIDE/floppy cables	EIDE/floppy cables,	EIDE/floppy cables	EIDE/floppy cables	EIDE/floppy cables
	CPU retention mechanism		CPU retention mechanism		CPU retention mechanism	
			64Mb SDRAM on-board		I/O shield	
USER MANUAL						
Installation instr (out of 5)	★★★★★	★★★★	★★★★	★★★★	★★★	★★★★★
BIOS s/w overview (out of 5)	★★★★	★★★	★★★	★★★★	★★★	★★★★

Key: [1]CPU Bus frequency multiplier modulator [2]USB/Serial/Parallel/PS2/5-pin DIN [3]On-board L2 cache/Upgradable/Frequency [4]Fan connections CPU/power supply/chassis [5]Antivirus/language options/auto EIDE

Table of features

MANUFACTURER	ASUS	CHAINTECH	GIGABYTE	MICRO-STAR	SOYO	TMC
MODEL NAME	P5A	5RSA2	GA-5AX (Rev4.10)	MS5169 (v3 AL9)	SY-5EMA+	TI5VG+
Price (ex VAT)	£60	£55	£52	£56.00	£48.16	£59
Price (inc VAT)	£70.50	£64.63	£61.10	£65.80	£56.59	£69.33
URL	www.asus.com	www.chaintech.com.tw	www.gigabyte.com.tw	www.msi.com.tw	www.soyo-europe.com	www.tmc-uk.com
UK supplier	Dabs Direct	Evesham Vale	Micro Direct	Dabs Direct	CCL	TMC Technology
UK supplier's telephone	0800 558866	0800 496 0800	0161 248 4848	0800 558866	01274 664110	01438 842305
Form factor/size (l x w)	ATX / 304 x 192mm	microATX / 244 x 220mm	ATX / 307 x 184mm	ATX / 304 x 186mm	ATX / 304 x 191mm	ATX / 304 x 180mm
CPU						
Socket type	Socket 7	Socket 7	Socket 7	Socket 7	Socket 7	Socket 7
CPU vendors supported	AMD/IBM/Cyrix/IDT/Intel	AMD/IBM/Cyrix/IDT/Intel	AMD/IBM/Cyrix/IDT/Intel	AMD/IBM/Cyrix/IDT/Intel	Intel, IBM, Cyrix, AMD	AMD/IBM/Cyrix/IDT/Intel
CPU Bus freq mult mod [1]	jumpers	jumpers	DIP switch	jumpers	DIP switch	DIP switch
CPU Bus freq mult options	x1.0 - x5.5 (0.5 ints)	x2.0 - x5.5 (0.5 ints)	x1.5 - x5.5 (0.5 ints)	x1.5 - x5.5 (in 0.5 ints)	x1.5 - x4.5 (in 0.5 ints)	x1.5 - x5.5 (0.5 ints)
CPU Bus freq modulator	jumpers	jumpers	jumpers	jumpers	DIP switch	DIP switch
CPU Bus freq options	60 - 120MHz (10 set)	60 - 120MHz (6 set)	66 - 140MHz (13 set)	50 - 100MHz (8 set)	66 - 124MHz (7 set)	60 - 100MHz (5 set)
Core voltage modulator	jumpers	jumpers	DIP switch	jumpers	jumpers	DIP switch
Core voltage I/O options	2.0v - 3.5v (0.1v ints)	1.7v - 3.5v (24 set)	1.3v - 3.5v (0.1v ints)	2.2v - 3.5v (0.1v ints)	2.0v - 3.5v (16 sets)	2.1v - 3.5v(6 sets)
Northbridge chipset	ALi Aladdin V M1541	ALi Aladdin V M1541	ALi Aladdin V M1541	ALi Aladdin V M1541	ETEQ 82C6638	VIA VT82C598MVP
Southbridge chipset	ALi M1543C	ALi M1543C	ALi M1543C	ALi M1543C	ETEQ 82C6629	VIA VT82C586B
BUS AND CONNECTIONS						
AGP/PCI/ISA/shared slots	1 / 4 / 1 / 1	1 / 1 / 1 / 1	1 / 4 / 1 / 1	1 / 3 / 2 / 1	1 / 4 / 1 / 1	1 / 4 / 1 / 1
USB/Ser/Par/PS2/DIN [2]	2 / 2 / 1 / 2 / 0	2 / 2 / 1 / 2 / 0	2 / 2 / 1 / 2 / 0	2 / 2 / 1 / 2 / 0	2 / 2 / 1 / 2 / 0	2 / 2 / 1 / 2 / 0
Parallel port support	Norm/EPP/ECP/ECP+EEP	Norm/EPP/ECP/ECP+EEP	Norm/EPP/ECP/ECP+EEP	Norm/SPP+EPP/ECP	Norm/EPP/ECP+EPP	Norm/EPP/ECP
IR port support	✓	✓	✓	✗	✓	✓
MEMORY						
168-pin DIMM slots	3	2	3	3	3	3
72-pin SIMM slots	0	0	0	0	0	2
Max system mem support	768Mb	512Mb	768Mb	768Mb	768Mb	768Mb
On-b L2 cache/Upgr/Freq [3]	512Kb/No/FSB	n/a	512Kb/No/FSB	512Kb/No/FSB	1Mb/No/FSB	512Kb/No/FSB
Power supply connectors	ATX	ATX	ATX	ATX	ATX	ATX
Fan Conn CPU/ps/chassis [4]	✓ / ✓ / ✓	✓ / ✓ / ✓	✓ / ✓ / ✓	✓ /✗ /✓	✓/ ✗ /✓	✓ /✗ /✓
BIOS s/w supplier/version	Award v4.51PG	Award v4.51PG	Award 4.51PG	AMIBIOS v2.6 121598	Award v4.51PG	Award v4.51PG
Antivirus/lang/auto EIDE [5]	✓ / ✗ / ✓	✓ / ✗ / ✓	✓ / ✗ / ✓	✓/ ✗ /✓	✓/ ✗ /✓	✓ / ✗ / ✓
ON-BOARD						
Sound manuf/model	n/a	Ensoniq/Solo-1 ES1938S	n/a	n/a	n/a	n/a
Graphics manuf/model	n/a	n/a	n/a	n/a	n/a	n/a
EIDE / floppy channels	2/1	2/1	2/1	2/1	2/1	2/1
DMI	✓	✓	✓	✓	✓	✓
Fan speed/volt/temp	✓/✓/✓	✓/✓/✓	✓/✓/✓	✓/✓/✗	✗ /✗ /✓	✓/✓/✓
Wake-on LAN	✓	✗	✓	✓	✓	✓
OTHER SUPPORTED FEATURES						
Extra supplies	EIDE/floppy cables	EIDE/floppy cables	EIDE/floppy cables	EIDE/floppy cables	EIDE/floppy cables	EIDE/floppy cables
	spare jumpers					
USER MANUAL						
Installation instr (out of 5)	★★★★★	★★★★	★★★	★★★★	★★★★★	★★★★
BIOS s/w overview (out of 5)	★★★★★	★★★★	★★★	★★★★	★★★★	★★★

Key: [1] CPU Bus frequency multiplier modulator [2] USB/Serial/Parallel/PS2/5-pin DIN [3] On-board L2 cache/Upgradable/Frequency [4] Fan connections CPU/power supply/chassis [5] Antivirus/language options/auto EIDE

group test

Choosing and installing your **motherboard**

The first stage in upgrading your motherboard is to decide which board will best suit your needs. But just settling for a board alone may not be enough: you may want to consider upgrading your case and power supply as well, to widen your options.

■ **Choosing your case and board**
Of the two main styles, the AT power supply has two six-hole plugs for supplying various voltages, which connect via power cables to the motherboard. The newer ATX standard consists of one 20-hole plug offering support for power management functions. Although you can still buy motherboards with AT-style power supply connectors, most support only ATX power supplies. Also, AT-style cases have a nasty habit of blocking off input device connections to your motherboard. But fear not. These days, you can buy a new system box with an ATX power supply from as little as £30.

Next, decide how much of your existing system is worthy of extended use in your new system. New boards have tended to feature fewer ISA card slots, and where peripherals have been integrated on-board, slot counts will be lower. So, before you buy, be sure to have enough for your devices. If your current system's memory modules are 72-pin SIMMs you will find that very few new boards have slots for these, so consider purchasing some 168-pin DIMMs before going further.

■ **Installation**
No two boards are the same, but in addition to the installation details in your user manual, the following guidelines are highly recommended.
☞ **For safety's sake,** switch off the main power supply at the wall and on the back of your system if there's a switch, but it's useful to leave the plug connected to an earthed socket.
☞ **Before placing** the board into your system, take advantage of the full access you currently have by looking carefully over the board, pressing down any chips that may appear unhoused. If you're

worried about static electricity damaging your board, then a gentle touch of the metal power supply casing will earth you.
☞ **It is easier** to set your configuration jumpers or DIP switches (if any) while the board is in your hands. This is also an ideal time to plug in your memory and processor, and connect your heatsink/fan, with the board supported underneath by a thick piece of cardboard on a flat surface.
☞ **When screwing your board** into the case it's important to remember that you will be plugging in more devices, sometimes quite firmly, and will need to provide enough support across the

▲ **(TOP) RAM MODULES, WHETHER OLDER-STYLE SIMMs OR NEWER DIMMs, SHOULD BE EASY TO SLIP IN (ABOVE) SUPPORTS FOR THE MOTHERBOARD. MAKE SURE NOTHING IN THE CASE WILL OBSTRUCT THE UNDERNEATH OF THE BOARD**

surface of the board. Locate which holes on your board will correspond to spacers provided with your system box and remove any that will not, as these are likely to short underside connections, preventing your board from working. Likewise be careful not to let any other objects find their way under the board as you screw it down.
☞ **Restrict yourself** to plugging in the bare minimum at this point, such as keyboard, mouse, graphics adaptor and, once that's in place, your monitor. For ATX power supplies you will also need to locate the power switch front panel connector. Then plug in the motherboard power supply and switch on. If nothing happens, at least you won't have to go far to retrace any problems. But most likely you'll get the POST screen displayed, indicating that you're almost there, so switch off to complete the installation.
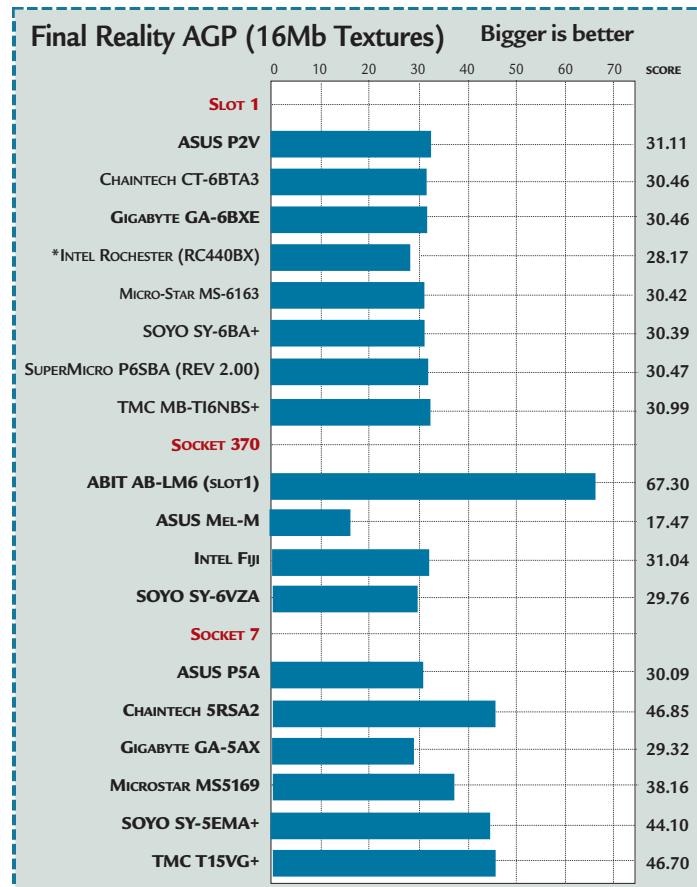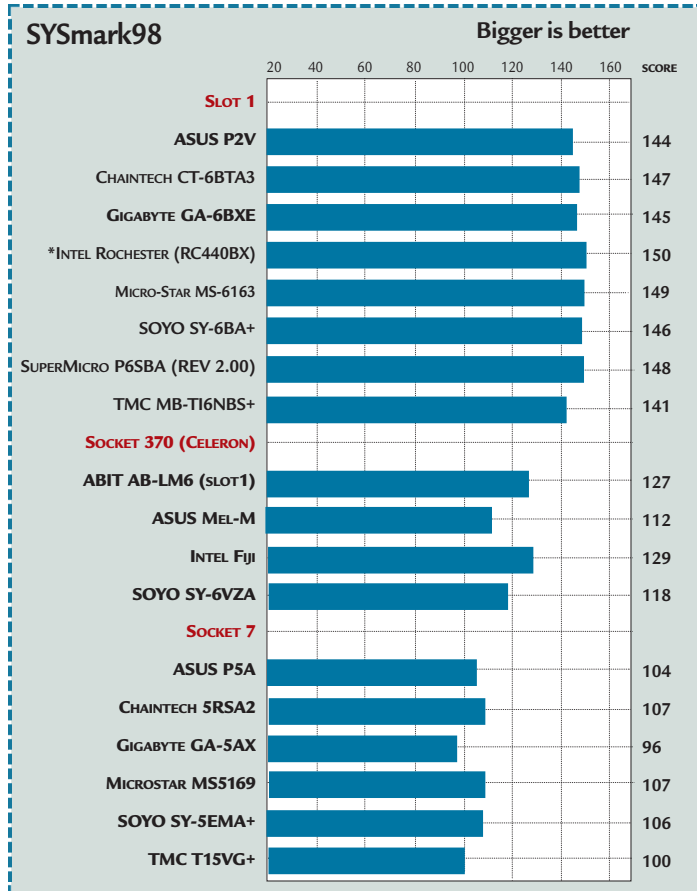☞ **Referring to your manual** at all times, plug in the rest of your peripheral cards, front panel connectors, hardware monitoring connectors and I/O devices, ensuring that the disk from which you boot your operating system is plugged into the first EIDE channel. If you're booting from another device, you'll have to set this through the BIOS software.
☞ **Now you can switch on** for the final time before entering your BIOS software to put in the configuration details needed for your specific hardware setup.

To your operating system, the motherboard installation is rather like adding around 50 devices all in one instance, but thankfully the majority of drivers required are in legacy databases contained by most operating systems. More specific drivers will be contained on any supplied CD or diskettes, but you can have a working system without them. However, a new board will generally seek support for its new chipset and the bus master drivers, which are the main culprits in under-performing systems. Check which drivers are currently installed and, if necessary, install newer bus master drivers: you may see drastic improvements over the entire system's performance.

SYSmark98

Bigger is better

	SCORE
Slot 1	
ASUS P2V	144
Chaintech CT-6BTA3	147
Gigabyte GA-6BXE	145
*Intel Rochester (RC440BX)	150
Micro-Star MS-6163	149
SOYO SY-6BA+	146
SuperMicro P6SBA (REV 2.00)	148
TMC MB-TI6NBS+	141
Socket 370 (Celeron)	
ABIT AB-LM6 (slot1)	127
ASUS Mel-M	112
Intel Fiji	129
SOYO SY-6VZA	118
Socket 7	
ASUS P5A	104
Chaintech 5RSA2	107
Gigabyte GA-5AX	96
Microstar MS5169	107
SOYO SY-5EMA+	106
TMC T15VG+	100

Final Reality AGP (16Mb Textures)

Bigger is better

	SCORE
Slot 1	
ASUS P2V	31.11
Chaintech CT-6BTA3	30.46
Gigabyte GA-6BXE	30.46
*Intel Rochester (RC440BX)	28.17
Micro-Star MS-6163	30.42
SOYO SY-6BA+	30.39
SuperMicro P6SBA (REV 2.00)	30.47
TMC MB-TI6NBS+	30.99
Socket 370	
ABIT AB-LM6 (slot1)	67.30
ASUS Mel-M	17.47
Intel Fiji	31.04
SOYO SY-6VZA	29.76
Socket 7	
ASUS P5A	30.09
Chaintech 5RSA2	46.85
Gigabyte GA-5AX	29.32
Microstar MS5169	38.16
SOYO SY-5EMA+	44.10
TMC T15VG+	46.70

* Intel's Rochester motherboard was tested with its own on-board graphics sub-system which was slightly different to that used with all the other boards. In this case, the scores could reflect differences other than those highlighted by the quality of the motherboard.

PCW Labs Report

■ **How we did the tests**

We tested each of the motherboard types with an appropriate processor: Intel's Pentium II 400MHz for the Slot 1 boards, Intel's Celeron 366MHz for the Socket 370 boards plus one Slot 1 board, and AMD's K6-2 300MHz for the Socket 7 boards. All other hardware configurations remained the same: ATi's Rage Pro Turbo AGP2x graphics accelerator with 8Mb video memory, 64Mb PC100 system memory (restricted to 66MHz for the Celeron boards) and a 2.4Gb Fujitsu ATA33 hard disk.

☛ **SYSMark98 results** depend on a variety of factors, but as we were only testing the motherboards, we are reflecting results based on the performance of the bus transfers and any other intricacies that a quality board may highlight. The better the score, the longer the bar graph. (*See p156 for a detailed description of SYSMark98.*)

☛ **Final Reality** is primarily designed to examine the processing power of the graphics sub-system using a 3D engine developed by Remedy. It runs through the DirectX 5.0 API developed by Microsoft. There is a special section designed to test the AGP performance. With the same graphics adaptor used in each setup, we were able to highlight performance differences between each motherboard in these specific areas. Again, the higher the score, the better the result.

■ **SYSMark scores explained**

We saw no major performance differences between the boards under the SYSMark98 test. In the Slot 1 category, the highest scored only five percent more than the lowest. All the boards sport the same Intel 440BX chipset save for ASUS, which again kept the scores on an even footing. The Celeron boards gave a different flavour to the results with almost a 15 percent maximum difference. All the boards had different combinations of chipsets, with the highest performance achieved by Intel's new ZX-66 chipset on its own board. Chaintech's best performing Socket 7 board manages an 11 percent gain over the lowest performer from Gigabyte. In this case, though, both use exactly the same chipsets, and reasons for the difference can only be put down to the quality of the electronics.

■ **Final Reality scores explained**

In the Final Reality AGP test, Abit's Slot 1 Celeron motherboard was the overall best performer, scoring twice that of most others. Rather than using a Socket 370 adaptor, a Slot 1 Celeron was used, which may have contributed partially to the results. Or it could be that the Socket 370 boards are very new and may be in need of performance modifications. Of the Socket 7 boards, the best and the worst performers were as in the SYSMark98 tests with similar reasons contributing to these results. The biggest margin for the Slot 1 PII boards was less than two percent between the best and worst performance. There is an accepted fluctuation of results in any benchmark and this result warrants no discussion.

Editor's **Choice**

When selecting motherboards for this group test, we decided on those which were likely to be put into machines used for a wide range of tasks, and tried to avoid those that constrained upgrading by having too many on-board peripherals. This brought about difficulties in picking the best, as all vendors submitted quality equipment equally capable of providing the required end result. However, when it came to selecting the winners, they did present themselves as the optimal packages, with little or no fuss on installation, and at very tempting prices.
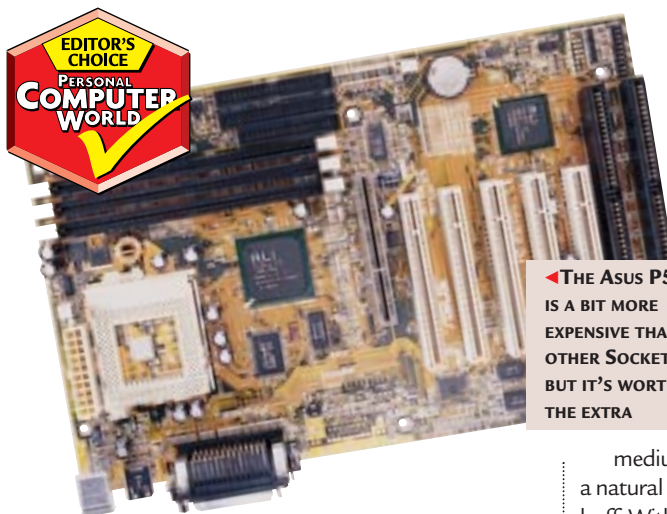
to the industry as a whole. This healthy competition has provided an opportunity to focus on extensions to features usually not thought of as necessary on a Celeron-based motherboard. But what was most impressive, and clearly helped SOYO to become our Editor's Choice, was the offer of an uncompromised quality construction with the least impact on your finances.
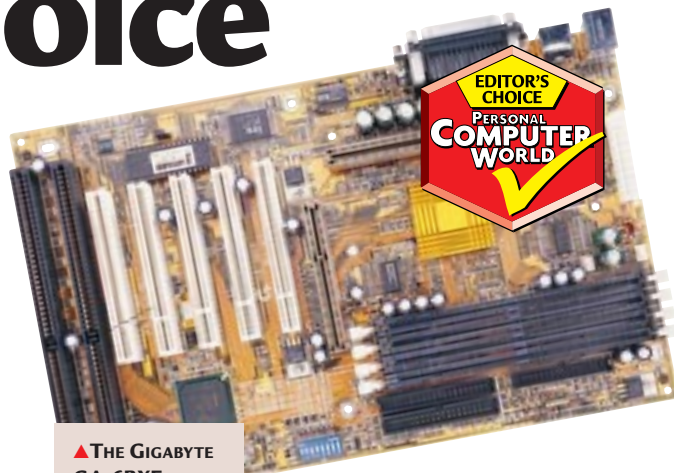
▲THE GIGABYTE GA-6BXE HAS INNOVATIVE TOUCHES

☞ Slot 1 motherboards
Our **Editor's Choice** in this category is **Gigabyte's GA-6BXE** — a clear winner, not just for an impressive build and design, but for all those innovative touches that helped it to poke its head above the crowd. Usability was a key feature, with clear labelling, bright colours and easily configurable switches all admirably accompanied by a manual pitched perfectly at the enthusiast and newcomer alike. Although there were no on-board peripherals, all other features offered a full spectrum of support with no compromises accorded to the tight price.

☞ Celeron motherboards
Our **Editor's Choice** in the Celeron category eventually went to a Socket 370 from SOYO, although the only Slot 1 Celeron board from ABIT did highlight the qualities of its experienced platform. **SOYO's SY-6VZA** was the only motherboard in this category not to feature an Intel chipset, VIA proving that its recently acquired core logic developer's licence was of benefit

◄THE ASUS P5A IS A BIT MORE EXPENSIVE THAN OTHER SOCKET 7S, BUT IT'S WORTH THE EXTRA

☞ Socket 7 motherboards
The prices of the Socket 7 boards was more of a reflection of their widely established acceptance resulting in masses of development, rather than indicative of inferior choices over the Slot 1
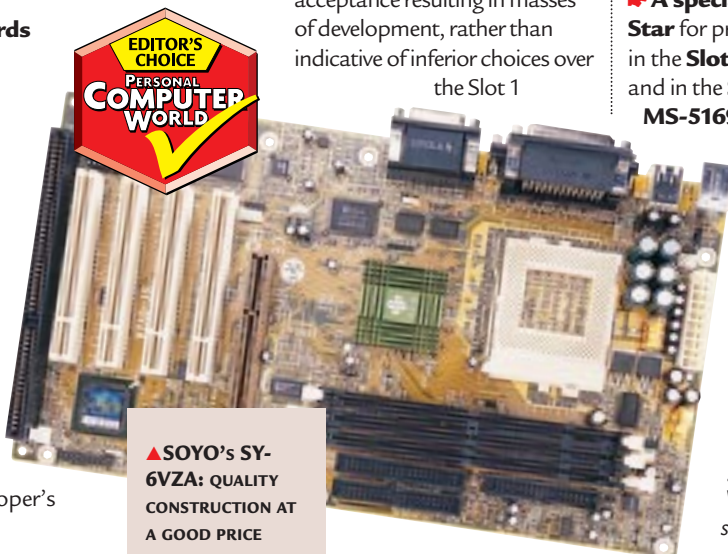
▲SOYO's SY-6VZA: QUALITY CONSTRUCTION AT A GOOD PRICE

boards. In support of this, there was a definite focus on boards designed and based on actual users' feedback, providing finely-tuned features across all the submissions with almost identical pricing. Our **Editor's Choice** is the **ASUS P5A**, which was marginally more expensive than the others, but the extra money was spent wisely. Options for personal settings had been widely expanded, providing support for most configurations of processor frequencies, bus speeds and core voltages. It's fine to just plug in your CPU at the requisite settings and proceed, but to offer a medium for dabbling in the unknown is a natural step for the enthusiastic computer buff. With the excellent manual providing the answers you'll be optimising the settings for your system in no time at all.

☞ A special mention goes to **Micro-Star** for providing excellent submissions in the **Slot 1** category for its **MS-6163**, and in the **Socket 7** category for its **MS-5169 v3**. Both motherboards ran as very close seconds, losing out only because of slight compromises in features and usability.

● Our thanks go to Intel and AMD for supplying processors, and to Kingston Memory for its generous supply of memory.

● Next month we look at 18 new graphics cards, including the new Voodoo3, and at removeable storage and hard disks.