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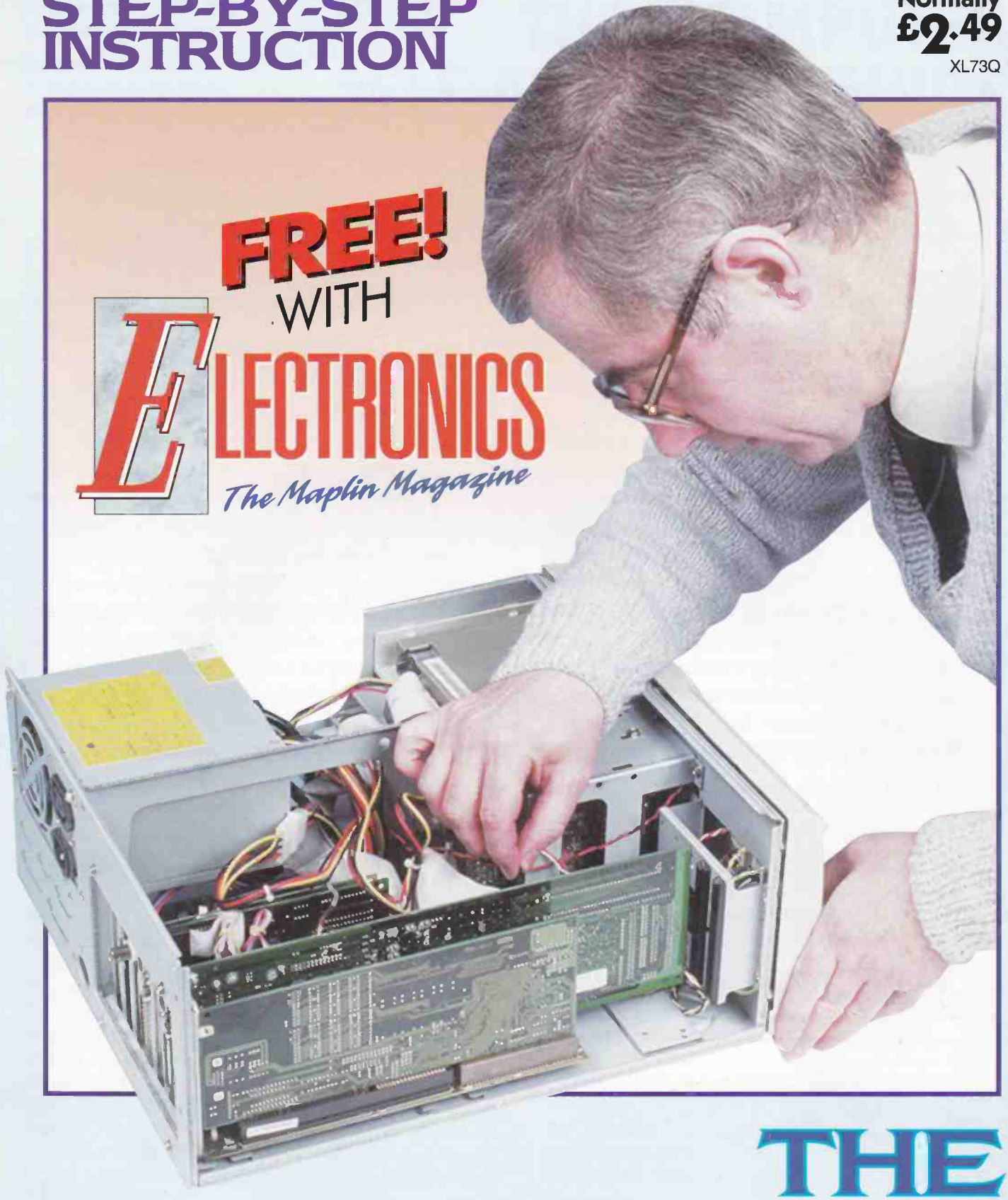

THE COMPUTER SELF-ASSEMBLY GUIDE

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Edition 3 1996

THE COMPUTER SELF-ASSEMBLY GUIDE

Foreword

Since this Computer Self-assembly Guide was first published in 1994, there have been many developments in computer technology. The introduction of faster double or even triple clocked microprocessors and the Pentium™ CPU, along with the universal use of full 32-bit bus systems found on VESA and PCI motherboards, make full use of 32-bit operating systems such as OS/2 Warp and Windows NT, and of course Windows '95.

As PC hardware is developed and refined to give more computing power, and I/O devices are improved to give better sound and graphic quality to the end user, so too the software becomes more complex and memory hungry in order to take full advantage of the capabilities of the newest machines.

The introduction of increased capacity 72-pin SIMMs (memory modules) make memory selection or expansion far simpler than it used to be. The dramatic reduction in price of IDE hard drives of up to 1GB in size, as well as the ready availability of double, quad and even 6x speed CD-ROM drives, makes it easier than ever before to install the very latest in games or business software, with rarely a floppy disk to be seen!

We have of course updated this guide to include information about the selection and use of the latest PC hardware and periferals, but the descriptions and explanations of the component parts of a typical PC and their interconnections still apply equally to PCs based on older processors such as the 386.

We are confident that you will find this guide a valuable reference, whether you are intending to build a PC from scratch, upgrade an older machine, or simply want to get a better idea of what those mysterious printed circuit boards inside your PC are actually doing there! Read on now and join us on a journey inside the PC . . . .

Contents

Introduction

Most computer users don't even see inside the computers they operate, for a number of reasons, one often being that the computer may be in an office where maintenance and upgrades are controlled by engineers, or in the home environment where there might be a maintenance contract, or the user may be fearful of opening up the machine and working on it.

IBM PC/AT compatible parts are ideal for new or experienced users alike to build up a powerful computer. The concept of designing and building a computer to meet your exact needs is very exciting and will dispel many myths and fears about computers, and show how easy it can be.

There are a variety of boards and peripherals, and at first sight this might all seem a bit bewildering. It is hoped that enough guidance can be given to the DIY builder to make up his or her mind. Do remember that, if you do decide to build your own computer, this booklet is only a guide and the fitting of each part or component is normally described in detailed instructions supplied with each part. If you are in any doubt and feel that you need to discuss your system requirements, or are simply unsure of any part of the design or building of your computer, please feel free to 'phone our computer hotline on 01702 552911. During normal office hours, our technical support staff will give you the same in-depth service that supports the building of our electronic kits. At the end of the day, when the computer has been built, you will see what has been achieved, and at the same time have a computer that you can justly be proud of.

One major consideration is in balancing the cost and performance of your system. It should be remembered that many cheaper computer systems bundled with seemingly free software, do not always represent the best value. This is often found out by the unlucky purchaser when he or she wants to install some new software, and finds out that it is not possible, or that the very basic specification of the machine means that the new programs run so slowly that they are unusable. When you design your own system you are not going to be tempted to buy an under-specified machine because of bundled software, but can concentrate on the individual components that make up your system.

Description

The computer to be built here is the 486DX4-100 system, which represents a good compromise between cost and performance. The prices of the 486DX2-66 have now come down to the point where you may wish to use it instead. The main fact to bear in mind is that the motherboards are working at 5V, whereas most modern microprocessors run at 3·3V. Make sure that you know what voltage your motherboard provides for your microprocessor, otherwise it will be 'plug and blow'.

It is possible to spend a lot more on a very high specification Pentium™ based machine, or to make a considerable saving with some loss of performance by basing your system on a 386 processor. We will explain these choices in more detail a little later but for the moment we will look at the parts which will be common to most systems. Apart from the motherboard, you will need a VGA or SVGA colour monitor (most modern programs make good use of colour, even for word processing), SVGA controller card (1MB or 2MB of memory on board), an IDE 16-bit or 32-bit I/O controller card which incorporates hard disk and floppy disk controllers, parallel (printer) port, serial (mouse/communication) ports and a game (joystick) port all on one plug-in card, an IDE hard disk drive (sizes from 540MB to 850MB are now considered as a good size to start with, although 1GB is becoming common), 3½in. 1·44MB floppy disk drive, hard disk drive fixing kit (if you decide to fit the hard drive into a 5¼in. slot in the case), 2 × 72-pin 4MB 70ns SIMMs (this is a minimum for many programs now), desktop case and floppy disk drive fixing kit, connectors, plugs and MS Windows '95 operating system, manuals and keyboard.

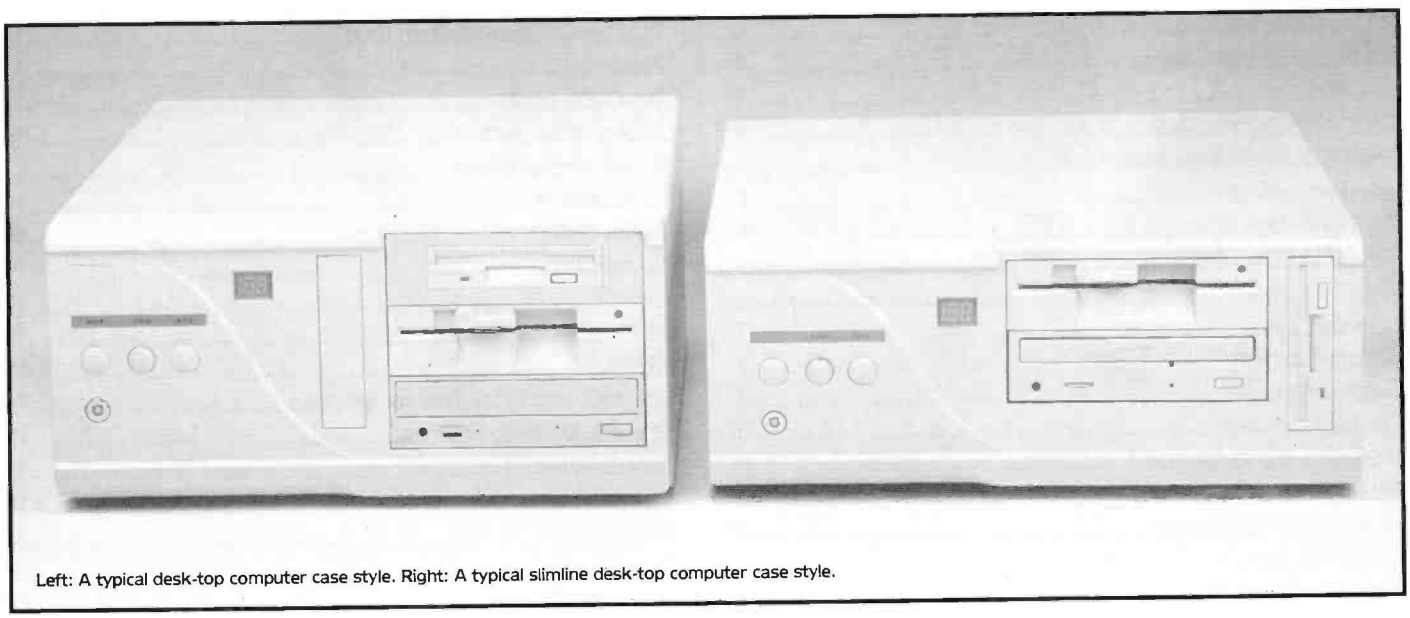
Individual cards and disk drives etc., are available from Maplin and will provide all you will need for building a new computer or for up-grading existing systems. The major elements in a computer will now be described individually, and interaction between them will also be explained.

The Computer Case

The (most popular) case used in the example throughout this booklet is of a type known as a desktop model, and there will be plenty of room in this to expand the system at a later date. The other choices in this range are a slimline case and mini or full tower cases. The slimline case has very little room for plug-in expansion cards but gives a neat low profile system for basic small or home office (known as SOHO) use, whereas the tower cases offer large capacities for expansion whilst taking up a small desk or floor space. The tower cases are often stood on the floor as the monitor used with them does not stand on top of the case as with slimline or desktop cases.

The desktop case is in two halves and is held together by screws. There is a mains power socket and plug on the back. It comes ready fitted with a 200W switched mode power supply, and has a number of leads and cables ready to be fitted to the boards. It has an integral extractor type cooling fan, and all the blanking plates at the front and back of the case are in position. It conforms to a universal format that has evolved from the IBM PC/AT compatibles/clones, and should be good for many years. If this format were to change significantly, then there would be many millions of disappointed computer users, although it must be said that it has taken many years to get to the stage where there is some form of uniformity between manufacturers. Having said this, the outward appearance and drive cage position layout differs hugely between different makes of case, but this does not affect the compatibility of the internal mounting points in each case with the standard fittings on all PC parts.

Coming out of the power supply, inside the case, are a number of leads which have power plugs on the end. There are generally two types of connector on the end of each power lead (except those which power the motherboard), the larger of which has four connections and is meant for powering up 5¼in. floppy disk drives (now quite rare) and certain hard disk drives. These have both +5V and +12V supplies. The smaller connector is intended for 3½in. floppy disk drives, and some smaller size hard disk drives. These power connectors are also used to power up peripheral add-ons and equipment, but more on that later. The remaining pair of leads are for powering up the motherboard. They are fitted with longer connectors to match up with the long multipin connector in the corner of each motherboard when plugged in side by



Left: A typical desk-top computer case style. Right: A typical slimline desk-top computer case style.

side. Note that each plug MUST be connected to the correct half of the motherboard connector, as described later. DO NOT assume that any connector numbers that may be marked on the power supply leads correspond in any way with the numbers marked on the motherboard or shown in the booklet supplied with the motherboard. The two parts were almost certainly made by different manufacturers and no common standard is used for plug and socket numbering!

There are two types of mains sockets on the back of the case, one which is in fact a chassis mounting plug for plugging in the lead from the mains, and the other a socket which will supply power to the SVGA monitor. In its empty state there will be a small round hole at the rear of the case where the keyboard will eventually be plugged into the motherboard, and a number of slot shaped holes, where the plug-in cards will be located.

On the front are a variety of switches and light emitting diodes, these will be used in the control of the computer. The switches are the Power On/Off, Turbo Mode, and the key control locking switch. The individual light emitting diodes are for power indication, hard disk operation, and Turbo Mode. Motherboards and their main processors will run at two speeds, selectable by a front panel switch. Most computers will spend their lives with their 'Turbo' switch permanently in the fastest position, but some older software may run at a more sensible speed with this switch in the 'Normal' position. On some models there is also a plastic window which will show the speed of the computer when all has been fitted, set up and operating. The number shown indicates the processor clock speed in megahertz, which directly relates to the speed of the system in running many programs.

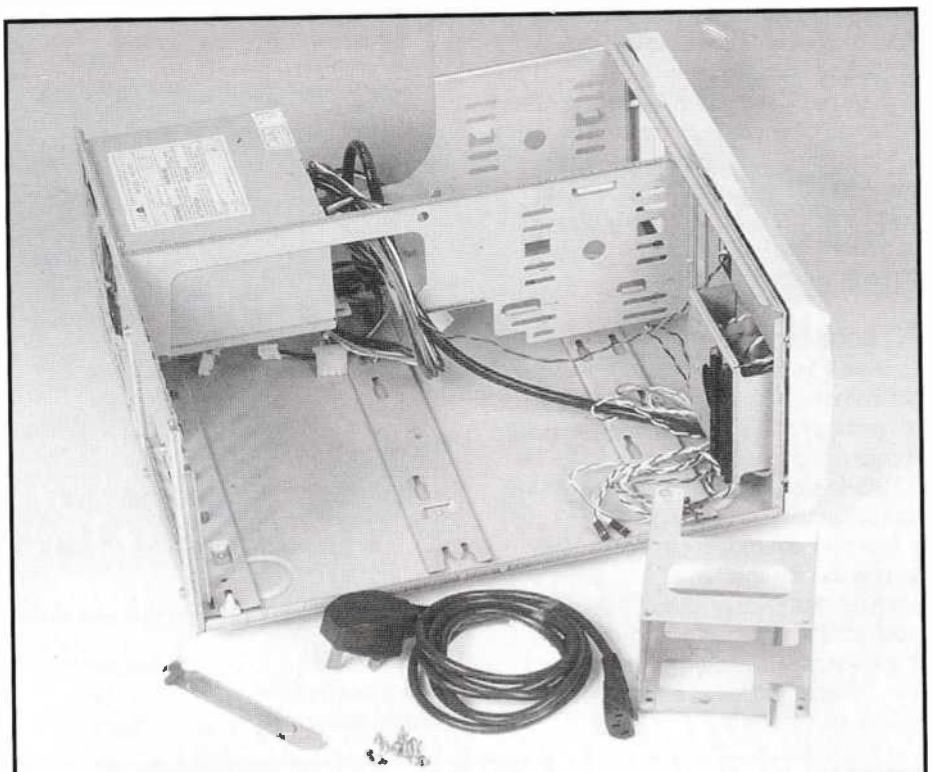
Inside the case, it will be seen that there are a lot of steel supports, bars and ironmongery used, the purpose of these will become clear later, as will the holes, slots and bays.

Originally the disk drives were full height monsters, but over the years these have been reduced to half height as drives became smaller. The disk drive bays are based on two types, the 5¼in. and 3½in. The case used in our example supports enough 5¼in. and 3½in. bays for all but the most ambitious designs. There are various options within the case to house the hard disk drive and a 3½in. floppy drive, which is the normal basic setup.

The Computer Motherboard

What will be surprising to many is the small size of modern motherboards. Traditionally the boards were quite large and hence the dimensions of the outer casing were really dictated by this. Rather than fitting these boards into smaller cases, different styles have evolved to suit the user.

A 486DX4-100MHz VL-Bus (Vesa Local Bus) motherboard is used in the example in this booklet. The 486DX4 processor benefits from a fast 32-bit data bus with a built-in 8KB RAM cache which allows much faster transfer of sequential data than earlier processors such as the 386 series. It also incorporates a floating point maths coprocessor which is used by some maths intensive programs to speed up calculation of very large numbers of noninteger



The computer case with the leads and cables and other fittings.

results, such as those used in rendering ray-traced graphics or engineering calculations. If this means little to you, suffice it to say that a 486DX4-100 based motherboard where the processor performs all of its internal operations at three times the speed of the rest of the motherboard, offers a very attractive performance to price ratio, especially as falling Pentium™ prices push 486 prices down. The 486DX4 is a good choice as the motherboard runs at 33MHz (which is the highest recommended speed for most of the VESA Local Bus graphics cards and hard drive controller cards) yet the processor performs its internal number crunching at an impressive 100MHz speed. Note that the 486DX2 66MHz processor runs at twice the clock speed of the motherboard. The 486DX4 runs at either two or three times the clock speed, depending on the core frequency.

Do not worry too much if you are baffled by all the speeds quoted in MHz (megahertz). Basically, the higher the number, the faster everything on the motherboard will work when you run a program.

However, if your budget is limited, or if you do not intend to run the latest software (many of the latest games on CD-ROM really require a 486 based system as a minimum for smooth sound and graphics), the ageing 386DX processor running at 33/40MHz still offers a very cheap low performance alternative, if you can get one. It differs from the 486DX in having no built-in maths coprocessor (although an add-on coprocessor, the 387, is available to plug in alongside the 386), no internal RAM cache and a slightly less efficient instruction set. It is quite adequate for most business software (if you stick to earlier versions such as Word for Windows version 2.0, instead of version 6.0, which are currently available at heavy discounts to clear) and most older games packages.

If you want to run multimedia software that will display moving video and sound (probably running under Microsoft Windows '95), usually from a CD-ROM drive, you would be best advised to use at least a 486DX based motherboard.

Lastly, at the time of writing this guide, the SX version of the 486 is still available at next to nothing prices. The 486SX is similar to the 486DX which handles 32 bits of data, but has its coprocessor 'disabled'. This was carried out at the time in order to have a cheaper alternative to the 486DX, but as time has progressed the price of microprocessors have fallen and this policy has left a good few 486SX on the market.

Motherboards

There are a number of major features on motherboards, such as a quantity of 16-bit ISA slots (long black connectors in a row across the motherboard) for connecting the plug-in SVGA graphics and disk drive controller cards, as well as any future expansion cards such as Sound Blaster cards or CD-ROM drive interface cards, etc. The longer connectors with two sections are 16-bit slots, and the shorter single black connectors (if any, some motherboards no longer have them) are the 8-bit slots for use with cards designed to fit the old 8-bit XT standard. Obviously, some plug-in cards have long edge connectors and a few have the short 8-bit edge connector. Apart from matching 16-bit, and 8-bit plugs and sockets, there is nothing to stop you plugging in any of the 8 or 16-bit boards in any of the motherboard positions, the choice being mainly one of convenience. 8-bit cards can use any slot, 16-bit cards must be used in the long 16-bit slots.

VESA VL Bus Motherboards

VESA (Video Electronics Standards Association)

The motherboards described have a 16-bit wide data transfer to their plug-in peripherals which is limited to about 8MB/second transfer rate via the standard ISA bus connectors.

This causes a noticeable bottleneck for faster processors and limits graphic animation speed

and communication speed with disk drives and other peripherals. To overcome this, newer motherboard standards such as VESA VL bus 1.0 have been designed with extra sockets fitted in line with the original ones to extend the data bus to the full 32 bits width, as well as careful design of layout and components used to ensure that a far faster data throughput may be obtained. The VESA VL bus 2.0 standard supports a 64-bit data pathway.

PCI Local bus Motherboards

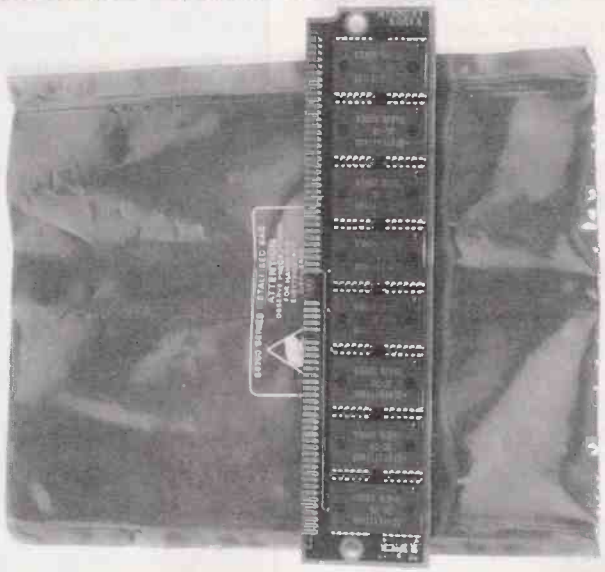
Standard PCI (Periferal Component Interconnect) bus motherboards use 32-bit standards (but not compatible with VESA) which provide extended sockets for faster and wider data transfer. The PCI SIG Revision 2.0 supports a 32-bit and 64-bit data pathway.

All of the motherboards provided by Maplin are now supplied as either VESA VL bus boards which can take a 486 or Pentium™ OverDrive processor if an upgrade is desired, or PCI based motherboards, which take the Pentium™ microprocessor and makes full use of the extended bus connector.

SIMMs (Single In-line Memory Modules)

There will be at least four SIMM sockets available to plug in the SIMM Dynamic RAM (Random Access Memory) memory modules on the motherboard. These will be either all 30-pin type sockets, a combination of 30 and 72-pin types, or on the more modern boards exclusively 72-pin types. Usually the SIMM sockets are identifiable as four or eight closely packed connectors with metal retaining clips at each end. The SIMMs are used to store programs and data whilst the machine is running. Note that most suppliers sell motherboards without the SIMMs which must be purchased separately. The earlier motherboards had their SIMM memory expansion areas divided into banks which had to be filled one complete bank at a time. As each bank had usually a group of four SIMM sockets (except for 386SX and some early 386DX motherboards which had two SIMM sockets per bank), a computer to be fitted with 4MB of memory would require four 1MB SIMMs, NOT one 4MB SIMM, which would not fill a bank and would not therefore be recognised by the motherboard.

The newer motherboards which use 72-pin SIMMs, can be fitted with a minimum of just one SIMM, i.e. 4MB (1MB × 32 or 1MB × 36).



The SIMMs, as supplied in antistatic bags.

Before making any definite decisions about SIMMs, ask before buying, or check your motherboard booklet for RAM configuration.

The BIOS

The BIOS of the computer is the Basic Input/Output System program. All motherboards have already been supplied and fitted with a licensed BIOS. This is housed in a ROM such as licensed by American Megatrends Inc., hence AMI BIOS, of course other makes are available such as Pheonix or Award.

The BIOS holds the skeletal program executed at power up that allows further software to be loaded from the disk drives and executed, as well as some of the operational information of the computer, such as the number and type of disk drives fitted, the time and date, and a lot of very technical information which sets the exact way the motherboard works at a chip to chip level.

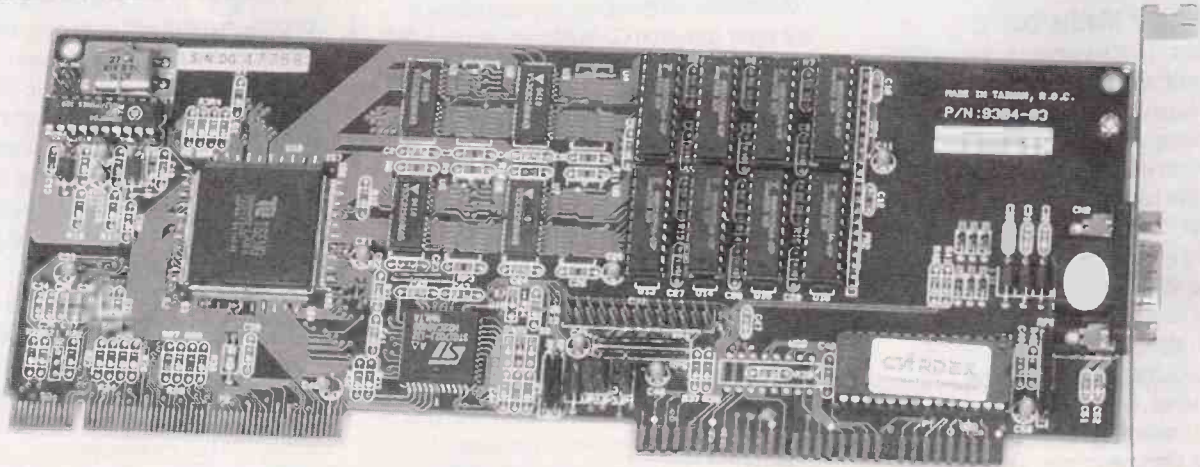
All of these settings are user adjustable at power up via a simple to use menu system. There are two main things to remember about entering the BIOS setup programs and adjusting motherboard settings. The first is that everyone will need to do this to set up their system to operate correctly and you should not be frightened of gripping your keyboard firmly and going ahead, once you have read about what you are going to do and how to do it. The second thing to remember is that while most of the settings in the BIOS may be simply changed back to their original values if the changes don't work as expected, there are hard disk diagnostic and formatting utilities on the BIOS menu which will delete the entire contents of your hard drive if run. They do generally warn you or give you an opportunity to confirm such an action before going ahead, but do think very carefully about what you are doing when selecting items from the BIOS menu. The rest of the setup data and the main operating system is obtained from a boot up floppy in drive A:> or once the hard drive has been formatted and the operating system installed, from drive C:>.

Just a word of caution though. Earlier types of BIOS (generally those manufactured before 1994) did not support hard disk sizes greater than 508MB as reported on the CMOS, or 528MB when using CHKDSK or SCANDISK.

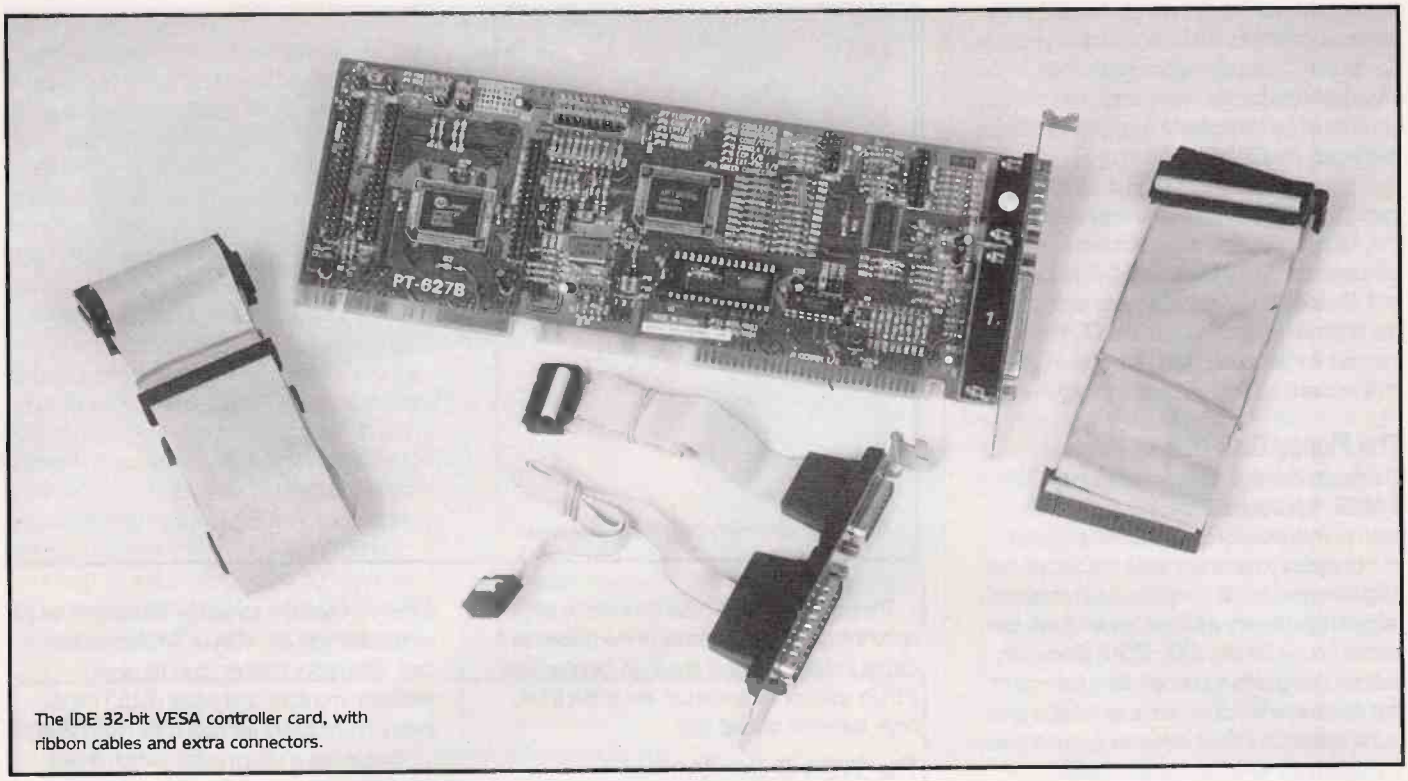
If you have one of the older BIOS you will still be able to support hard drives greater than 508MB but only by the use of a software utility, or by use of a controller card with an extended BIOS.

The SVGA Interface Card

There are a huge number of different makes and specifications of video cards available. AT type motherboards traditionally have no video output capability (actually, some now do have an interface built in, please check your configuration first) so you will need to choose and fit a Super



The SVGA driver card.



The IDE 32-bit VESA controller card, with ribbon cables and extra connectors.

Video Graphics Adaptor (SVGA) card which will provide a high resolution video output to drive a specialised monitor screen.

The SVGA driver card used, is the highest screen resolution currently in use for most games and business software although some computer aided design packages can make use of much more expensive specialised display cards requiring special large screen colour monitors. The following resolutions/colours require 2MB of video ram, 1080 × 1024 pixels with 256 colours, 1024 × 768 with 64K colours, and 800 × 600 with 16M colours.

A cheaper choice is the 1MB SVGA card supporting screen resolutions of 1280 × 1024 with 16 colours or 1024 × 768 with 256 colours, or 800 × 600 with 64K colours or 640 x 480 with 16·7M colours.

Alternative choices for the budget conscious would be the 512KB VGA card, which will be adequate for most software, supporting screen resolutions up to 800 × 600 with 256 colours or 1024 × 768 with only 16 colours, or the 256KB card for mainly text or low resolution graphics up to 800 × 600 with 16 colours.

The SVGA monitor will be connected to the card via a 15-pin D-type connector at the back of the case. The card will be pushed into one of the 16-bit slots, or 32-bit slots (depending on the card) on the motherboard, and the metal backing plate attached to the card, will be held in position by a screw onto the casing.

The IDE 32-bit Disk Controller Card

There are two types of hard disk controller cards in general use, and the IDE (Integrated Drive Electronic) 32-bit controller card is typical of the most common type. We have chosen an IDE hard drive for our example as the interface is inexpensive and a wide range of IDE drives of ever increasing capacities at low prices are now available. The alternative would have been to specify an SCSI (Small Computer Systems Interface, pronounced "scuzzy"!) card and hard drive. SCSI drives have traditionally offered larger capacities and faster access times. The SCSI interface is also designed to allow a number of drives or other devices to be strung together on the same cable, which may be a consideration in very large systems. Our IDE card supports two hard disk drives, two floppy disk drives, two serial ports (Com1 and Com2), one parallel printer port (LPT1-2), and a games port.

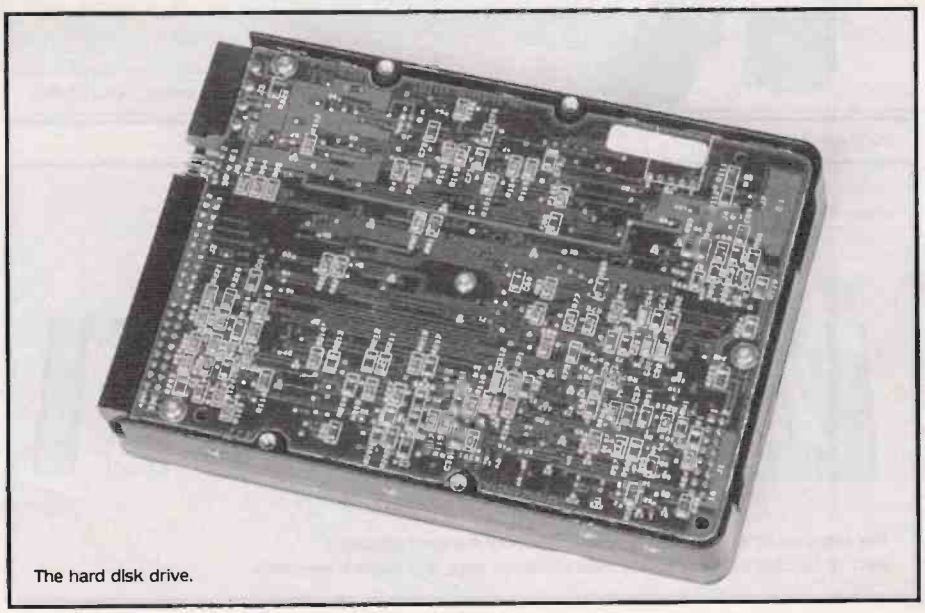
On the controller card, there are jumper links which allow flexibility in the configuration, and these should be set up for the requirements of your system, referring to the leaflet supplied with the card. Our example is a 32-bit type and will be pushed into one of the 32-bit slots on the motherboard, with the metal backing plate held in position by a screw onto the computer case.

Along with the card and manual are various leads, and these will be used to connect the card to the floppy disk and hard disk drives. Provision has been made for further expansion of disk drives, with extra connectors on the ribbon cables. Also provided is a metal backing plate which has two connectors attached and two cables. This is an extension for the serial ports, and will be attached to one of the free slots in the back of the case.

The Hard Disk Drive

The hard disk drive we have chosen is the Western Digital IDE 540MB hard disk drive. This is the same size as a 3½in. floppy disk drive, but it has multiple platters with more heads. The disk drive is completely sealed and on no account should any attempt be made to open it. Normally the hard disk drive is fitted internally in the case, out of the way, rather than in one of the main bays, but there is a hard disk fixing kit available, if the option to fit the hard drive in one of the 5¼in. bays is required.

The hard disk drive is the main form of storage of programs onto the computer. The drive as supplied is low level formatted which means that information has already been stored on the disk to tell the operating system which areas can be used. However, the MS-DOS operating system will further format (high level



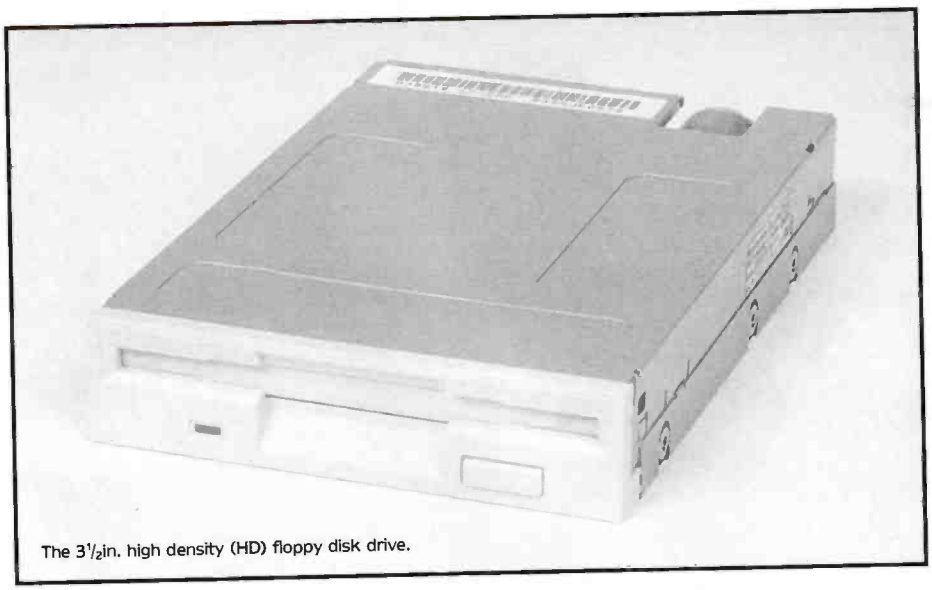
The hard disk drive.

format) and partition the drive before it is ready for use. Instructions will be given as to how to do this after the construction details. It is very important that the instructions are read and understood before embarking on this, see the section on The CMOS setup.

Problems encountered when using large capacity hard drives with older motherboards may be overcome by using Windows '95 which can support LBA and Extended CHS methods, and Windows 3.11 with suitable drivers. Refer to the information provided with the IDE interface card or information supplied with the motherboard if the interface is onboard.

The Floppy Disk Drive

The floppy disk drive chosen is a Mitsumi 3½in. 1·44MB High Density drive. This represents another method of storage of programs, and of introducing programs or data not held on the hard disk drive to the computer. As in common with all High Density (HD) disk drives, it will also accept Double Density (DD) 720KB disks, with suitable changes to some operating commands. It is possible to fit a 5¼in. drive as the only drive in the system, but most software is now supplied on 3½in. disks so a 5¼in. drive is best used as a second drive, if required. Of course you may choose to fit a 3½in. drive as a second drive instead, especially if you need to duplicate a lot of disks regularly.



The 3½in. high density (HD) floppy disk drive.

The positioning of the disk drive will be left up to the personal preference of the builder, as it can be installed in one of the 3½in. bays or when a 5¼in. adaptor kit is used, in any of the 5¼in. bays, but more on that later.

The SVGA Colour Monitor

An average SVGA colour monitor is the 14in. 0·28mm dot pitch screen allowing up to 1024 × 768 resolution with a special protective layer on the screen to reduce radiated energy.

The SVGA colour 14in. monitor.

The extended AT Style (tactile response), industry standard keyboard.
With 12 function keys at the top, separate cursor keys, and numeric keyboard.

It has the capability to display 16M colours and is compatible with any VGA or SVGA interface card. Alternative choices could be larger resolution monitors, and prices of 15,17 and even 21in. monitors are now quite reasonable.

You can use a VGA monitor (which is best used only if you do not intend to run programs with high resolution graphics). The only word of caution is that whereas SVGA monitors are downward compatible regarding screen resolutions, severe damage could result to an VGA monitor on a high resolution SVGA card if the higher resolutions are tried out. It is accepted that 800 × 600 is the crossover point between VGA and SVGA.

Low budget or basic word processing systems could use a Mono (black and white, green or amber) VGA monitor, but do bear in mind that even the simplest word processors make good use of colour to clarify command and menu selection, highlighted text and so on.

Modern monitors are now power conscious, look for the Energy saving label. This means that in conjunction with the motherboard and the Windows '95 operating system that if required, the monitor and/or SVGA card will shut down, thus saving power, if there is no activity detected from either the keyboard or the mouse. All the monitors have swivel bases and can sit on top of the computer case (except tower cases) or on a desktop. There are two leads supplied with the monitors, a mains power cable so that it can obtain its power from the mains socket on the computer, and a video cable with a 15-way D-type connector on the end which is to be plugged into the SVGA driver card.

The AT Keyboard

The AT type keyboard is a conventional 102 key extended AT style keyboard, with 12 function keys at the top, separate cursor keys and numeric keypad. The keyboard will be connected to the computer via its lead which normally has a conventional 5-pin DIN connector on the end (some have a miniconnector known as a PS2 connector and may require an adaptor). The AT style keyboard has become the industry standard layout.

There are other types of compatible keyboards (such as the Microsoft Natural Keyboard and Windows '95 keyboards) and these likewise can be used.

Operating System

There are several varieties of operating system such as IBM's OS/2 Warp, and MS-DOS 6.22 along with Windows for Workgroups 3.11, and now there is Microsoft Windows '95.

With the MS-DOS 6.22 and Windows 3.11 package you will find a number of 3½in. disks with the Operating Manual in the sealed package. The Disk Operating System, or DOS as it is commonly known, is automatically loaded from the hard drive when you switch the computer on. This is called 'booting up' the system and causes a set of programs to be loaded into the memory of your computer which allows you to look at, edit, move, delete or run other programs stored on your disk drives. The operating system may be booted from either the hard drive (which will be installed as drive C) or from your floppy drive (installed as drive A). Initially of course, your hard drive is empty and the computer will be booted from the MS-DOS setup disk one. This will lead you through a set of procedures which will high level format your hard drive to prepare it for use by DOS and install the main set of DOS programs on the hard drive so that you may bootup from the hard drive in future.

The MS Windows '95 Upgrade operating system includes manual, disks and CD-ROM.

With Windows '95, there are options to either upgrade from MS-DOS 6.22 and Windows 3.1/3.11 and whether or not to take advantage of using a CD-ROM based package. The installation is mainly automatic with choices given throughout. An extremely powerful part of the installation is the ability of Windows '95 to check accessories that are plugged in and will work out their IRQs and locations and store them. Further additions can also be detected later in a similar fashion. The main drivers for the sound, video, and network cards and monitors are all either on disk or CD-ROM.

However, Windows '95 is not the only operating system available for the PC. You may prefer disk operating systems such as MS-DOS 6.22 with Windows for Workgroups 3.11, International Business Machines (IBM) OS/2 Warp, Windows NT, or one of the forms of UNIX, but for the new user it will be wise to stay with the suggested system. The style of the computer will allow upgrades in the operating system in the future, which is one advantage of this type of system.

System Summary

You should by now have a good idea of all of the parts needed to make up a complete PC system to your chosen specification, but if you are not confident that you can now form a shopping list of the parts needed and place your order, now is the time to phone our computer hotline on 01702 552911 and ask for help! Don't be worried about seeming foolish and please don't go ahead and order the parts before you are sure that your choice is right. Ten minutes on the phone now could save a lot of grief later on.

Before we go on to assemble a computer, we will look at the specification and parts list of our example system.

This is a fast computer with enough RAM (readable or writable memory) to run programs under Windows, with a reasonably sized hard drive, a 3½in. floppy drive for new software installation and data backup, a safe, low emission SVGA colour monitor, standard keyboard and desktop case. It should be emphasised that, as everything simply plugs together like building bricks, the computer is easy to assemble and easy to modify if we need to upgrade by adding boards or replacing them in the future. This machine will run most games and business software at a good speed, although more RAM and a faster video card would improve the speed considerably.

There are other items you may wish to order when building your computer, such as a serial or bus mouse, a sound card, a CD-ROM drive or a joystick for example. We will examine some of these upgrade options later in more detail.

The following section will describe the assembly of our example system. You may find slight differences in detail when assembling your specification of system but you will find that most of the steps do apply to any system. Do remember to look at the booklet supplied with the motherboard and the leaflets with the other cards. Although often short on explanation, they do give essential information on the location and polarity of connectors and jumper (link) functions.

Specification

Processor:	486DX4 100MHz Microprocessor
RAM:	8Mb (Expandable at a later date) SIMMs
Hard Drive:	540Mb IDE Hard Drive
Floppy Drive:	3½in. 1·44Mb High Density
Monitor:	14in. SVGA Colour Monitor 1024 x 768 pixels
Keyboard:	102 AT Style Keyboard
Case:	Desktop Type 38 x 18 x 41·5cm
Operating System:	Microsoft Windows '95
Supply:	220 to 240V AC

Parts List

Desktop Case
486DX4 100MHz Motherboard
486DX4 100 Microprocessor
4M SIMM 70ns x 2
2M SVGA Card
IDE Controller
540MB Hard Drive
1·44MB 3½in. Floppy Drive
14in. Lo-Emsn Monitor
102 Key AT Keyboard
Microsoft Windows '95
Mains Cable and Fitted Plugs
Monitor Mains Cable and Fitted Plugs
3A Fuse
3½ to 5¼in. fixing kit (if required)

Construction

You will not require many tools for the construction, just one cross-headed and one slot-headed screwdriver. A bench or tabletop in a well lit area will need to be used. As a number of devices are static sensitive it will be as well to briefly touch an earthed object such as a radiator just before handling the boards or drives. If possible avoid moving about once construction has started. Also be careful about handling the circuit boards and disk drives, do not touch the components or edge connectors. Hold them by their metal cases or end plates, whenever possible, but look out for sharp edges!

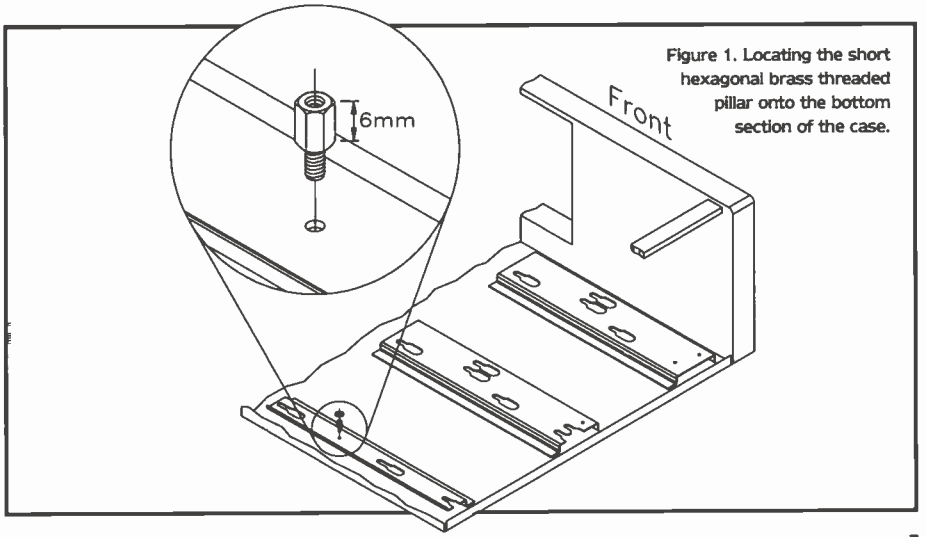


Figure 1. Locating the short hexagonal brass threaded pillar onto the bottom section of the case.

The Desktop Case

Undo the flanged screws at the back of the case, and then lift the top cover off. Be particularly careful not to catch your fingers on the metal sections within the case as they may be quite sharp. Inside the case or packing should be the mains power lead and a bag of fixing accessories to be used with the computer.

Turn the case upside down and locating the four rubber feet in the accessories bag, peel off the backing paper and stick the feet in the locations provided.

Unpacking the Motherboard

With the static warning in mind, next unpack the motherboard from its box and protective wrapping. Place the motherboard on a clear static-free area on the desk, preferably on the antistatic bag it came in, try not to touch any of the connections or components on the board.

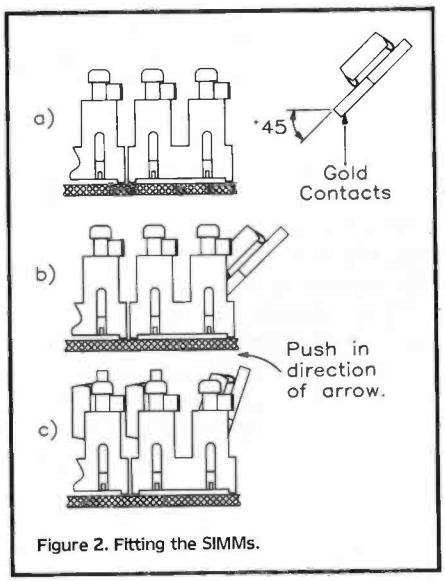


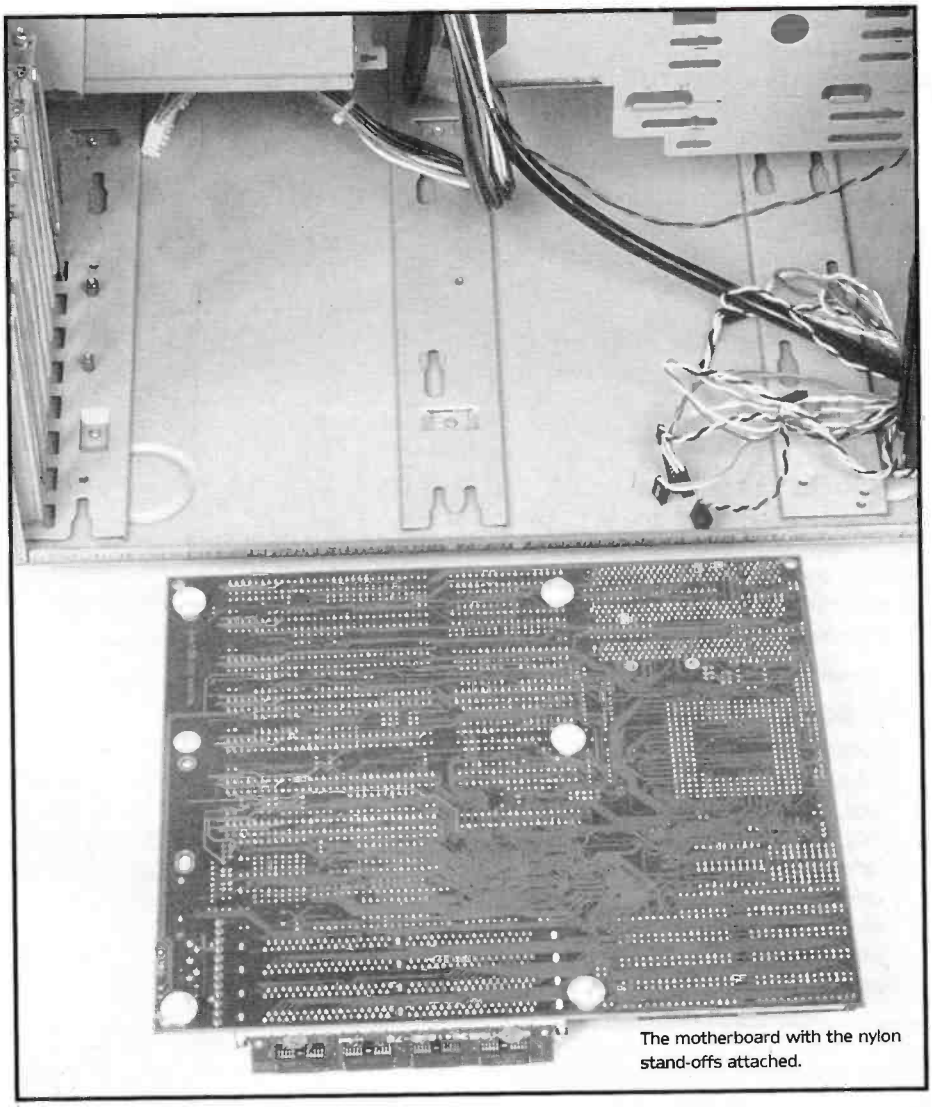
Figure 2. Fitting the SIMMs.

Fitting the SIMMs

Next unpack the SIMM memory module or modules, the older variety were contained in antistatic foam, but the newer SIMMs are now usually contained in antistatic bags which should have an unopened yellow seal which will have to be broken. It is recommended that when handling SIMMs, that if possible, a purpose made antistatic strap be attached to the wrist, and then onto the metal case of the computer, in order to minimise risk of damaging the SIMMs by static discharge.

Fitting the SIMMs, will only work (or fit) one way round, and must be located in the correct memory bank. The exact order may vary from one motherboard to another so do refer to the motherboard booklet for the type and number of SIMMs to fit for various memory capacities.

The preferred method of fitting them is to hold each SIMM module at each end, and angle it at 45 degrees as shown in Figure 2a, and place the edge connections in the SIMM socket on the motherboard from the side as in Figure 2b. Once in the socket, gently bring to the upright position until the two metal locators at each end of the socket click into place, with the SIMM module being held in an upright position as in Figure 2c. The other SIMM modules can be fitted in the same manner. Check that all SIMMs are fully home and level before continuing.



The motherboard with the nylon stand-offs attached.

Fitting the Microprocessor

When fitting the microprocessor make absolutely sure that you operate in a static free environment, and avoid touching the pins on the microprocessor at any stage.

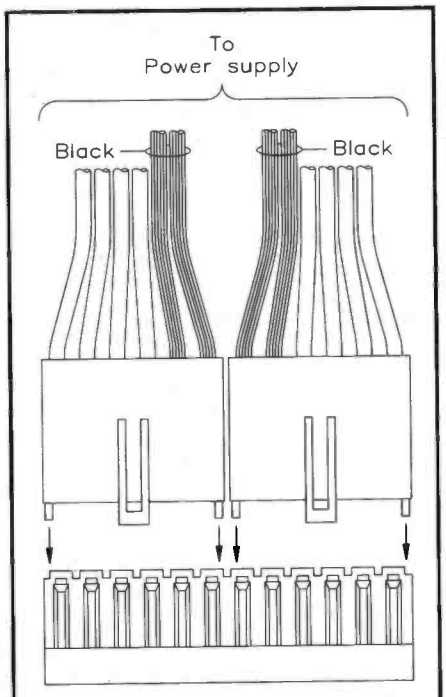


Figure 3. The two large white power connectors, illustrating the importance of their correct orientation.

On the microprocessor at one corner there will be a small dot or marking, likewise, there will be a similar marking on the socket. In all cases refer to the motherboard handbook and to any information contained with the microprocessor. Reference to the motherboards handbook will also be required to set the boards jumper configuration for a particular microprocessor if your motherboard is the dual voltage type.

It is essential that the microprocessor is correctly fitted into its socket. To extract the microprocessor (once fitted) without using the correct tool is likely to severely damage the microprocessor as well as the socket and motherboard. The ZIF type socket has a small lever at one side and this must be lifted into the upright position before fitting the microprocessor. When seated correctly, the arm can then be lowered and clipped into place, the base will then firmly hold the microprocessor in position.

With the 386 type microprocessors, a clip on heatsink was all that was required, but with the 486 microprocessors, some of which have a heatsink already in place (do not try and remove this), it is recommended to use further cooling of the microprocessor. Those without a built-in heatsink can use a cooling fan placed directly onto the microprocessor. Although it is now possible to obtain cooling fans to sit on top of the heatsink as well. The power for the cooling fans is obtained through the same type of connector as used for the 5¼in. disk drive and the hard disk drive, and is normally placed in line with one of these.

Fitting the Motherboard

In the fixing accessory bag will be a number of nylon stand-offs (straight snap-in types), that will enable the motherboard to be attached to the case. Before fitting the stand-offs to the motherboard fixing points, offer the motherboard into place in the case with the keyboard connector aligning with the round hole at the back of the case. You will see that one or two the of the holes at the back of the motherboard nearest the slot in the case are aligned with small threaded holes rather than slots. These (one or two) threaded holes accept the threaded brass pillars found in the bag with the nylon standoffs. Remove the motherboard and then locate two (sometimes only one) short hexagonal brass threaded pillars and screws to fit same, see Figure 1 on page 7.

Attach the stand-offs to the holes in the motherboard, leaving the one or two holes which align with the brass pillars at the rear of the case. Make sure that you have only fitted two brass pillars if the motherboard has two holes for mounting at these points. If you trap an unused pillar under the motherboard it may short things out! The case has been designed to take any of the motherboards whether full size or half size.

The power supply and fan are already in position, with the power supply leads for the computer motherboard and disk drives already attached.

You will also need to check that the Mains Earth has been connected, inside the case. Near to the front panel there should be a green/yellow wire with an eyelet attached (this is a small round metal plate with a hole in it) this needs to be connected to the front of the case with a screw.

Locate the two power supply leads with the larger white plastic connectors on the end. They must be fitted in the correct order on the appropriate connectors which will be found as a pair adjacent to each other. The black wires on each connector must be located together in the centre, so that all the black leads end up together (see Figure 3). It is extremely important that these leads are the correct way round. There are white plastic locating polarizing pegs on each of the connectors, as well as a locking tag, and these make sure that the connectors cannot be fitted the wrong way round, so that they are held tightly onto the motherboard.

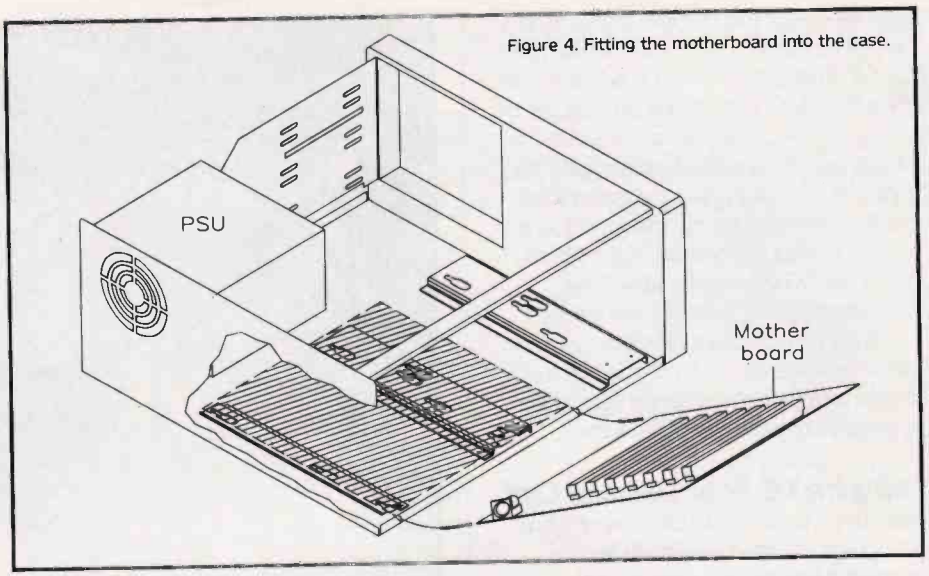
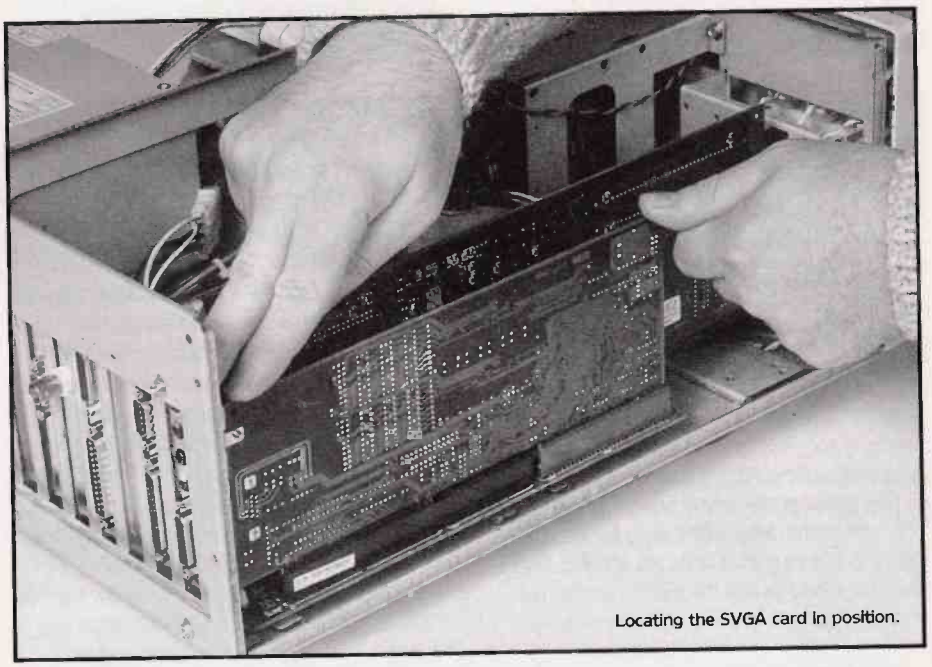


Figure 4. Fitting the motherboard into the case.

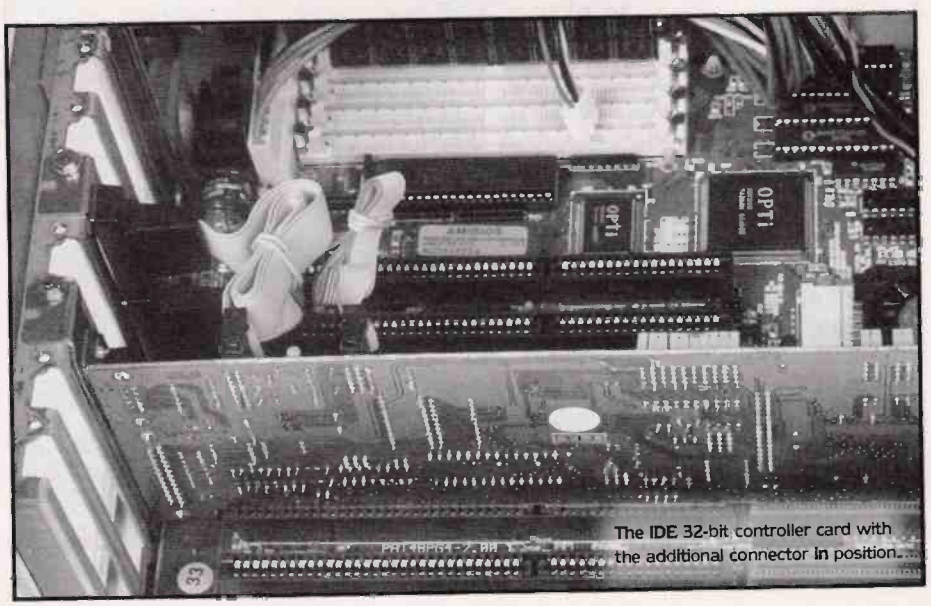


Locating the SVGA card in position.

Note. These polarizing pegs and locking tags may make it awkward to insert these connectors, just persevere and they will eventually push into place!

Note that Figure 4 shows the view from the rear of the motherboard.

Gently lower the motherboard into the case at an angle making sure that the nylon stand-offs are correctly positioned in their respective locations on the slotted plates on the case. You may find this easier if you stand the case on its side with the power supply downwards. The spacers should be fitted so that they slide into the slotted plates. It may take a couple of attempts to get this right, so be patient. Once the motherboard is in position, check that it is the right height, hold it in place with a screw through the appropriate hole(s) in the motherboard onto the hexagonal pillar(s).



The IDE 32-bit controller card with the additional connector in position.

Fitting the SVGA Card

Unpack the SVGA card from its box, and take off the protective covering. Again take precautions against static. At the rear of the computer case will be a number of slotted holes. Included with the case will be a complete selection of blank metal back plates and flanged screws, which will be used later to seal the case.

The SVGA card can be fitted in any of the 32-bit slots. Depending on the motherboard there will also be 16-bit slots in the line-up, but these should not be used for the SVGA card unless of course you are fitting an 16-bit SVGA card. It is suggested that the nearest 32-bit slot near the side of the case be selected.

Carefully line the card up into the 32-bit slot, the metal back plate at one end on the card should be butted up against the rear of the

computer case. It may be found difficult to place the card in position, and this might be due to a number of reasons. There should not be any part of the metal back plate outside the case, and the 15-way D-connector should be central in the slot. It might be that the motherboard is slightly out of position, if this is the case the motherboard may be slightly adjusted by loosening the screws securing it. Make sure that the edge connector part of the SVGA card is aligned with the motherboard socket. If you are sure that all is well, firmly push the board into place – you may feel some resistance, but it will go in. When all is well the back plate should be held in its position by using the correct sized flanged screw.

Fitting the IDE 32-bit Controller Card

Next unpack the IDE 32-bit controller card from the box and protective covering (unless the controller is built into your motherboard). Included in the box should be the appropriate leads for the drives and an extension plate with a two lead assembly for the serial connectors.

This circuit board is of the type commonly known as a 'super I/O card' and contains not only the connectors for attaching your floppy and hard drives to the system, with a built-in hard drive controller circuit, but also two serial communications ports (used for serial printer, mouse or modem connections for example), a parallel printer port and a joystick socket.

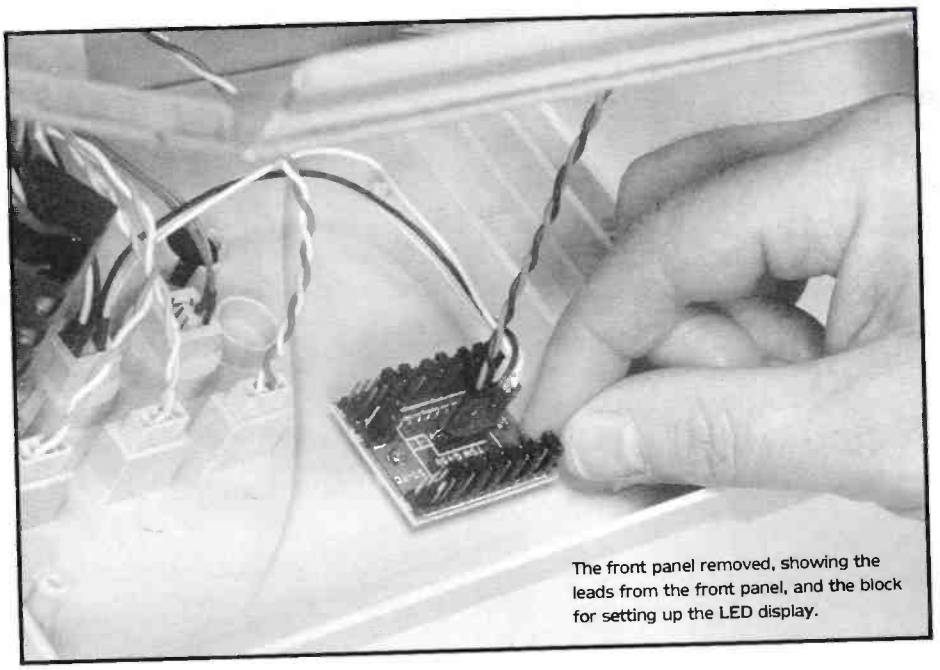
There are a number of options that you can setup on this board by moving small push-on jumper links from one set of connections to another. Some of these control quite exotic functions such as the internal address number used by specific ports on the card, but it is wise to take a look at the jumper positions as supplied and refer to the rather intimidating set of link tables to ensure that all ports are enabled. Note that you should disable the joystick (game) port if you are going to fit a Sound Blaster or similar card, which also has a joystick port fitted.

Select a free 32-bit slot, this time near the power supply end of the row. Bear in mind that you will need to leave at least one case slot (although not a motherboard slot) for fitting the extension plate. Again, do be careful not to select an 16-bit slot (unless it is a 16-bit I/O card you have chosen). As before, align and push the card firmly into position and butt the metal back plate up against the rear of the computer case. Do not screw the board in just yet as there are cables that need to be fitted, and this could be awkward if the board is fully screwed down.

Using one of the free positions in the case, preferably where there are not any 32-bit or 16-bit slots, locate the extension plate and serial connectors. The plate is attached to the rear of the computer case with a single screw as are the plug-in cards. There are usually two ribbon cables from this plate to attach to the I/O card. Connection details may vary somewhat from one make of card to another, but once you have used the leaflet accompanying the card to identify the COM connectors all should become clear.

Altering the Speed Indicator

On some cases there is an LED speed indicator located on the front panel. This is normally set to indicate a speed such as 25 or 33MHz. Depending on the speed of the machine you may wish to alter this.



The front panel removed, showing the leads from the front panel, and the block for setting up the LED display.

If you can get to the Speed Indicator Board, which is located at the front of the case, use the sheet that came with the case and follow the table, to work out the link changes for the speed configuration of your particular computer. The two settings are for 'Normal Speed' and 'Turbo Speed' or 'LO' and 'HI' if these can be displayed.

You will find that the tables supplied for this purpose are somewhat cryptic, but studying the example given will show that the highlighted link patterns in the table are those that must be fitted for the 'tens' and 'units' blocks of jumpers, for the example speeds to be displayed. If you simply substitute your own required 'normal' and 'turbo' speeds for those in the example and look along to the new X and Y points, the link patterns at those co-ordinates will show the links required. Please note that these indicators are purely cosmetic and do not alter the actual speed of the machine.

If you had to remove the front panel to change the speed display jumpers, then this would be a good time to decide which of the bays the 3½in. disk drive will be mounted in before screwing the front panel back in position. Once this has been decided, remove the required front plate. This is easily done by lifting the plastic locators back and pushing the plate out, or by simply pushing the plate out of the front firmly from the centre until the locators disengage. Keep this in a safe place in case it is required in the future.

Then screw the front panel back in position, making sure that no leads have been damaged or trapped in the process.

Fitting the Hard Drive

Remove the hard disk drive from its antistatic packaging, making sure that the drive is not subjected to any shocks or knocks, which may result in irreparable damage. Note down any information inscribed on the casing of the drive. Look for Type, Cyln, Head, Wpcom, Lzone, Sect and Size. Having said that, most motherboards now have a CMOS option called 'Auto-detect hard drive' which sorts this all out for you.

The normal position for mounting the hard

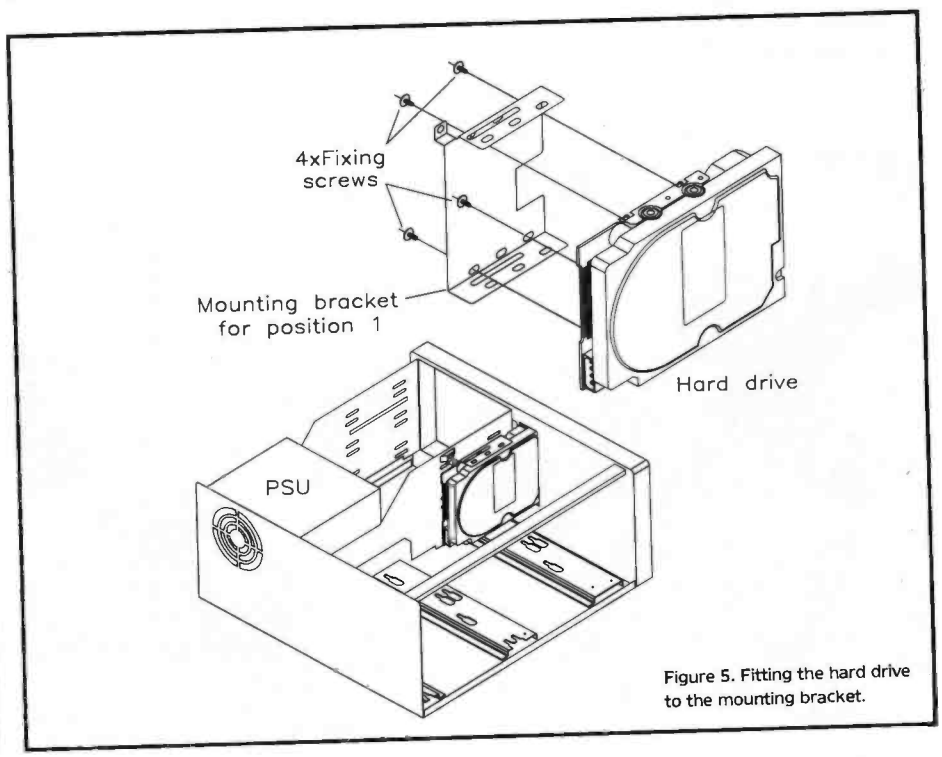


Figure 5. Fitting the hard drive to the mounting bracket.

disk drive is behind the front panel of the case at the side of the mounting for the other drives. If this position is chosen it is best to remove the cross supporting bar in order to obtain a clearer working area (if the case has one fitted).

On the main body of the hard disk drive are a number of fixing holes, not all of these will be required, but at least four should align with the holes on the mounting bracket. Orientate the disk drive so that the connectors are at the rear. Using the mounting screws from the hard drive mounting kit, locate the disk drive and screw in position on the mounting bracket as shown in Figure 5. Tighten up, but not too tight or you will strip the thread.

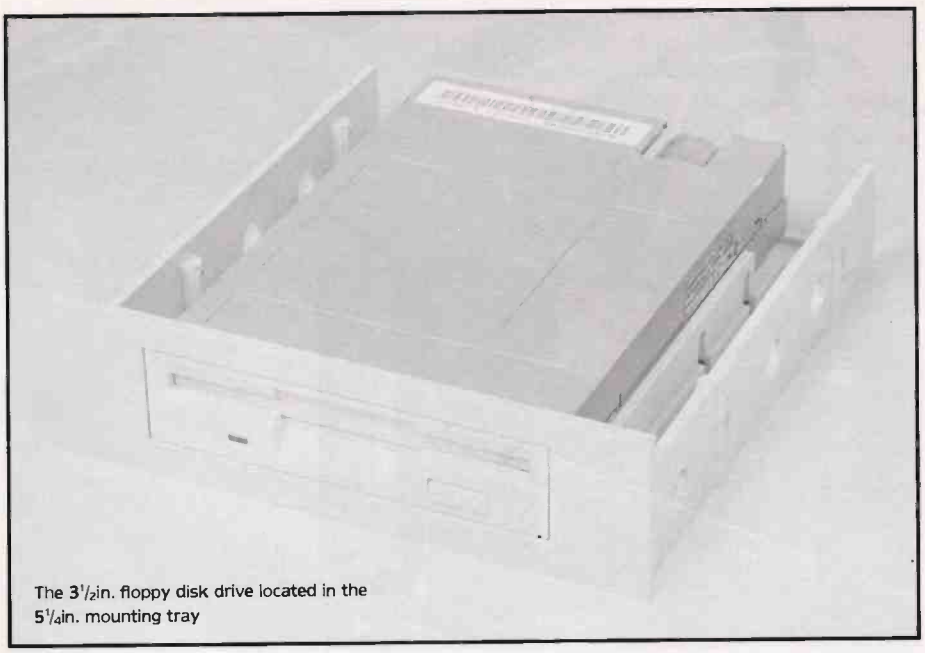
Fitting the 3½in. Floppy Disk Drive

Unpack the 3½in. floppy disk drive from its packaging, being very careful as with the hard disk drive.

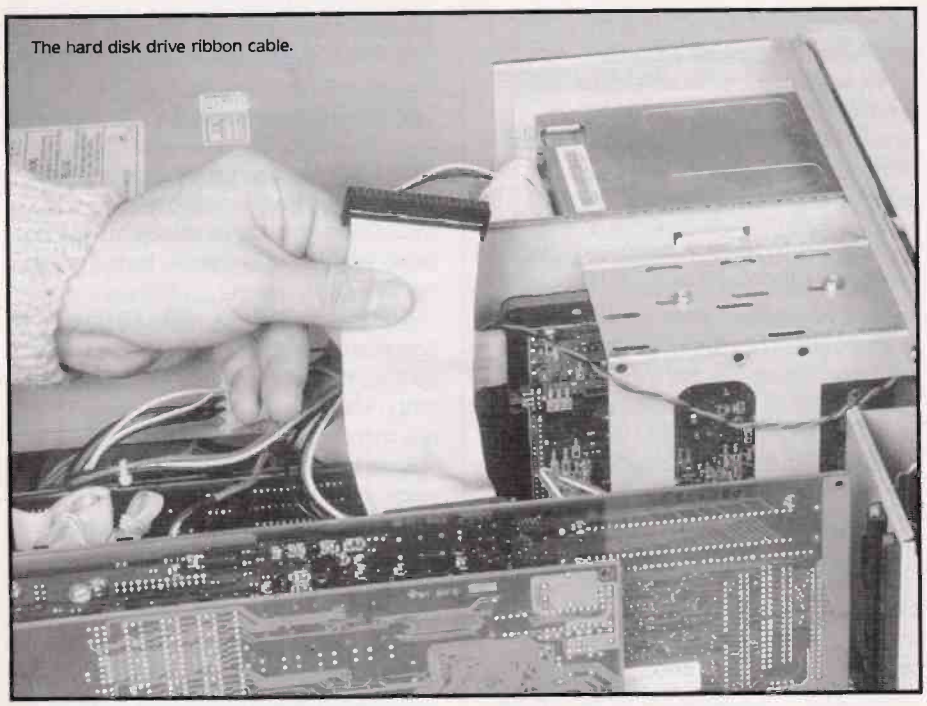
The main horizontal floppy disk drive bays on the computer are for 5¼in. drives. In order to mount a 3½in. floppy disk drive in position, a 5¼in. floppy disk drive mounting kit will be required if you are not using a 3½in. bay. The number and size of drive bays may vary from case to case.

If the front panel blanking plate was not removed previously then use a finger to push the middle of the blanking plate forward from the inside of the case until it bends far enough so that the lugs disengage from the case and the plate pops out. This procedure will have to be repeated to the other bays when further accessories such as other disk drives, CD-ROMs or Tape Streamers are added to the computer at a later date.

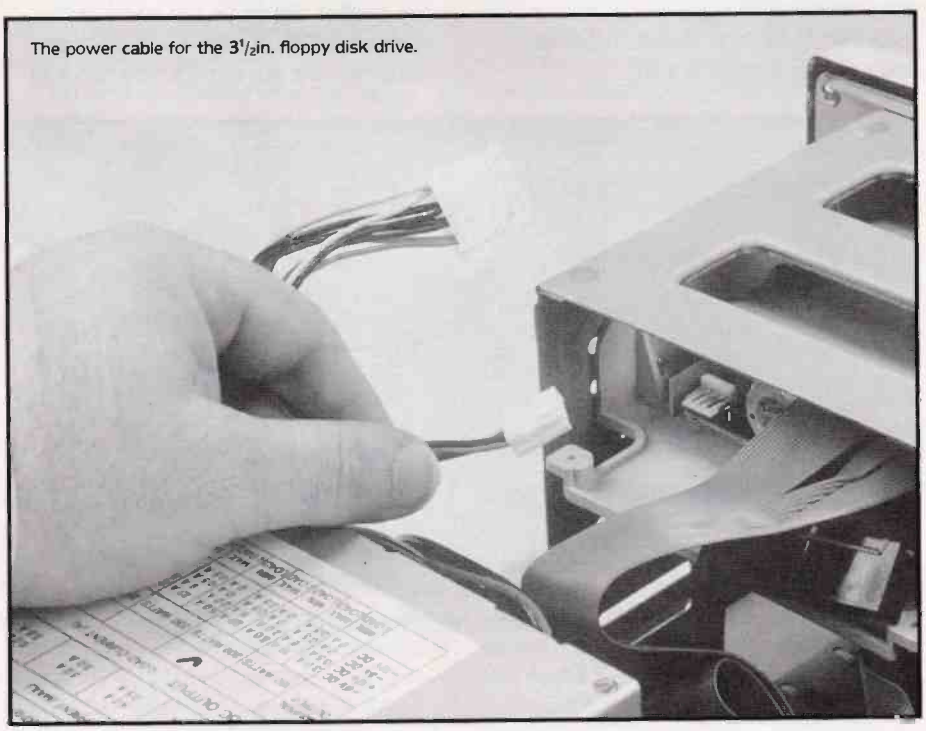
If you are fitting the 3½in. floppy disk drive into a 5¼in. drive bay, you will need to mount the 3½in. floppy disk drive into the mounting frame/adaptor first, before mounting it in the computer case (follow the instructions on the box). Slide the 3½in. floppy disk drive into the mounting frame. Screw it into position with the screws provided in the mounting kit. Next slide the whole disk drive plus mounting frame into the hole, where the front panel was removed



The 3½in. floppy disk drive located in the 5¼in. mounting tray



The hard disk drive ribbon cable.



The power cable for the 3½in. floppy disk drive.

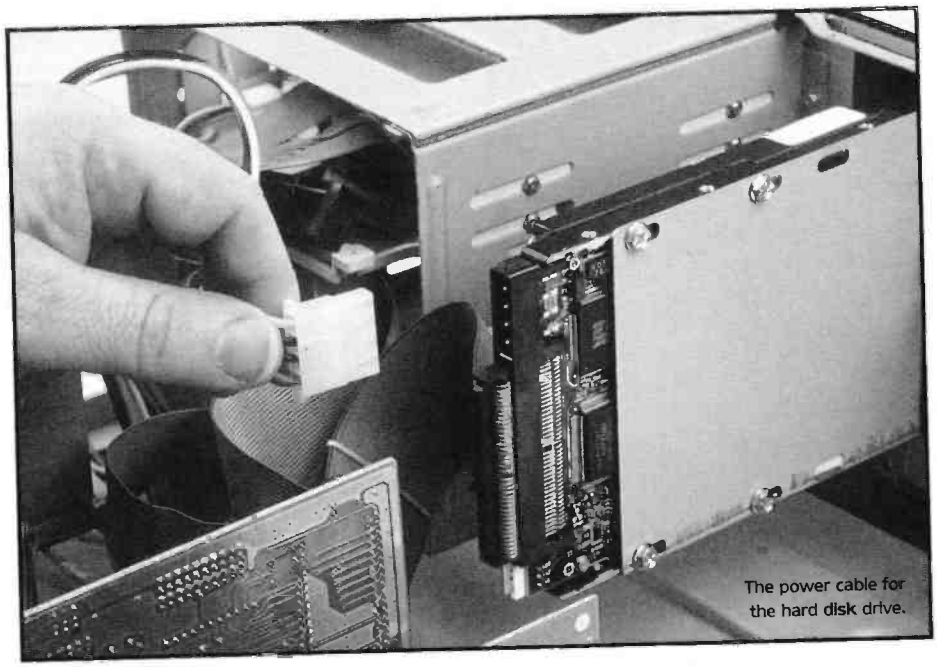
from the front of the case. Make sure that the mounting frame and disk drive are in position, and with the remaining small screws fix the mounting frame to the mounting bracket inside the computer case.

Now that the two disk drives have been installed, their cables can be attached.

Connecting up the Disk Drives

Supplied with the IDE controller card are two or more ribbon cables. One type is for connecting to the hard disk drive, and the other to the floppy disk drive.

Identifying these cables is fairly straightforward. The hard disk drive cable is slightly wider and has two or three identical connectors. The floppy disk drive cable has a 34-way connector at one end and two pairs of connectors at the other, separated by a twist in the cable. There are connectors for 5¼in. disk drives as well as 3½in. Both ribbon cables have a thin red line down one side, this indicates pin 1 (this red stripe is always located next to the PIN 1 mark. Ensure that all pins are fitted correctly)



The power cable for the hard disk drive.

and that there are none left out at one end or the other by offsetting the connector.

First select the hard disk drive ribbon cable. Plug the end of the cable with the single connector into the matching connectors on the interface card (check your own IDE controller leaflet for the location of this connector). Be especially careful to make sure that pin 1 on the cable (indicated by the red stripe) is located at pin 1 on the card, as in some cases polarizing keyways are not fitted on the connectors. Next locate the other end into the socket on the hard drive, again making sure that the red stripe indicating pin 1 on the ribbon cable is located at the pin 1 end of the connector (this is often the end nearest the power connector, but look carefully). The spare connector near this end of the lead (if fitted) is for connecting a second IDE hard drive, or an IDE CD-ROM drive.

Now select the floppy disk drive ribbon cable and fit the end with the single 34-way connector onto the matching set of pins on the interface card, again making sure that the red stripe is located at pin 1. Next, using the connector at the far end beyond the twist in the cable, connect the cable to the socket at the end of the floppy disk drive (disk drive A), making sure that pin 1 is correct as before. The spare connectors on the cable on the controller side of the twist are for an optional disk drive B.

Next identify the power cables from the power supply to the disk drives. These have both large and small four way connectors attached, which are polarized. The 3½in. disk drive requires the smaller of the connectors. The hard disk drive usually takes the larger power connector, as do 5¼in. floppy drives.

Remember to refit the case cross supporting bar (if supplied) after the cables have been tucked away.

Final Fitting Out

The colour coded leads from the front panel to the motherboard may vary. Basically all the cases will have the same switches and LEDs, which are often labelled quite well. To find out which lead goes where to the front panel, follow the leads back to the switches and LEDs.

The motherboard will have marked out the corresponding sockets to the plugs. Refer to the motherboard details for pin identification on the motherboard connectors but don't be too worried about the consequences of wrong connection of these leads. Generally, wrong connections will cause the (polarized) LEDs not to light and switches to work the wrong way around although it may be possible to short the power supply using the speaker leads if you are really unlucky!

Note that generally the 'HDD' LED should be connected to the pair of pins on the IDE controller card, unless there is no separate driver card in which case connect to the appropriate pins on the motherboard.

Some cases include a very small loudspeaker which needs to be located onto a plastic mount, screwed in position inside the case and held by one screw and a plastic lug. It is a bit fiddly to do, but not impossible. Many cases have the speaker already fitted.

There are sometimes plastic locators which need to be put inside the front panel near the loudspeaker. This is in case full size cards are fitted. When in position and a full size card is used, the edge can then be guided down and held in position by these locators.

The main part of the computer having been constructed, you are now ready for the next stage. Check out the system before putting the lid back onto the case, and doubly check the wiring to make sure that the cables are neatly routed around the case. It is wise to secure the case with only one or two easily removable screws at this point, as it is unlikely that you have got every connection right the first time!

Connecting Up

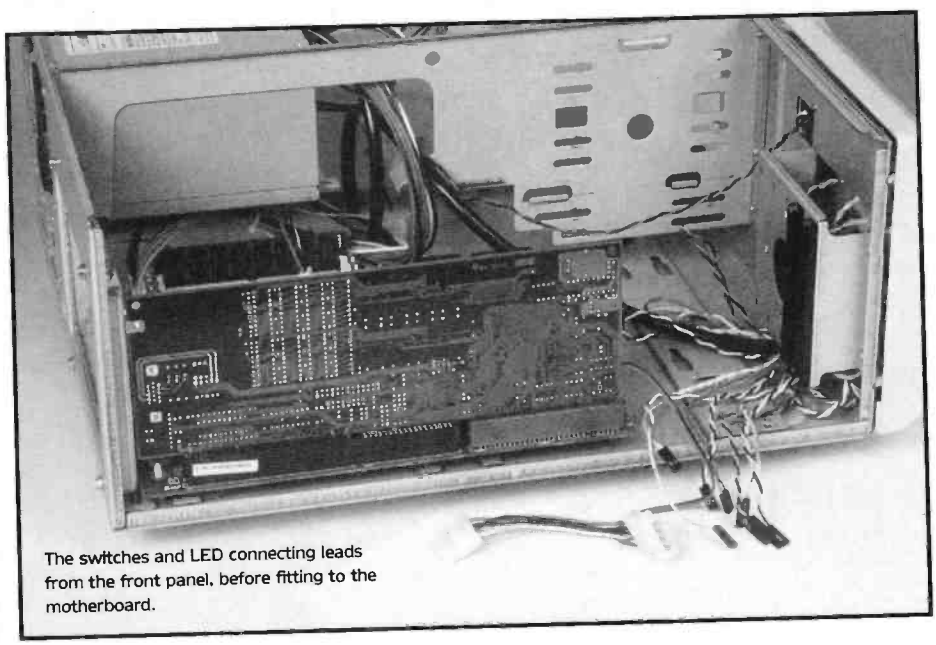
Clear the table and locate the computer in a convenient position. Unpack the keyboard from its box and check that there is no damage to the keys. Locate the socket at the rear of the computer, and plug the 5-pin DIN plug from the keyboard into it. At this stage look at the keys on the keyboard and locate the 'Del' (Delete) key. This is situated at the bottom right of the numeric keypad next to the 'Enter' key. Remember to press this key down if prompted when switching on the computer for the first time.

Next unpack the monitor from its box, and again check to make sure that there is no damage.

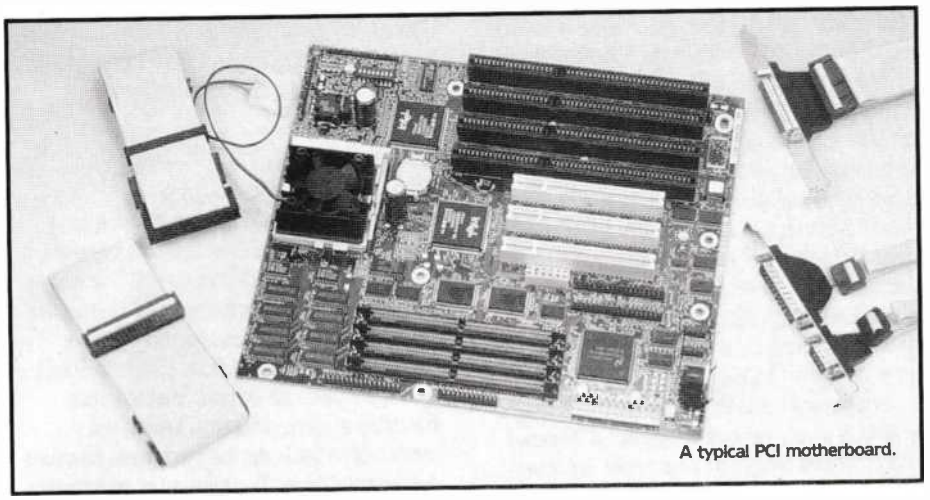
The position of the monitor can either be on top of the computer case (except tower cases), or on the table-top. Depending on the monitor, the video lead will either be attached to the monitor, or a separate lead will be provided. Plug the video lead from the monitor to the SVGA card, the 15-pin D-type connector on the end of the lead should only locate one way, but be careful not to force it on the wrong way. When in position tighten up the screws on the plugs.

The power lead for the monitor has a plug on one end and a socket on the other. This is so that the mains power for the monitor can be obtained from the computer, thus saving on a mains lead to the mains socket. Plug this cable in the back of the monitor and then into the back of the computer, the connector is located next to the fan. Double-check that the small Mains Voltage selector switch (if fitted) is set to the 220V or 240V position, NOT the 110V or 120V position.

With the switch in the 'Off' position at the mains socket, and the ON-OFF switch on the computer to 'Off', plug the mains lead (after fitting the mains plug onto the cable with a 3A



The switches and LED connecting leads from the front panel, before fitting to the motherboard.



A typical PCI motherboard.

fuse if not prewired) into the mains socket at the rear of the monitor, and the mains plug at the other end into the mains socket.

The Disk Operating System (DOS)

The next part of the operation is to power up the computer system and install the Disk Operating System (DOS).

Unpack the MS-DOS package or preferred operating system, there should be a manual included, with at least three disks (or CD-ROM if this option has been chosen) and software licensing notices.

Powering Up

Insert the disk labelled 'Disk 1' into the floppy disk drive. The disk will only operate one way, so make sure it is inserted with the arrow moulded into the disk sleeve pointing into the drive slot at the top left of the disk.

The monitor ON-OFF switch may not be obvious as to whether it is On or Off. Operate the rocker switch (many monitors have a 'I' symbol to indicate the on position) and be prepared to switch this again should the monitor not show signs of life when the computer is switched on (check the LED on the monitor).

Now switch on the AC mains at the mains socket, and push the 'ON-OFF' switch on the front panel of the computer to ON. All being well the computer will now start up and proceed along its preprogrammed path.

At the same time that the computer starts up, check to see that the monitor is showing life, there is an LED at the front and this should illuminate immediately, even if the screen has not warmed up. The computer will make a ticking noise whilst checking the RAM and once completed will announce this by giving a loud beep.

The procedures having been followed correctly and no faults detected on the computer system, you will be prompted to press the F1 key. Do so, and the screen should now show what is known as the 'CMOS' setup screen. Congratulations!

If, however, there is no display on the screen, or the speaker is still beeping, switch off immediately, and disconnect the computer from the mains and thoroughly check all the work carried out, up to this point. The number of times that the speaker beeps does indicate the nature of the fault detected. A sequence of three repeated beeps indicates a RAM fault and points towards a SIMM problem. Also check any links fitted on the motherboard to ensure that they are set correctly for your system.

This is a good time to check the operation of the various switches and LEDs on the front panel. One simple mistake that can have worrying symptoms (screen remains blank after flickering on power-up) is misconnection of the RESET switch lead, which is often fitted with a three-pin plug to be connected to two pins on the motherboard. If the wrong pair are used, the computer is held in the reset state all of the time so nothing works. If this happens, simply change the connections to use the other combination of pins, i.e. the same inner pin, but the opposite outer pin.

Any LEDs that do not work (press the 'Turbo' in to check this LED but HDD (Hard Drive activity LED) cannot be checked yet) should have their connector reversed after checking that they are in the right places.

The CMOS Setup

Welcome to this part of the operation. If you have an older AMI BIOS type CMOS setup, you should be looking at a green, purple and brown coloured screen, or if the latest type of CMOS setup this will be a blue icon driven menu. Congratulations you have reached the CMOS menu which will help you to configure your motherboard for your type and number of disk drives as well as providing a way of fine tuning a large number of electronic settings on the board.

The reason behind CMOS, is that originally PC/XT computers had what are called dip switches on the motherboard and a combination of these then indicated to the computer how the hardware was set up, which was not very flexible. The next stage on PC/AT computers was to have the computer store the configuration in CMOS (battery backed memory), but the CMOS setup was only accessable through a special CMOS setup disk, which was very easy to lose. The modern method of accessing the CMOS setup is via the keyboard at bootup.

The CMOS setup is a very powerful tool and normally one would not spend too much time there once the computer is set up, although the CMOS will have to be informed of any major changes to the system later on.

As there are a number of different CMOS setups available we cannot be too specific about them but there will be some common factors. Refer to the CMOS setup in your motherboard's handbook for further information, or help screens that may be available on the system.

The CMOS setup is a menu driven system with the screen showing a number of options, such as Standard, Advanced, Chipset and Management. It is advisable to look into the various areas in your CMOS setup to familiarise yourself with the settings before attempting to change them.

Note: Under NO circumstances should you select the hard disk utility from the CMOS menu as this contains a low level hard disk format program which may cause irreparable damage to your hard disk drive. This process will have already been carried out before the hard disk drive was shipped out, and is not required.

Standard setup contains menus for changing the Date/Time, settings for floppy drives A: and B: and settings for the hard drives. In some cases these will require changing from the default settings.

Advanced setup is for changing the typematic rate, display type, extended memory test, and extended BIOS.

Select 'System Bootup Sequence' and change this to read A:, C:

Chipset setup is used to alter the AT bus selection, cache read/write and other facilities connected with RAM.

Some CMOS will have a Power Management setup which when activated will shut power down after a pretermined time to the hard drive and video monitor via their controller interfaces.

Note: On modern CMOS setups there is the ability to check for Boot Sector Viruses, and this facility should be turned off until after completing the installation.

Once you have completed these steps, select 'Write to CMOS and EXIT' or equivalent – it will ask you to confirm, press 'Y' and press the 'Enter' key. Just before doing so make sure you place the MS-DOS install disk in drive A:

The system should now restart itself and bootup from the DOS disk. Once this has been loaded it will run the setup program, follow the instructions to install the MS-DOS (6.2) Operating System. Read the MS-DOS book, to understand the operation on formatting the hard drive.

If the MS-DOS setup screen does not appear, it may be that there is a connection problem between the disk drives and IDE card. Double-check the polarity and position of the floppy drive cables and if they seem correct, verify the link positions on the IDE card.

The setup will lead you through the various steps involved in formatting the hard disk drive. The operating system will then be installed onto the hard disk drive, and the Disk Operating System files will be copied into the newly prepared DOS directory.

Once the Operating System and DOS files have been loaded into the computer, it will now be ready for use. Just to check that all is well, take the current disk out of the A: drive and switch off the computer. Wait a short while, and then switch on the computer. If all goes well, then the computer will start up and go through its routines, and within a short while the C:> prompt should appear on the screen. If for any reason this should not do so, then reboot the computer and enter CMOS and check that all the changes made before are still valid.

There are many refinements that are possible within the CMOS setup, and as the user gains experience in using the computer these will become apparent.

Now check that the 'HDD' LED lights for hard drive access, if it does not light reverse its connections to the IDE card. Then, all being well, you may refit the case lid if removed and fit all fixing screws.

Adding to the System

One of the first items to be added to the basic system will be either a mouse or trackball. Many programs, especially those running under Windows, expect the user to have some form of pointing device to select actions or press buttons on the screen.

There are many styles and colours of two and three button mice available. Most of them are supplied with device driver programs on floppy disk which allow the mouse handling routines to slot into the operating system at bootup. These programs, which most commonly emulate the standard Microsoft mouse driver, work well in most applications with mouse support, but you may find the odd program which hangs up or behaves oddly unless the genuine Microsoft mouse driver is used. The Microsoft drivers are supplied with some Microsoft products, other mouse drivers are to be found on some shareware CD-ROMs or on bulletin board services.

Most mice are now supplied with a 9-pin D-type plug, but there may be a 9-pin to 25-pin D-type converter included, available from Maplin if not included. The mouse can be plugged into either COM 1 or COM 2, and when booted the system should recognise that there is a mouse attached. Note that mice having a switch for selection of two or three button modes should be set to two button mode prior to bootup if you are using the most common Microsoft compatible driver. A few programs use a three button Mouse Systems mouse driver, which may also be included on the driver disk supplied with the mouse. Lastly for this section, note that all of the above also applies to installation of a trackball as it behaves identically to a mouse as far as the computer is concerned.

Adding further SIMMs

Further SIMMs can be fitted to increase the RAM memory capacity of your computer. The type and number of SIMMs to use will depend on the motherboard and the size (and price) of expansion required. Check the motherboard booklet to see what combinations of SIMMs can be used.

The price of SIMM modules may vary considerably throughout the year. It is possible to upgrade using 4MB, 8MB or 16MB SIMMs but the cost may be a limiting factor. One point to be aware of is that SIMMs with parity are normally used, but now there is a move towards SIMMs without parity, check your motherboard handbook, the CMOS may allow either type to be used simply by switching parity either on or off in the CMOS setup.

As a general guide to memory, a total capacity of 4MB is a very basic starting point if Windows and programs designed to run under Windows are not to be used. Some games may also refuse to run under a 4MB configuration. 8MB is a much more realistic starting point, allowing most Windows based programs to run at a reasonable speed and giving enough space for all but the most memory hungry games programs. 16MB will give a noticeable speed increase to Windows work and run just about anything with no problems.

The SIMMs ICs are available at different speeds and the normal speed at present is 70ns, although 60ns SIMMS may be required for faster motherboards (check your manual). Previously the speeds ranged from 120ns to 80ns but you may find that any older SIMMs you have to hand may not work in faster motherboards. However, it is worth trying them as they may be fine, and no harm will result to the motherboard if they do not work.

It must be remembered that when fitting 30-pin SIMM boards to older type motherboards that the banks must be filled by the same type, one should not mix 1MB with 4MB SIMMs in the same bank, and if slower SIMMs are used then this will slow the system up even if other faster SIMMs are fitted in another bank.

On the newer motherboards that accept 72-pin SIMMs, there is not this complication and a mixture can be used. Different motherboards allow different combinations, and dictate the exact location on the sockets.

The CMOS will have to be informed at some point as to the amount of memory available. There is no menu selection to do this, simply running the CMOS menu screen, hitting 'delete' during power up automatically sets this.

Coprocessors

The 486DX and Pentium™ range of microprocessors have an on-board maths coprocessor fitted as standard, but there are many microprocessors that do not. There are a range of maths coprocessors available that are matched to each of these microprocessors. The clock speeds range from 25MHz to 50MHz. These will deal with complex mathematical functions in some programs, leaving the processor to deal with the more basic functions it is best suited to. The increase in performance to the 386DX or 486SX with a coprocessor such in applications such as spreadsheets and computer aided design (CAD) is extremely good. Unless using a microprocessor with an on-board coprocessor, the CMOS will have to be informed that there is a coprocessor fitted by enabling the test for it in the Advanced CMOS setup submenu. Note that many motherboards will also require a link change to use a coprocessor.

Floppy Disk Drives

Although not essential, another floppy disk drive such as the 5¼in. high density (HD) is available. It can also handle 360KB floppy disks, which are still used for some programs or for older software. Fitting the 5¼in. disk drive is very similar to fitting the 3½in. Open the case up and take out another front panel, slide the drive into position and screw into place. Locate a spare 'large' power lead and, making sure of the polarized connector, fit into the power socket on the back of the disk drive. The cable from the controller card that goes to the A: disk drive has another form of connector on it for 5¼in. Disk drives, and this should be fitted in the socket provided on the rear of the disk drive. Again be certain that the red line on the ribbon cable which represents pin 1 is located at pin 1 on the socket. The reason for the twist in the cable is in order that the disk drives can invariably be fitted without changing the selector links on the disk drive. This system is regarded as the IBM method. Bear in mind that you may only have one drive each side of the twist in the cable, i.e. one A drive and one B drive.

If the B drive is to be used, the CMOS will have to be informed that the drive has been fitted and what size and capacity it is, by using the standard CMOS setup, as described earlier.

Another form of disk drive is the dual floppy disk drive. This is contained in a standard half height unit. It is able to read both 5¼in. and 3½in. disks. It is particularly handy if there are no free bays available and space is at a premium.

Sound Cards

There are now a confusing number of different sound cards on the market, but all of them are produced to allow owners to upgrade their machines to improve on the harsh beeping sounds which are all that the standard PC can produce. There have been a number of sound card standards over the years, but the following points should make your choice a little more clear.

The Ad-lib card was one of the first to gain

A range of computer accessories.

A selection of Windows '95 products.

general acceptance in the games world and is still compatible with much modern software, though by no means all. It allows musical backing to be played by some software which sounds far better than PC speaker beeps and has a small built-in amplifier to drive a set of small external speakers. Note that clones of this card, which are very cheap, do not have a capacity for digital sound effects or for sampling (no mike or line inputs) so do not work fully with many games programs.

The Sound Blaster 16 or its derivative is now the standard games or basic multimedia sound system. It provides a set of FM sound generators very similar to the Ad-lib compatible cards for music playing, as well as an 16-bit analogue to digital converter for sampling sound and the matching digital to analogue converter for playing sound effects as used by most modern software. It also has an amplifier for external speakers, a combined joystick port and MIDI connector (an external music synthesizer with a MIDI interface may be controlled or read from via this port and a special interface cable) and is often bundled with some software and speakers. This card drives two speakers in either mono or stereo. Newer versions of the Sound Blaster card are now available with converters for CD quality sampled sound and effects, stereo amplifiers and built-in CD-ROM interfaces for some of the more popular CD drives.

The Sound Blaster AWE 32 is a typical example of the latest generation of Sound Cards. It features 32 channels of very high quality sampled musical instruments as well as all the features of the more expensive of the earlier cards. For the musician, this card produces sound comparable with a professional synthesizer and is fully compatible with MIDI sequencer programs.

It should be remembered that there are alternatives to each of the cards mentioned from other manufacturers, which are all to a large degree Sound Blaster compatible, but it is true that 'clone' cards may occasionally cause a few problems with some games not quite accepting them as 100% compatible.

At the time of writing, it is not clear who is the winner in the wave table synthesis generation of cards, either from the point of view of sound quality (which is important at this end of the market) or general acceptance. Some demonstration CDs are available (in audio CD CD-ROM format so that they may be listened to on a hi-fi) and it may well be worth listening to these and asking about 100% hardware Sound Blaster compatibility if you would like a top quality card.

Installation of these cards is a simple matter of lifting the lid of your case, checking a few link settings, pushing the card into a spare slot (the leftmost slot is a good one as the volume control on the back plate of the card may be most easily reached) and installing the software on your hard drive (usually by typing 'Install' on DOS based operating systems and answering a few prompts about your system).

When installing any additional software on Windows '95, there is a special section which needs to be used. This is especially the case with Sound Blaster setups and the program has to run in DOS. Windows '95 takes this in its stride.

CD-ROMs

Apart from a sound card, A CD-ROM drive must be one of the most popular and worthwhile additions that you can make to enhance a basic PC. It will allow you access to a huge number of magazine and shareware CD-ROMs each containing hundreds of megabytes of demo or public domain programs, shareware (try before you buy software), pictures, sounds, video articles and interviews that play live and interactively on your PC and much more! It will also enable you to run computer based encyclopedias for education or reference as well as the many movie or cartoon like games with full audio soundtracks which are now available.

The main difference between CD-ROM drives is in the speed of data transfer. The original drives were called single speed (approximately 150KB/second), which is really too slow for much modern software. Double (2x) speed drives (approximately 300KB/second) are still available. However, nothing stands still in computing and quadruple (4x) speed drives should now be considered the entry level and 6x even 8x speed drives are now available, albeit at higher prices than the slower drives.

The installation process is very similar to that for an ordinary disk drive, fitting into a 5¼in. drive bay, in some cases a special interface card will be required unless you have a sound card with the required interface built in (check this before buying, as there are several different interfaces). There is now a move towards IDE interfaced CD-ROMs, and this means that they can now share the hard drive IDE controller, and use the second connector on the IDE cable.

Multimedia

This is a very trendy term for the use of computers (with the inclusion of CD-ROMS and sound cards as described above) to enable use of moving graphics and sound in interactive business or leisure presentations. Many magazines now exist which include a CD-ROM with a mixture of audio effects, video both 'filmed' and computer generated graphics, music, text and speech all controlled by a mouse driven 'point and click' selection system which makes it simple for anyone to browse a selection of articles and features as easily as leafing through a printed magazine. This type of system which, once running, requires no specialist computer knowledge to operate will revolutionise the way we learn from reference books and manuals over the coming years. Not only does it make the learning process more exciting for children and adults alike but it also brings many references to life.

For example, point and click on a box with a picture of the rain forests of the Amazon and you can hear the jungle sounds while your monitor displays your selection of moving images showing the wildlife or native tribes, each of which selections may give the further choice of reference text or images. Whether for this type of browsing or for a fully interactive repair manual with detailed diagrams and videos of dismantling, repairing and reassembling the parts prompted in response to your selection of fault symptoms, the future possibilities of this type of system are endless.

MPEG

Motion Picture Expert Group (MPEG) developed by the International Standard Organisation (ISO) and the International Electrotechnical Commission (IEC) as a universal standard suitable for all types of computer.

It allows you, with additional hardware, to play full screen full motion video with stereo sound on a standard PC. Playing MPEG movies under Windows Media Control (MCI) also requires the installation of a software driver.

AVI, MOV and Quick Time for Windows

Movie clips can be viewed through Windows using software drivers either supplied with Windows or provided separately. Most computer users in the absence of a MPEG hardware solution will use at least one or more of these software options.

Printers, Modems, Scanners

There are quite a number of other peripherals that you can add to your system to communicate better with the outside world.

Detailed discussion of the types available and their various merits would be beyond the scope of this introduction to building your own computer. We would recommend that you use the basic system for a while until you are quite familiar with basic DOS (and Windows) use and have come to grips with the Autoexec.bat and Config.sys bootup control files. It is a fact that the PC's control of large amounts of memory is rather odd, and quite a bit of fiddling with memory settings may be necessary in order to optimise your systems memory usage for each new program you buy. While you are learning about your machine, do look at the many PC magazines available at all good newsagents. Many of them include cover disks with software you can try, and all contain a wealth of information on the configuration and setup of PC systems, as well as detailed reviews of upgrade cards of all types.

There are many different printers available in Laser or Inkjet varieties, only a study of the magazine reviews and prices will guide you towards a decision on the right one for your intended use.

Modems allow your PC to communicate with local bulletin board services to upload and download messages and software, as well as the possibility of subscribing to worldwide specialist services like CompuServe and the Internet.

Scanners may be used to input printed pictures or text into your computer, although some practice may be necessary before reasonable results are achieved when using a hand scanner, but the price of flat-bed scanners are now extremely competitive and well worth considering.

Tape Backup

With large amounts of data being held on the hard drive it is wise to back this data up. One method of back up is to use a tape streamer, although there are other methods appearing on the market. Over the years there have been a number of capacities for tape streamers and with compression double the amount of data can be stored.

Tape streamers can be mounted either externally or internally. There are a number connection methods, such as to a floppy disk controller interface (QIC-80 – Quarter Inch Cartridge), to SCSI, and through the parallel port.

The advantage of running a external tape streamer through the parallel port is that the tape streamer can be used on different computers very quickly, such as a backup situation in an office, the disadvantage is that the transferrence rate is slower than through SCSI.

The backup facility in Windows '95 is compatible with a number of tape streamers such as JUMBO and IOMEGA with the backup program controlling the process. Some types of tape streamers are not compatible and software provided with the tape streamer will have to be used instead.

Networking

An exciting development ideal for the home user or a small business with more than one PC is the ability to network computers without recourse to buying expensive 3rd party networking systems.

With the arrival of Microsoft Windows '95, the networking feature was expanded, with the facility of each computer once set up, to automatically log each computer as it comes on line. Also the ability to share printers not only through Windows '95 but on DOS as well, again a tremendous bonus.

The networking ability of Windows for Workgroups 3.11 and Windows '95 are mutually compatible. This means that a slower 386DX or 486SX computer using Windows for Workgroups 3.11 can still be networked to a 486DX4-100 or Pentium™ based computer using Windows '95. The Microsoft Network is compatible with Novel Netware, as found in many businesses, and both systems can run together using the same network components. Any individual or small company that runs a number of 386 and above AT type computers should really look towards this Microsoft solution to networking, especially as it is there free on the operating system.

Viruses

Unfortunately not all is sweetness and light itself in the computer world. Although not a major problem, there are now hundreds of potential viruses ready to invade your machine, and it only takes one to get into your system and wreck havoc before you realise it. To combat this, be aware that after setting up your computer with the official software, it is likely to be virus free and only additions to the software are potential sources of virus. There are now a number of antivirus type programs which can be bought as a package or downloaded from bulletin boards or through shareware disks in magazines. It must be remembered though that all shareware, bulletin board and copied software from friends and colleagues are potential carriers of viruses.

Good strategies to adopt, are to write protect all your original disks. Make back up copies if the software licence allows you to do so, and likewise write protect. Run an antivirus program in the background at all times. Check new disks for viruses, do not run newly obtained copied software without first checking it. Regularly update your preferred antivirus software and regularly backup your hard disk.

Having said this most computer users will not probably encounter a virus, but if they do, the type of virus, will determine what damage will be caused. Most antivirus software packages also include a 'cleanup' type program, but as the medical profession say, "prevention is better than cure."

Final Words

Hopefully by now you will be less worried about working on computers. With the hardware and software sorted out great pleasure can be obtained by using some of the thousands of computer programs available. There are many books available on the subject, and in most cases these books explain in better terms the programs than the original manuals supplied. A series of books that are useful especially for beginners are the Dummies books, these cover about everything for the PC.

The computer can be used in various applications, such as word processing, desktop publishing, graphics, computer-aided design, home and business accounts, and record keeping. It can also be used to supplement hobbies, and can be linked to other computers either directly with a network card through Local Area Networks (LANs) or over the telephone lines via modems, to download information from Internet and bulletin boards, or place orders such as to Maplin using the CASHTEL system, the opportunities to use the computer are endless.

The 'building block' concept of IBM compatible PCs means that there are endless possibilities for expansion of any system you put together now, as long as you give a little thought to providing for that expansion. For example, if you started with a VESA motherboard it will be easy to fit faster SVGA cards with more memory, or cached IDE controllers in the future, even if you only have ISA type cards fitted initially.

A Working Setup

You will find over the coming months that you execute some commands time and time again.

If you are using MS-DOS it is a good idea to store such sequences or long lines of DOS commands as batch files (give them the extender .BAT) which may be called by typing their filename as a new command. See your MSDOS handbook for more details on batch files and other commands, also the help files on the hard drive.

The PATH statement in your Autoexec.bat file contains all of the subdirectory names which DOS will use to search for executable files (programs or batch files). It starts off with \DOS; as the only one, but you may well find it convenient to keep a number of general utility programs together in one subdirectory such as \ODDBITS; which may contain a text reader for ASCII text files, a multistandard graphics viewer for display of GIF or PCX pictures (you will find that there are many different ways a picture may be stored), etc., sound drivers and accessories for playback of VOC or WAV files, music players for MOD, ROL or CMS files, MIDI players for MID or MTS files, Video players for MPEG or other compressed video files and so on almost without limit. None of these accessories are essential but they do make life a lot easier when exploring new software, especially on CD-ROMs.

Lastly, you will also find that much software is supplied in a compressed format, especially if you use a modem to download programs from a bulletin board service. You may wish to set up a further subdirectory and add it to your path statement containing compressor and decompressor programs for the most common file formats such as ZIP and ARC files. In particular, the PKZIP and PKUNZIP programs supplied by PKware are very useful and very widely used to compress software for distribution.

That is about all you need to know at the moment. Whether you have used this guide to build your first computer, or to look into what is involved, we hope that you now have a good outline of what you need and why you need it. Do remember that we will continue to support you in your computing needs after you purchase your computer system parts from Maplin for as long as you need to become confident and happy with a system which works exactly as you want it to. Good luck and goodbye for now!