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Desktop

Laptop

Practical Session

Chapter – 1
Introduction to Computer Hardware

Objective of learning:

- Introduction to computer
- Application of computer, Advantage and disadvantage of computer
- Different types of computers
- Identifying the different components of computers
- How to install the different components of computers

Introduction to computers

Are you new to computers? Do you wonder what they do and why you would want to use one? Welcome—you're in the right place. This book will guide on different computers: what they are, the different types, and what you can do with them.

What are computers?

Computers are machines that perform tasks or calculations according to a set of instructions, or *programs*. The first fully electronic computers, introduced in the 1940s, were huge machines that required teams of people to operate. Compared to those early machines, today's computers are amazing. Not only are they thousands of times faster, they can fit on your desk, in your lap, or even in your pocket.

Computers work through an interaction of hardware and software. *Hardware* refers to the parts of a computer that you can see and touch, including the case and everything inside it. The most important piece of hardware is a tiny rectangular chip inside your computer called the *central processing unit (CPU)*, or *microprocessor*. It's the "brain" of your computer—the part that translates instructions and performs calculations. Hardware items such as your monitor, keyboard, mouse, printer, and other items are often called *hardware devices*, or *devices*.

Software refers to the instructions, or programs, that tell the hardware what to do. A word processing program that you can use to write letters on your computer is a type of software. The operating system (OS) is software that manages your computer and the devices connected to it. Two well-known operating systems are Windows and Macintosh operating system. Your computer uses the Windows operating system.

ENIAC

Introduced in 1946, ENIAC (Electronic Numerical Integrator and Computer) was the first general-purpose electronic computer. It was built for the United States military to calculate the paths of artillery shells. Physically, ENIAC was enormous, weighing more than 27,000 kilograms (60,000 pounds) and filling a large room. To process data, ENIAC used about 18,000 vacuum tubes, each the size of a small light bulb. The tubes burned out easily and had to be constantly replaced.

Types of computers

Computers range in size and capability. At one end of the scale are *supercomputers*, very large computers with thousands of linked microprocessors that perform extremely complex calculations. At the other end are tiny computers embedded in cars, TVs, stereo systems,

calculators, and appliances. These computers are built to perform a limited numer of tasks.
The *personal computer*, or *PC*, is designed to be used by one person at a time. This section describes the various kinds of personal computers: desktops, laptops, handheld computers, and Tablet PCs.

Desktop computers

Desktop computers are designed for use at a desk or table. They are typically larger and more powerful than other types of personal computers. Desktop computers are made up of separate components. The main component, called the *system unit*, is usually a rectangular

Desktop computer

case that sits on or underneath a desk. Other components, such as the monitor, mouse, and keyboard, connect to the system unit.

Laptop computers

Laptop computers are lightweight mobile PCs with a thin screen. They are often called notebook computers because of their small size. Laptops can operate on batteries, so you can take them anywhere. Unlike desktops, laptops combine the CPU, screen, and keyboard in a single case. The screen folds down onto the keyboard when not in use.

Laptop computer

Handheld computers

Handheld computers, also called *personal digital assistants (PDAs)*, are battry-powered computers small enough to carry almost anywhere. Although not as powerful as desktops or laptops, handhelds are useful for scheduling appointments, storing addresses and phone numbers, and playing games. Some have more advanced capabilities, such as making telephone calls or accessing the Internet. Instead of keyboards, handhelds have touch screens that you use with your finger or a *stylus* (a pen-shaped pointing tool).

Handheld computer

Tablet PCs

Tablet PCs are mobile PCs that combine features of laptops and handhelds. Like laptops, they're powerful and have a built-in screen. Like handhelds, they allow you to write notes or draw pictures on the screen, usually with a tablet pen instead of a stylus. They can also convert your handwriting into typed text. Some Tablet PCs are "convertibles" with a screen that swivels and unfolds to reveal a keyboard underneath.

Tablet PC

What can you do with computers?

In the workplace, many people use computers to keep records, analyze data, do research, and manage projects. At home, you can use computers to find information, store pictures and music, track finances, play games, and communicate with others— and those are just a few of the possibilities.
You can also use your computer to connect to the *Internet*, a network that links computers around the world. Internet access is available for a monthly fee in most urban areas, and increasingly, in less populated areas. With Internet access, you can communicate with people all over the world and find a vast amount of information. Here are some of the most popular things to do with computers:

The web

The *World Wide Web* (usually called *the Web*, or *web*) is a gigantic storehouse of information. The web is the most popular part of the Internet, partly because it displays most information in a visually appealing format. Headlines, text, and pictures can be combined on a single *webpage*—much like a page in a magazine—along with sounds and animation. A *website* is a collection of interconnected WebPages. The web contains millions of websites and billions of WebPages.

Surfing

Surfing the web means exploring it. You can find information on the web about almost any topic imaginable. For example, you can read news stories and movie reviews, check airline schedules, see street maps, get the weather forecast for your city, or research a health condition. Most companies, government agencies, museums, and libraries have websites with information about their products, services, or collections. Reference sources, such as dictionaries and encyclopedias, are also widely available.

The web is also a shopper's delight. You can browse and purchase products—books, music, toys, clothing, electronics, and much more—at the websites of major etailers. You can also buy and sell used items through websites that use auction-style bidding.

E-mail

E-mail (short for electronic mail) is a convenient way to communicate with others. When you send an e-mail message, it arrives almost instantly in the recipient's e-mail inbox. You can send e-mail to many people simultaneously, and you can save, print, and forward e-mail to others. You can send almost any type of file in an e-mail message, including documents, pictures, and music files. And with e-mail, you don't need a stamp.

Instant messaging

Instant messaging is like having a real-time conversation with another person or a group of people. When you type and send an instant message, the message is immediately visible to all participants. Unlike e-mail, all participants have to be online (connected to the Internet) and in front of their computers at the same time. Communicating by means of instant messaging is called *chatting*.

Pictures, music, and movies

If you have a digital camera, you can move your pictures from the camera to your computer. Then you can print them, create slide shows, or share them with others by e-mail or by posting them on a website. (To learn more about what you can do with photos, see Working with digital pictures.) You can also listen to music on your computer, either by importing (transferring to your computer) music from audio CDs or by purchasing songs from a music website. Or, tune in to one of the thousands of radio stations that broadcast over the Internet. If your computer comes with a DVD player, you can watch movies.

Gaming

Do you like to play games? Thousands of computer games in every conceivable category are available to entertain you. Get behind the wheel of a race car, battle frightening creatures in a dungeon, or control civilizations and empires! Many games allow you to compete with other players around the world through the Internet. Windows includes a variety of card games, puzzle games, and strategy games.

Full form of computer abbriviation:

C – Commonly
O – Operated
M – Machine which
P – Process
U – Under
T – Technical &
E – Educational
R – Reports

Definition of Computer:

In Layman's language **"A computer is a simple electronic machine that helps you to solve problems."**

In Technical manner **"A computer is a high speed electronic device which follows instruction & is capable of performing arithmetical and logical operation."**

Advantage of Computer:

1) **Speed:** Computer can carry out any instruction in less than a millionth of a second. Naturally, in any job, involving lots of calculation, computers are very useful. A computer can sort a set of thousand names in less than hundredth of a second.
2) **Accuracy:** This is the most important characteristic of computer. Computer can do calculation without errors and very accurately. Even when computer is making thousand calculations every second, not a single one will go wrong. If mistakes occur in any calculation, they are due to human mistakes.
3) **Diligence:** Computer is capable of performing any task given to them respectively. This property of computer to do the given task obediently without asking any question is called diligence. If any calculation has been done a million times, a computer will do so with same accuracy and speed.
4) **Storage capacity:** Computer can store large volume of data and information on magnetic media. Computers also have enormous speed to retrieve this saved data. Computers can carry out the given task using a small set of elementary instructions. These instructions are extremely simple; e.g. add, subtract, compare, etc. and are collectively known as programs. It is not necessary to have more than 100 distinct instructions even for a very powerful machine.

Limitation/Disadvantage of Computer:

(1) **Lack of commonsense:** Computer can work as human beings but it is only a tool. It cannot think. It does not have common sense or intelligence as human being have. Computers are to

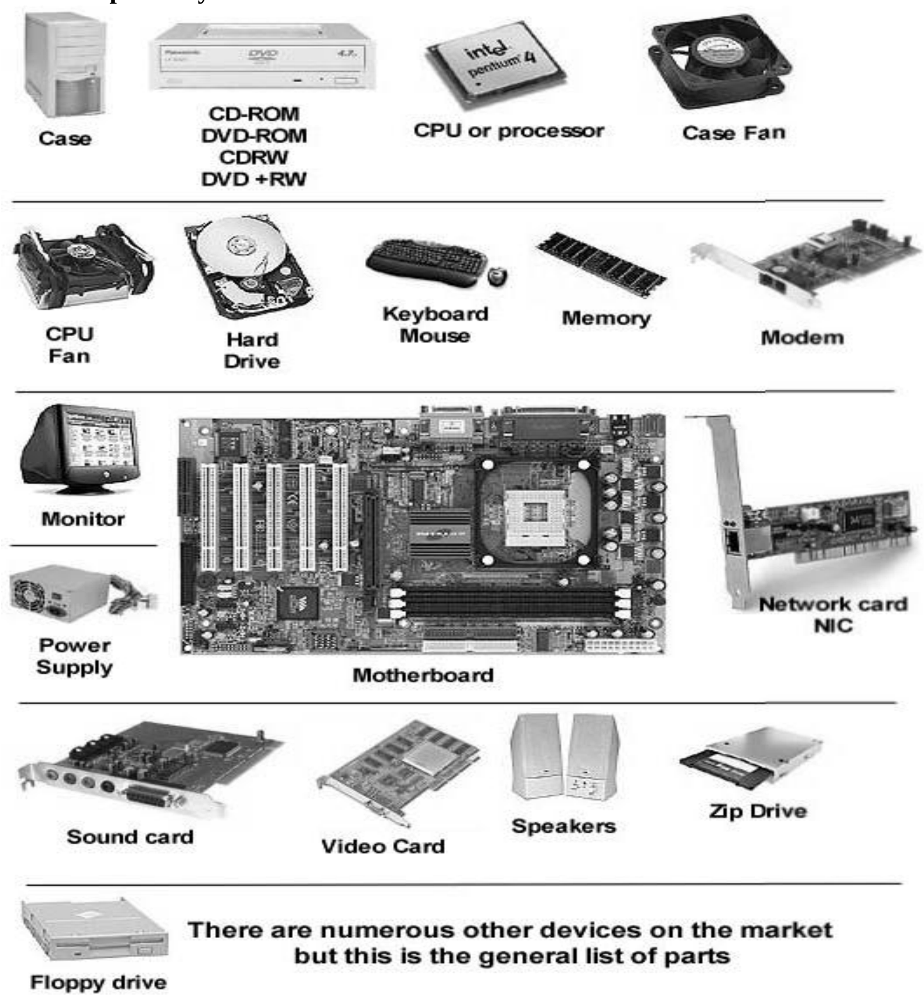
be instructed for making them perform any task. So every time when we have to use computer for a task, we need to first tell computer what to do.

(2) **Inability to correct:** when we give instruction to the computer we must give correct instructions. A computer cannot prompt for wrong instructions. If there is a mistake in giving data to the computer, the end result is wrong. Popularly this is termed as Garbage In – Garbage Out.

(3) **Dependence on human instructions:** Computers look as the y are very clever. Actually they are only tools. They cannot do anything unless a man instructs them. A computer cannot generate any information on its own. It can only do what it has been instructed or told to do.

(4) **Dependence on Electricity:** Computers depend on electricity for their functioning. Just imagine the state of an organization using computers and not having power. Manpower will be sitting idle without any work. An organization will be totally crippled in case there is no power. A lot of pending work will be left for completion.

Parts of the Computer System:



Different types of computer:

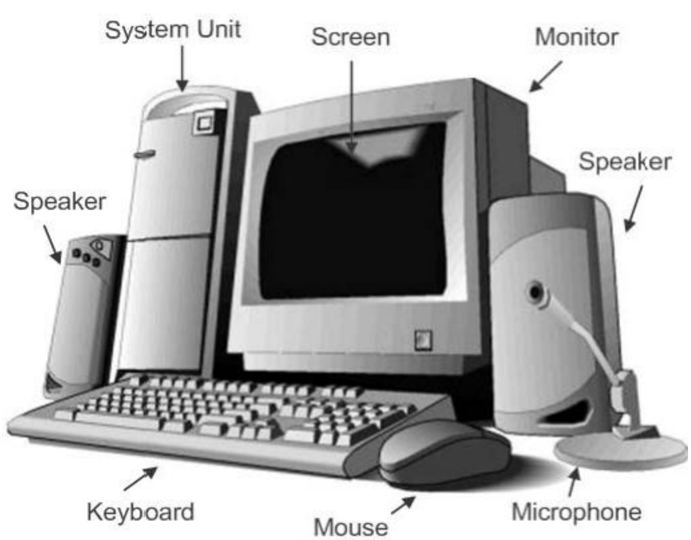
(1) **Super Computer:**
Speed: 64-128 bit
Use: Weather reports and defence.
Size: Building size
Example: Param 10000, Anand Param 2

(2) **Mainframe Computer:**
Speed: 32-64 bit
Use: Big organizations like TATA, Railways etc.
Size: Room size
Example: IBM 360 series, Honeywell's, PDP 88/860.

(3) **Mini Computer:**
Speed: 16-32 bit
Use: small organizations, Branches, Offices, etc.
Size: Desk size
Example: RPG AS-400

(4) **Micro Computer:**
(i) Desktop
(ii) Portable Speed:
8-32 bit Use:
Personal use Size:
Desktop size
Example: Personal computers (P –I, P –II, P-III & P –IV etc.)

The basic components of a typical Computer System consists of Monitor, System Unit , Keyboard, Mouse, Speakers & Printer as shown in following figure:

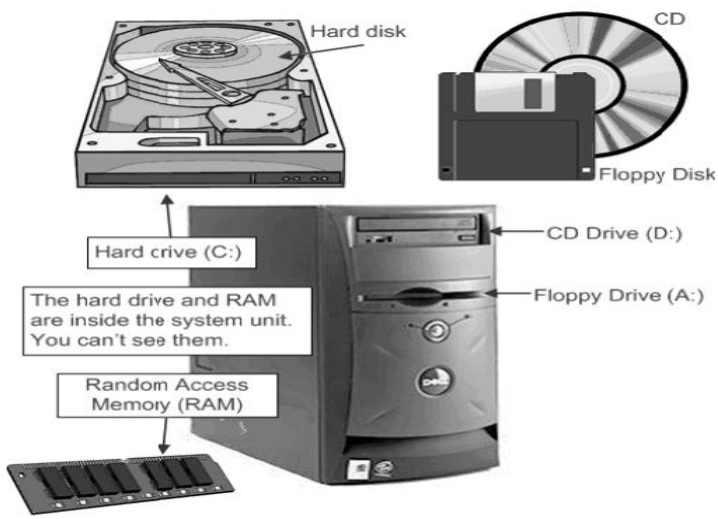


Parts of Computers:

1. **System unit / CPU (Central Processing Unit):**

The system unit is the core of a computer system. Usually it's a rectangular box placed on or underneath your desk. Inside this box are many electronic components that process information. The most important of these components is the central processing unit (CPU), *or* microprocessor, which acts as the "brain" of your computer. Another component is random access emory *(RAM)*, which temporarily stores information that the CPU uses while the computer is on. The information stored in RAM is erased when the computer is turned off.

Almost every other part of your computer connects to the system unit using cables. The cables plug into specific *ports* (openings), typically on the back of the system unit. Hardware that is not part of the system unit is sometimes called a peripheral device *or* device.

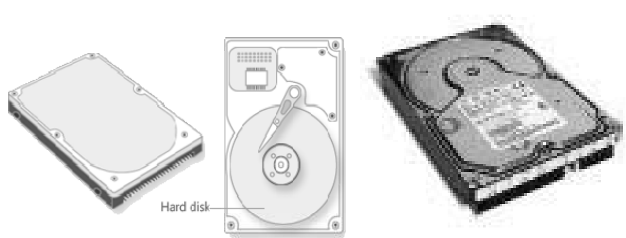


2. **Storage:**

Your computer has one or more *disk drives*—devices that store information on a metal or plastic disk. The disk preserves the information even when your computer is turned off.

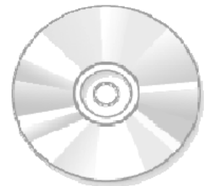
A. **Hard disk drive**

Your computer's *hard disk drive* stores information on a *hard disk*, a rigid platter or stack of platters with a magnetic surface. Because hard disks can hold massive amounts of infor r ation, they usually serve as your computer's primary means of storage, holding almost all of your programs and files. The hard disk drive is normally located inside the system unit.



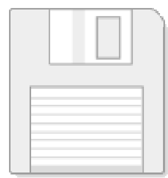
B. CD and DVD drives:

Nearly all computers today come equipped with a CD or DVD drive, usually located on the front of the system unit. CD drives use lasers to read (retrieve) data from a CD, and many CD drives can also write (record) data onto CDs. If you have a recordable disk drive, you can store copies of your files on blank CDs. You can also use a CD drive to play music CDs on your computer. DVD drives can do everything that CD drives can, plus read DVDs. If you have a DVD drive, you can watch movies on your computer. Many DVD drives can record data onto blank DVDs. If you have a recordable CD or DVD drive, periodically back up (copy) your important files to CDs or DVDs. That way, if your hard disk ever fails, you won't lose your data.



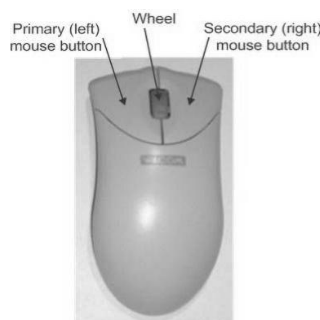
C. Floppy disk drive:

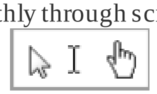
Floppy disk drives store information on floppy disks, also called floppies or *diskettes*. Compared to CDs and DVDs, floppy disks can store only a small amount of data. They also retrieve information more slowly and are more prone to damage. For these reasons, floppy disk drives are less popular than they used to be, although some computers still include them. Why are floppy disks "floppy"? Even though the outside is made of hard plastic, that's just the sleeve. The disk inside is made of a thin, flexible vinyl material.



3. Mouse:

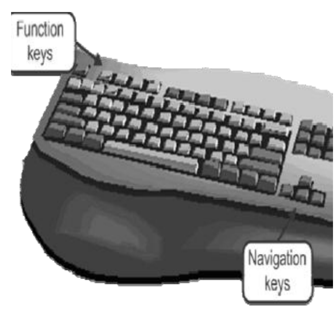
A mouse is a small device used to point to and select items on your computer screen. Although mice come in many shapes, the typical mouse does look a bit like an actual mouse. It's small, oblong, and connected to the system unit by a long wire that resembles a tail. Some newer mice are wireless. A mouse usually has two buttons: a primary button (usually the left button) and a secondary button. Many mice also have a wheel between the two buttons, which allows you to scroll smoothly through screens of information.





When you move the mouse with your hand, a pointer on your screen moves in the same direction. (The pointer's appearance might change depending on where it's positioned on your screen.) When you want to select an item, you point to the item and then *click* (press and release) the primary button. Pointing and clicking with your mouse is the main way to interact with your computer.

4. Keyboard:



A keyboard is used mainly for typing text into your computer. Like the keyboard on a typewriter, it has keys for letters and numbers, but it also has special keys:

- The *function keys*, found on the top row, perform different functions depending on where they are used.
- The *numeric keypad*, located on the right side of most keyboards, allows you to enter numbers quickly.

- The *navigation keys*, such as the arrow keys, allow you to move your position within a document or webpage.

5. **Monitor:**

A monitor displays information in visual form, using text and graphics. The portion of the monitor that displays the information is called the *screen*. Like a television screen, a computer screen can show still or moving pictures.There are two basic types of monitors: *CRT* (cathode ray tube) monitors and *LCD* (liquid crystal display) monitors. Both types produce sharp images, but LCD monitors have the advantage of being much thinner and lighter. CRT monitors, however, are generally more affordable.

6. **Printer:**

A printer transfers data from a computer onto paper. You don't need a printer to use your computer, but having one allows you to print e-mail, cards, invitations, announcements, and other materials. Many people also like being able to print their own photos at home.
The two main types of printers are *inkjet printers* and *laser printers*. Inkjet printers are the most popular printers for the home. They can print in black and white or in full color and can produce high-quality photographs when used with special paper. Laser printers are faster and generally better able to handle heavy use.

7. **Speakers:**

Speakers are used to play sound. They may be built into the system unit or connected with cables. Speakers allow you to listen to music and hear sound effects from your computer.

8. **Modem:**

To connect your computer to the Internet, you need a *modem*. A modem is a device that sends and receives computer information over a telephone line or high-speed cable. Modems are sometimes built into the system unit, but higher-speed modems are usually separate components.

9. **Scanner:**

Scanners are not just for scanning pictures. Scanners can read printed text and convert it to files (OCR) that you can manipulate with your word-processing program. You can also scan a handwritten letter and send it by fax directly to somebody, or put it in permanent storage on your hard drive.
Because of its many uses, perhaps the most important question facing someone who wants to buy a scanner is:
What will you are doing with the scanner?

- Do you want it to provide visual enhancements to your e-mail, your Web page, or your holiday greetings,?
- Do you want to use the scanner primarily to turn your computer into a fax machine?

- Or are you a graphic artist, needing quality images that will be included in your newsletter?

You must also decide how precise you need your scanner to be. This precision is measured as the scanner's resolution. Scanner resolution is measured in terms of dot s per inch (dpi).
Think of each dot as an element of a picture that the scanner has scanned you also must decide how precis e you need your scanner to be. This precision is measured as t he scanner's resolution. Scanner resolution is measured in terms of dots per inch (dpi). A sc anner with a hig h resolution is ver y precise, while a scanner with a l ower resolution is less so. The more elements of a pict ure that a scanner can detect, the more detailed the picture will be and the higher the resolution will be.
On the scan head in each scanner, there are a certain number of sensors. As the scan head passes under or over the document or image, it stops, - too b riefly to be detected - a number of times so that each sensor can take a picture.
The amount of resolution a scanner can produce depends on how many electronic sensors it has on its scan head and how many times it will stop as it moves across the original document or image. If the scanner had 600 sensors for each inch of the scan head, the resolution would be specified as 600 x 600dpi.
Different applications require t he use of differe nt types of scanners an d each type of sca nner has unique features and comes in a different price range.

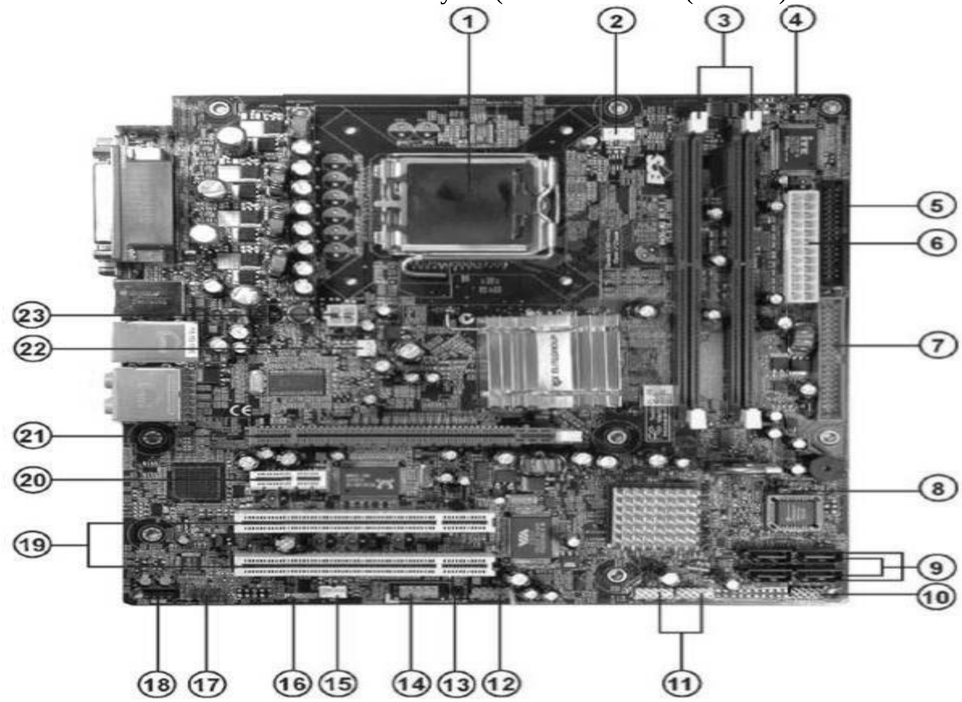
Parts of Computer CPU:

1. Motherboard
2. Processor (with Heat sink & CPU Fan)
3. RAM
4. Display Card(Integrated or Add-on Card type)
5. SMPS (Switch Mode Power Supply)
6. Hard Disk Drive(IDE or SATA type)
7. Floppy Disk Drive
8. CD or DVD Drive

1. Motherboard:

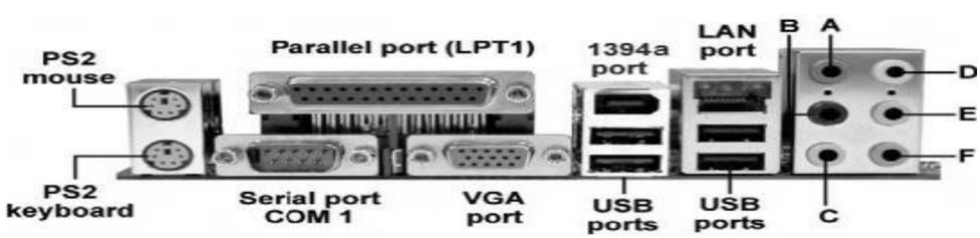
This is a Main Circuit Board found in all Computer systems. This Circuit Board provides the platform to all other devic es to c ommunicate with each other, as all internal as well as external devices are ultimately connected to this component of computer system. It has got various connectors and ports on it, to communicate with the devices e.g. Hard Disk Drive, Floppy Disk Drive Connectors, Printer port, Keyboard and Mouse connectors, Display connectors etc.
A typical Motherboard is shown here:

Common Motherboard Layout (INTEL Socket T (LGA775)



1 CPU Socket
2 CPU_FAN - CPU cooling fan connector
3 DIMM1~2 - 240-pin DDR2 SDRAM slots
4 IRDA - Infrared header
5 FDD - Floppy diskette drive connector
6 ATX1 - Standard 24-pin ATX power connector
7 IDE1 - Primary IDE channel
8 CLR_CMOS - Clear CMOS jumper
9 SATA1~4 - Serial ATA connectors
10 PANEL1 - Panel connector for case switches and LEDs
11 USB1-2 - Front Panel USB headers
12 1394a - IEEE 1394a header
13 BIOS_WP - BIOS flash protect jumper
14 COM2 - Onboard Serial port header
15 WOL1 - Wake On LAN connector
16 S/PDIF - SPDIF out header
17 F_AUDIO - Front panel audio header
18 AUX_IN - Auxiliary In connector
19 PCI1~2 - 32-bit add-on card slots
20 PCIE1 - PCI Express x1 slot
21 PCIEX16 - PCI Express slot for graphics interface
22 SYS_FAN - System cooling fan connector
23 ATX12V - Auxiliary 4-pin power connector

Rear panel on of a motherboard with many integrated inputs and outputs (I/O's).

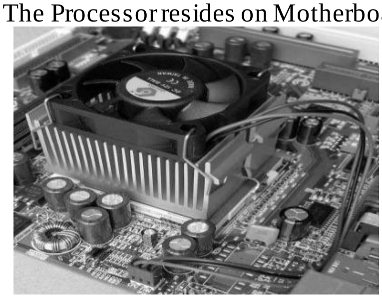


a. PS2 Mouse Used to connect a PS/2 pointing device.
b. PS2 Keyboard Used to connect a PS/2 keyboard.
c. Parallel Port (LPT1) Used to connect printers or other parallel communications devices.
d. Serial Port used to connect serial devices such as mice or (COM1) fax/modems.
e. VGA Port Connect your monitor to the VGA port.
f. 1394a Port Use the 1394a port to connect to any fire wire device.
g. LAN Port Used to connect an RJ-45 cable to a Network hub or router.
h. USB Ports Used to connect USB devices such as printers, scanners cameras etc...
i. Audio Ports used to connect audio devices.
j. The D port is for stereo line-in signal, while the F port is for microphone in signal. This motherboard supports 8-channel audio devices that correspond to the A, B, C, and E port respectively. In addition, all of the 3 ports, B, C, and E provide users with both right & left channels individually.

- A. Center & Woofer
- B. Back Surround
- C. Side Surround
- D. Line-in
- E. Front Out

2. Processor:

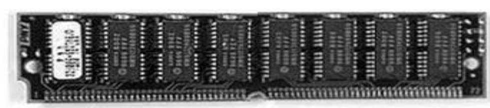
As the name suggests, this is a main chip which processes all instructions and data provided to the computer system. This is a Logic Unit of Computer System. The Processor resides on Motherboard,

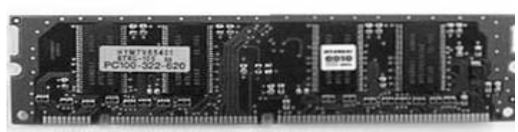


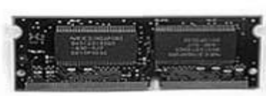
and does all the processing functions required.

3. RAM:

RAM *(Random Access Memory)* is the computer's primary working memory. The OS *(Operating System)* controls the computer's functions. When the OS loads, it loads into RAM; when applications load, they load into RAM; when you open documents, they load into RAM; and when you need to send output to your monitor, the output is loaded into RAM before it hits your monitor.RAM is used in many areas of your computer, and in many different forms. It is used by the base OS in one big chunk that most people think of as RAM, but it is also Implemented as processor cache (L1 and L2), video RAM for your video card, and any number of components that claim to have caching.RAM speeds are usually measured in nanoseconds. One nanosecond is a billionth of a second.







4. <u>Display Card/ Video Adapter /Graphics Card /Graphics Adapter</u> :

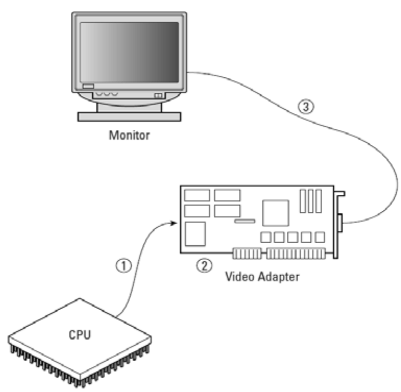
Video adapter

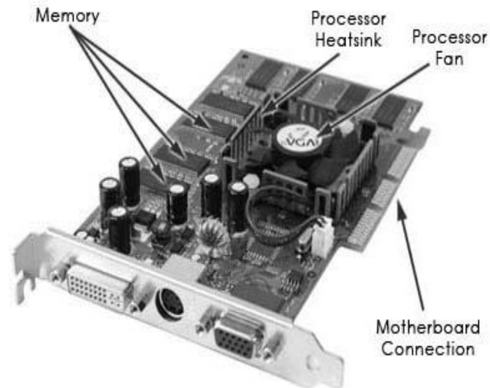
Many motherboards today come with a built-in video adapter, sometimes called a video card or video controller. Following figure shows how information flows from the system to the monitor. The following steps refer to the numbers in Figure.

1. The video adapter is responsible for receiving digital data from the processor, which instructs the video adapter on how the images are to be drawn on the screen.

2. The video adapter stores the information about drawing the images in its memory and starts converting the information into analog data that the monitor can understand.

3. The data is sent in analog format from the video adapter to the monitor.





5. SMPS (Switch Mode Power Supply):

This device in Computer System is used to convert A.C. Voltage into D. C. Voltage and gives out the desired voltage levels required by various components of Computer System. It is present on the back-side of the Computer case.

Assembling a Computer:

After buying all the computer components they must be put together. This process is called assembling. It usually takes about fifteen minutes (installing not included). Although easy, it must be done carefully so as to avoid unnecessary damage to the system.

Materials required for assembling a computer:

Make sure that you have all the below materials before starting.

1. All the necessary components (Although the all the below components a e preferable, not all are necessary. Then necessary ones are marked with a *)

   - Processors *
   - Motherboard *

Computer Hardware (Desktop & Laptop)

- Hard disk *
- RAM *
- Cabinet *
- Floppy Drive *
- CD Drive *
- **Cards**
  - Display Card (Not needed if On-board display is available on Motherboard)
  - Sound Card (Not needed if On-board sound is available on Motherboard)
  - Modem
  - Other Cards(If Any)
- Monitors *
- Keyboard *
- Mouse *
- Speakers
- UPS
- Other Components(If Any)
- Also keep the cables that came with the components close by

2. Philips head Screwdriver(also known as Star Screwdriver)
3. Flat head Screwdriver
4. Forceps (for pulling out jumpers and screws)
5. Magnetized Screwdriver
6. Multi meter (Testing)

Required Environment for assembling PC:

Make sure that the following things are true of the room in which the computer is assembled/kept.

- Make sure that a flat surface of a good area is available when the system is assembled. Make sure that the room has enough space to move.
- See that the place where the Computer is kept is dust free as dust can harm the system.
- Make sure that the room has good ventilation and won't be very hot.
- Check the grounding in the plug to make sure that earthing (Grounding) is done properly.

Precautions to be care while assembling the PC:

Before Starting the actual assembly of the PC System, the following precautions would help you to avoid any mishap during the assembly process:

- While the motherboard has to be fitted at a fixed place inside the PC cabinet, the locations of add-on cards (as and when used) and the drivers (hard disk drive, floppy disk drive, and CD-ROM drive) within the drivers bay of the cabinet can be changed within certain limits. But it is better to place them far away from each other. (The length of the cable provided for interconnections to the motherboard has to be taken into account, as there must be some slack after these are installed and connected.) This will improve the cooling and reduce the chance of electro-magnetic interference between them.
- The motherboard contains sensitive components, which can be easily damaged by static electricity. Therefore the motherboard should remain in its original anti static envelope until required for installation. The person taking it out should wear an anti static wrist strap that is properly grounded.

In the absence of a proper wrist strap, you must make one on your own, using a peeled of multi-stranded copper cable and ground it properly. Similar handling precautions are also required for cards.

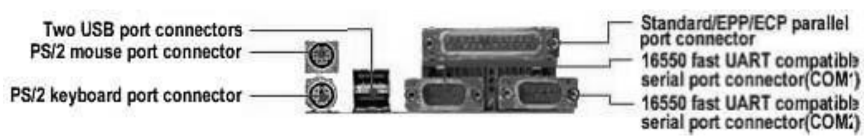
- Be sure to handle all the components with great care. If a small thing like a screw is dropped on the MB, it can damage the delicate circuitry, rendering the Main Board useless.

Assembling the PC:

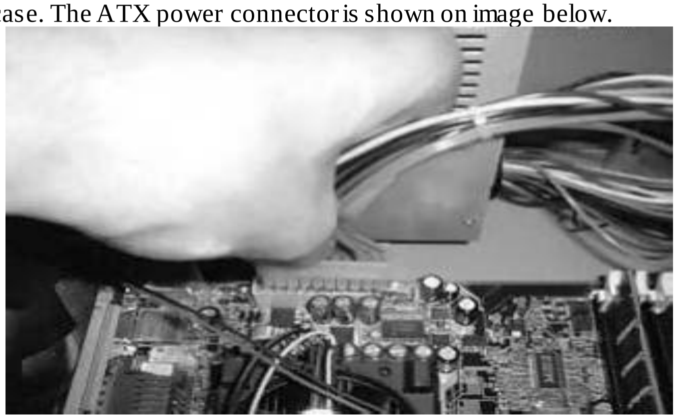
If you have purchased all the necessary hardware your are ready assemble your PC. Before unpacking your components from its original anti-static bags you must put on your anti-static wrist strap, which will discharge yourself. It is important that you discharge yourself or there is a danger that you can damage your components by anti-static shock by touching the components. If you don't have an anti-static wrist strap you can discharge yourself by touching the metal edges of your ATX case, although this is not recommended.

The first thing you should do is unpack your ATX case. Take off the cover of your case so that you can access the inside. Place the case on a desk so that you are looking down towards the open case. Your case should come with motherboard mounting screws. If your ATX back plate it not already fitted you can fit it by placing your plate near the ATX back plate cut out and pushing the plate outwards, it should clip on.

Now place your motherboard on top of the mounting screw holes. Make sure your ATX devices on the motherboard such as PS/2 and parallel port are facing towards ATX back plate cut out. Gently push your motherboard towards the cut out; every device should fit easily into its corresponding cut out, as shown below.

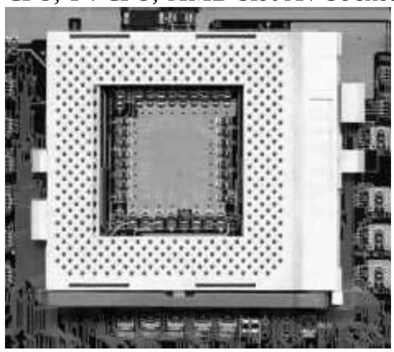


The screw holes on your motherboard should align with the screw holes on your case. Place your screws that came with the case into the appropriate holes and gently screw it on using a screw driver. The motherboard is now securely mounted to the case. You can now place the ATX power connector to the motherboard. Your ATX case should come with a power supply unit (PSU) and should already be mounted to the case. The ATX power connector is shown on image below.



Place the ATX power connector on top of the power socket on the motherboard. Push down the power connector and it should clip onto the socket. If you try to fit the power connector the wrong way round, it won't fit, it will only fit one way. So, if the power connector does not go in, it should go in the other way round.

Locate the processor socket on your motherboard. I am installing an Intel PIII 866 processor on a socket 370 as shown on the following image. The installation would be slightly different if you have a different processor i.e. Slot1 PIII CPU, P4 CPU, AMD Slot A / Socket a CPU etc.

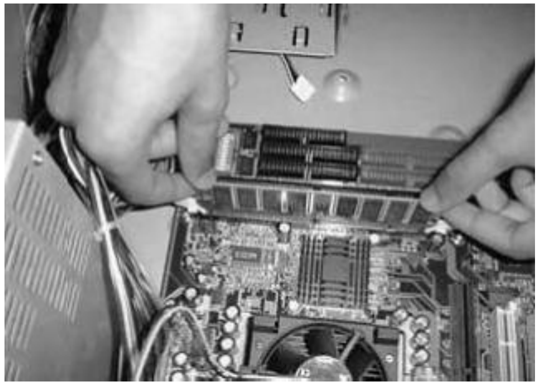


Raise the brown lever on the socket and slowly put the processor in place. You have to make sure the pin 1 of your CPU goes into the pin 1 of your CPU socket otherwise the CPU would not get into the socket, so don't try to force it in. It will go in gently if you fit it correctly. Now close the brown lever which will securely hold the CPU in place. If you bought retail boxed CPU it would include a heat sink + fan. If you bought an OEM CPU make sure you got a fan that is correct for the speed of your CPU, otherwise your CPU will overheat and behave abnormally or could be damaged. Take off the plastic cover from the bottom of the CPU fan that covers the heat transfer pad. Now place the CPU fan on top the CPU and push down the metal clips on the fan so that it clips onto the CPU socket.

CPU fan has a power connector which needs to be connected to CPU fan power socket on your motherboard as shown on the image above.

Finally, you have to specify what frequency (speed) your CPU is running at. This can be done using jumper settings, or on some modern motherboard it can be done in the BIOS, or your motherboard may have automatic detection for your CPU frequency. Please refer to your motherboard manual for more details. The motherboard I am using (A bit BX133) has a dip-stick jumper setting and it can be setup in the BIOS. I have left the jumper setting to default as I will use the BIOS to specify the CPU

frequency. The CPU runs at the bus spe ed of 133 MHz therefore I will use the settings 133 * 6.5(multiplier) under the BIOS, which will the run the CPU at 866 Mhz.
Installing memory is quite simple. Find the SDRAM banks on your motherboard; they should look similar to the banks below. Notice the memory banks have a white clip on each side. Make sure you release the clips so it bends to each side.



Hold each corner of the SDRAM placing it on top of the bank 1. You will notice that the SDRAM has a cut at the bottom side; it is there to prevent the memory going in the wrong way round. If you are holding the SDRAM the incorrect way you will not be able insert it. Gently push down the SDRAM and it should clip on to the memory bank. The two white clips will now become straight holding each corner of the memory. If you have more than one SDRAM perform same steps as above but placing the SDRAM in memory bank 2 and so on.If you look at the rear side of a n IDE hard drive it should look similar to the image below.

The IDE/ATA connector is on the left hand si de which consists of m any ins. Next to the IDE connector is the jumper setting for the drive. The jumper should be set to Master, which the default is setting for a new HDD. Any other device sharing the same IDE cable should be set to Slave. Different HDD has different jumper settings; please refer to your HDD manual for more information. On the right hand side, next to the jumpers is the power connector. Every device except FDD uses this type of power connector. Figure 1 and 2 below shows what an ATA 66 and a power cable looks like. The ATA 66 cable which is also known as UDMA 66 cable is an advance IDE cable, which offers higher performance and data integrity than the standard IDE cable. ATA 66 cable consists of 80 conductor cable where as the standard IDE cable consists of 40 conductor cable. I am using an ATA 66 cable because the above HDD is an ATA 100 drive which requires an ATA 66 cable.

Figure - ATA 66 Cable

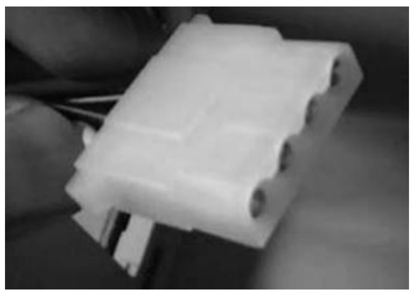
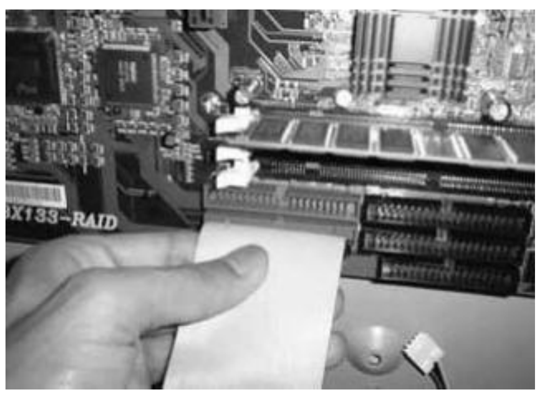


Figure - Power cable

Place your hard drive into the HDD mounting slot of your case; make sure the IDE/ATA connector is facing outwards. Screw the HDD to the case using screws provided with the HDD or the ATX case.

Insert the ATA 66 cable into the ATA connector of the HDD. Make sure the pin 1 on the cable is connected to pin 1 on the HDD connector. Pin 1 is the red or pink strip on the edge of an ATA cable. Most new IDE/ATA cables are designed so that it will only go in one way which will correspond to pin 1.


X133-RAID

The black connector on the left hand side is the floppy disk connector. It is different from the IDE connector and uses a different cable. The small white connector on the right hand side is the power connector for the floppy drive. Figure 1 and 2 below shows what a floppy drive cable and floppy drive power connector looks like.

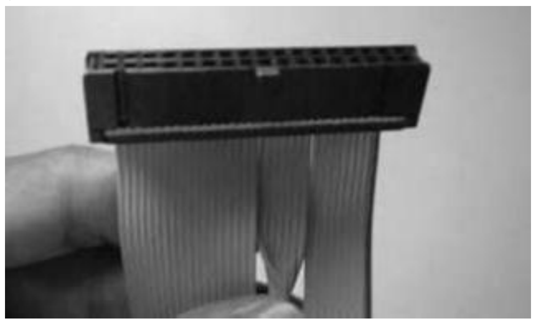


Figure - Floppy drive cable.

Figure - Floppy drive power cable

Place the floppy drive into the FDD mounting slot as shown. Screw the drive securely into place.

Insert the floppy drive cable into the floppy drive connector. Make sure the pin 1 on the cable connects to the pin 1 on the floppy drive connector. As you already know by now that pin 1 is the red or pink strip on the edge of the floppy drive cable. Most floppy drive cables are designed so that it will only go in on way, so you cannot connect it incorrectly.

Push the floppy drive power cable to the power connector. This will only go in on way.

Finally connect the other end of the floppy drive cable to floppy drive connector on your motherboard. Make sure pin 1 on the cable connects to pin 1 on the connector. If you look at the rear side of your CD / DVD-ROM it should look similar.

Figure Back Panel of CDROM

On the right hand side you have the power connector. Next to power connector you have the IDE connector. On the left hand side near the IDE connector you have the jumper settings for the DVD-ROM. The jumper is set to Master by default. I am connecting the DVD-ROM on a separate IDE cable therefore I will leave the jumper setting to Master. However if you are sharing an IDE cable with another device like HDD, then you would have to set jumper to Slave, as your HDD would be set to Master. Next to the jumpers you have the CD Audio-Out socket. One side of your audio cable connects to this socket and other side connects to the sound card cd-in socket. This would allow you to listen to Audio CD's on your computer.

Figure Front Panel of CDROM

Mount your CD/DVD-ROM drive into its mounting slot. Use the supplied screws to screw the drive into position.

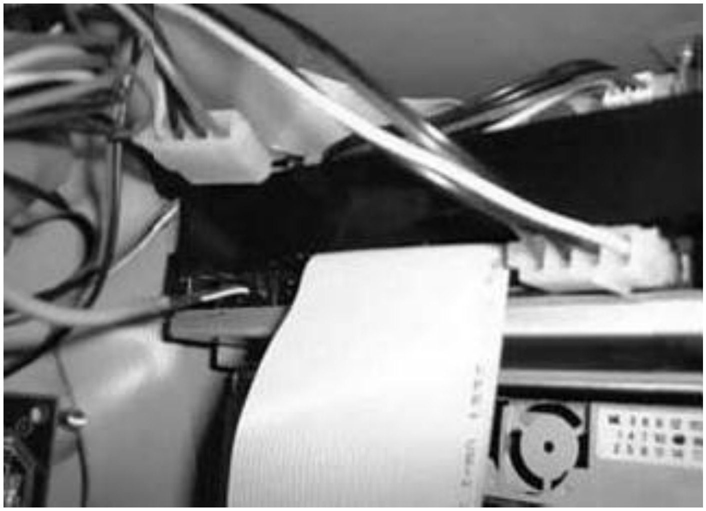
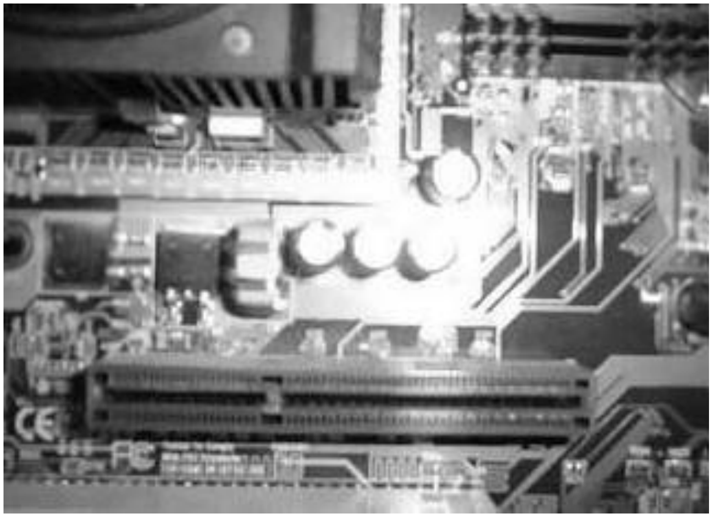


Figure connecting Hard disk

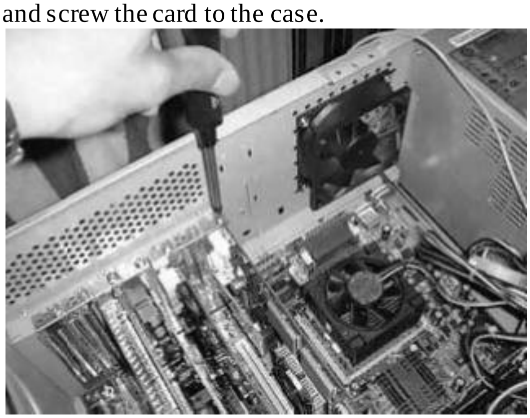
Connect the IDE cable to the drives IDE connector. Make sure the pin 1 on the cable is connected to pin 1 on the drives IDE connector. Pin 1 is the red or pink strip on the edg e of an IDE cable. Connect the other end of the IDE cable to the IDE socket on your motherboard as shown in figure 4. Again, make sure you connect the cable to pin 1. The IDE socket could be your primary or secondary socket depending which socket you choose. If your HDD is on the primary IDE socket and your secondary IDE socket is free, then it is better to use your secondary IDE socket for the CD/DVD-ROM.

Finally connect the power cable to power connector and connect the audio cable to the CD Audio-Out socket. Most modern graphics cards are AGP based and connects to the AGP bus of the motherboard. An AGP bus (slot) looks like the following image. The brown slot is where you connect your AGP graphics card.

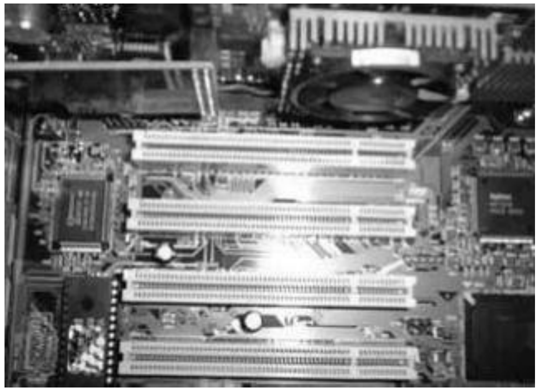


Place your AGP card on top of the slot and gently push it down. The card should firmly sit into position.

All you need to do no w is to screw the metal plate on the front of the card to the ATX case. Use the screws supplied with case and screw the card to the case.



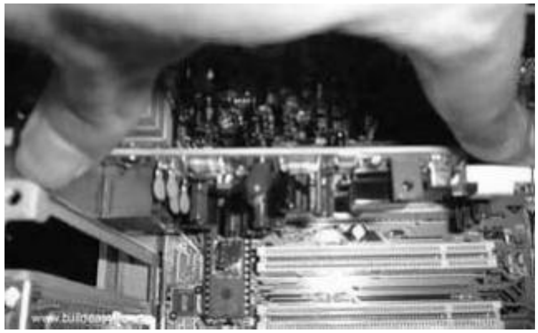
Most modern sound cards are designed with the PCI interface and connect to the PCI slot of your motherboard. A PCI slot looks like the slots on the following image.



Place your sound card on top of a chosen slot. Gently push down the card so it sits into position. Once the card is seated correctly into position, screw the card on to the case.

Finally insert the audio cable into the CD-IN socket. The other end of the cable should be connected to Audio-out socket on your CD/DVD-ROM drive.

Find a free PCI slot on your motherboard (assuming your modem is a PCI modem). Place your modem card on top of the slot and gently push it down into position.



Once the card has seated correctly into position, screw the card to the case using the screws supplied with the case. Now you have installed all the prerequisite hardware devices. You can either proceed to the finalizing stage, or you may want to install optional devices like a ZIP drive, CD-RW drive or a TV-Card. If you do not want to install these devices you can now proceed to the finalizing stage. Just like any other IDE device, a zip drive connects to an IDE cable and a power cable. The rear side of the ZIP drive looks similar to the image below.

On the left h and side you have the IDE connector. On the right hand side you have the po wer connector. In the middle you have the jumpers. You have to specify if the ZIP drive is being connected as a Master or a Slave device using the appropriate jumper setting.

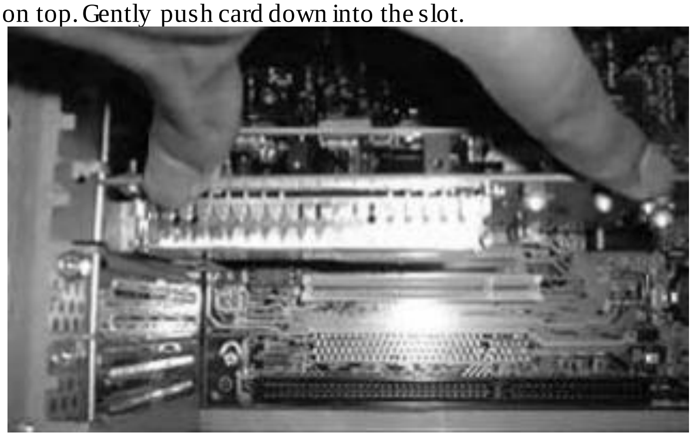
Place the ZIP drive into a mounting slot and screw it securely into position.

Connect the power cable and the IDE cable to the corresponding connectors. Connect the other end of the IDE cable to the IDE socket on the motherboard. Make sure the pin 1 on the cable connects to pin 1 on the motherboard IDE socket and on the ZIP drive socket. The rear end of your CD-RW drive should look similar to the image below.

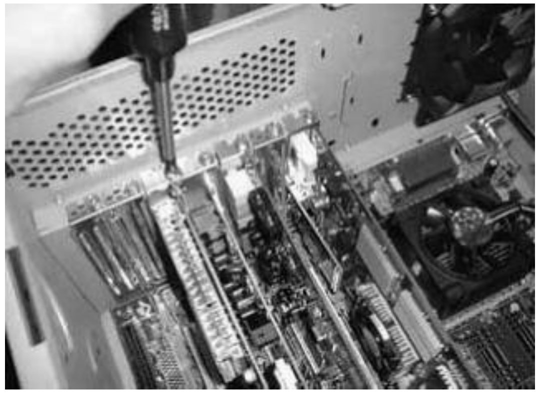
It contains all the usual connectors such an IDE connector, a power connector, audio connector, and a place to set the jumpers. Set the jumpers so the drive is configured to run as a Master device. It is best to connect your CD-RW on separate IDE cable. This would avoid problems while you copy CD's on-the-fly. This means copying a source CD from a CD/DVD-ROM drive to a blank destination CD in your CD-RW drive without the source CD being copied to the hard disk first. Copying on-the-fly is less time consuming than copying the source CD to the hard disk first. However if you decide to connect your CD-RW drive and another device like a DVD-ROM on the same IDE cable, it would be fine providing you make an image of your source CD on a HDD first before copying to your blank CD. You may have problems such as "buffer under run" errors if you try to copy on-the-fly.
Place your CD-RW drive into a mounting slot as shown. Position the drive correctly and screw it onto the case.

Connect the IDE and the power cable to the drive. If you want to use the CD-RW drive for playing Audio CD's then you also need to connect an audio cable to the Audio-out socket of the drive. If you have a CD/DVD-ROM then the audio cable is usually connected that drive instead of the CD-RW, but there is no reason why you can't have both.

Finally the other end of the IDE cable should be connected to an IDE socket of the motherboard.
Installing a TV card is no more difficult than installing any other PCI cards. Locate an unused PCI slot and place the card on top. Gently push card down into the slot.



When the card is correctly in position, screw the card securely on to the case.



Note that a TV card uses two IRQ (Interrupt Request) one for video and one for audio. It is best to place your TV card into a slot which does not conflict with an IRQ of another device. Although IRQ sharing is possible, some TV cards may behave abnormally if you are sharing IRQ's.

Now that you have installed all the necessary hardware there are still few more things you need to do before switching on your PC for the first time. Your ATX case has a power switch which turns the PC on, a reset switch for resetting the system, a power LED which comes on when the PC is switched on and a hard drive LED which flashes when data is being written or read from your hard drive. You also have an internal speaker.

Power and Reset switch

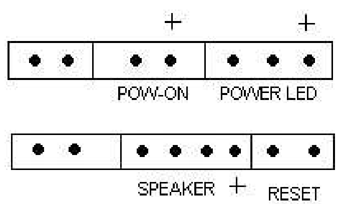
The switches and LED's need to be connected to its corresponding connectors on the motherboard. Please refer to your motherboard manual to locate where the connectors are. Different motherboards place the connectors in different locations. The connectors for the switches and LED's are normally grouped together. They should look similar to the image below.

Switch and LED connectors

Every cable is normally labeled; they are normally named as follows, but could be slightly different on your system.

Power switch	Power / PWR-SW
Reset switch	Reset
Power LED	Power LED / PWR-LED
Hard drive LED	HDD-LED / IDE LED
Speaker	SPK / Speaker

The connectors on the motherboard are also labeled but may be too small to see. Instead refer to your motherboard manual which would provide details on which pins you should connect the cables to. The image below shows how the pins may be organized on your motherboard.



Once you have connected all the cables to the correct pins on the motherboard, you are ready to switch the PC on. At this point you can close the cover of your ATX case but don't screw it on just yet as you might have possible problems that needs rectifying. Connect all the cables to back of ATX case. This includes the main power cable that connects to the power supply. PS/2 mouse and keyboard that connects to the PS/2 ports. Monitor cable that connects to the graphics card port, etc. Finally the moment has arrived. Switch on your monitor first. Your ATX power supply might have a main power switch at the back so make sure that is switched on.
Now we have to learn configuring BIOS.

Chapter- 2
Basic Electronic

Objective of Learning

- Basics of electronics
- Ohms law
- Different electronics components and its types
- Tools required to work with electronics components
- Microprocessor and its architecture & block diagram of computer

In this fast developing society, electronics has come to stay as the most important branch of engineering. Electronic devices are being used in almost all the industries for quality control and automation and they are fast replacing the present vast army of workers engaged in processing and assembling the factories. Great strides taken in the industrial applications of electronics during the recent years have demonstrated that this versatile tool can be of great importance in increasing production, efficiency and control.
The rapid growth of electronics technology offers a formidable challenge to the beginner, who may be almost paralyzed by the mass of details. However, the mastery of fundamentals can simplify the learning process to a great extent.

Electronics

The branch of engineering which deals with current conduction through a vacuum or gas or semiconductor is known as electronics. Electronics has gained much importance due to its numerous applications in industry. The electronics devices are capable of performing the following functions:

- Rectification
- Amplification
- Control
- Generation
- Conversion of light into electricity
- Conversion of electricity into light

Atomic Structure

According to the modern theory, matter is electrical in nature. All matter is comprised of molecules, which in turn are comprised of atoms, which are again comprised of protons, neutrons and electrons. A molecule is the smallest part of matter which can exist by itself and contains one or more atoms. The word matter includes almost everything. It includes copper, wood, water, air....virtually everything. If we were able to take a piece of matter such as a drop of water, divided it by two and kept dividing by two until it couldn't be divided any further while it was still water we would eventually have a molecule of water. A molecule, the smallest particle which can exist, of water comprises two atoms of Hydrogen and one atom of Oxygen - H2O.

An atom is also divisible - into protons and electrons. Both are electrical particles and neither is divisible. Electrons are the smallest and lightest and are said to be negatively charged. Protons on the other hand are about 1800 times the mass of electrons and are positively charged. The fact that electrons repel electrons and protons repel protons, but electrons and protons attract one another follows the basic law of physics: Like forces repel and unlike forces attract.

When electrons are made to move, the result is dynamic electricity. "Dynamic" means movement. To produce a movement of an electron it is necessary to either have a negatively charged field "push it", a positively charged field "pull it", or, as normally occurs in an electric circuit, a negative and positive charge (a pushing and pulling of forces).
Most atoms have a nucleus consisting of all the protons of the atom and also one or more neutrons . The remainder of the electrons (always equal in number to the nuclear protons) is moving around the nucleus in different layers K, LM, N...etc.

Some of the electrons in the outer orbit of atoms such as copper or silver can be easily dislodged. These electrons travel out into the wide open spaces between the atoms and molecules and may be termed free electrons. It is the ability of these electrons to drift from atom to atom which makes electric current possible. Other electrons will resist dislodgement and are called bound electrons.

Basic Electronic Concepts

Current

In electronics the current is defined as the flow of electrical charge from one point to another. It is measured in ampere.
We know that when a negatively charged body is touched to a positively charged body electrons flow from the negative object to the positive object. Since electrons carry negative charge, this is an example of electrical charges flowing. Before an electron can flow from one point to another it must first be freed from the atom by gaining some energy.

Voltage

It is defined as "potential difference" between two ends of the circuit. It can be seen that a potential difference is the result of the difference in the number of electrons between the terminals or ends of any circuit. . It is measured in volt which can be defined as the pressure required forcing a current of one ampere through a resistance of one ohm.

Resistance

In the topic current we learnt that certain materials such as copper have many free electrons. Other materials have fewer free electrons and substances such as glass, rubber, mica have practically no free electron movement therefore the are good insulators.
Technically we can say the ability of a substance to oppose the flow of current is known as resistance**.** It is measured in ohm.

OHMS LAW

Ohms law, sometimes more correctly called Ohm's Law, named after Mr. George Ohm, mathematician and physicist b. 1789 d. 1854 - Bavaria, defines the relationship between power, voltage, current and resistance.
This law states that current is directly proportional to voltage and inversely proportional to resistance. Ohms Law is the foundation stone of electronics and electricity. These formulae are very easy to learn and are used extensively throughout our tutorials. Without a thorough understanding of "ohms law" you will not get very far either in design or in troubleshooting even the simplest of electronic or electrical circuits.
Some important formulas from ohms law.

VOLTAGE	CURRENT	RESISTANCE
$E = I \times R$ $12V = 2A \times 6R$	$I = E / R$ $2A = 12V / 6R$	$R = E / I$ $6R = 12V / 2A$
$P = E^2 / R$ $24W = [12V \times 12V] / 6R$	$P = I^2 \times R$ $24W = [2A \times 2A] \times 6R$	$P = E \times I$ $24W = 12V \times 2A$

Mr. Ohm (that is his 're al' name) [George Ohm b 1789 d 1854 - Bavaria] established in the late 1820's that if a voltage [later found to be A.C., D.C. or R.F.] was applied to a resistance then "current would flow and then power would be consumed".

ELECTRONIC COMPONENTS

Resisters

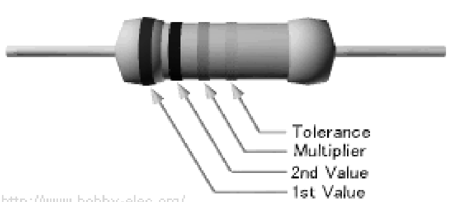
The resistor's function is to reduce the flow of electric current. This symbol  is used to indicate a resistor in a circuit dia gram, known as a schema tic. Resistance value is designated in units called the "Ohm." A 1000 Ohm resistor is typically shown as 1K-Ohm (kilo Ohm), and 1000 K-Ohms is written as 1M-Ohm (megaohm).

They are classified according to the material from which they are made. The typical resistor is made of either carbon film or metal film. There are other types as well, but these are the most common. The resistance value of the resistor is not the only thing to consider when selecting a resistor for use in a circuit. The "tolerance" and the electric power ratings of the resistor are also important. The tolerance of a resistor denotes how close it is to the actual rated resistance value. For example, a ±5% tolerance would indicate a resistor that is within ±5% of the specified resistance value.

The power rating indicates how much power the resistor can safely tolerate. Just like you wouldn't use a 6 volt flashlight lamp to replace a burned out light in your house, you wouldn't use a 1/8 watt resistor when you should be using a 1/2 watt resistor. The maximum rated power of the resistor is specified in Watts. Power is calculated using the square of the current (I2) x the resistance value (R) of the resistor. If the maximum rating of the resistor is exceeded, it will become extremely hot and even burn. Resistors in electronic circuits are typically rated 1/8W, 1/4W, and 1/2W. 1/8W is almost always used in signal circuit applications.

Resisters Colour Code Identification

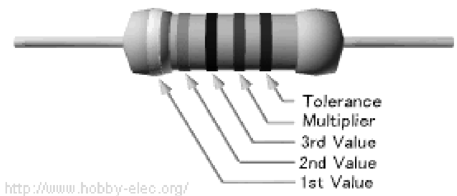
The following table shows how to find out the resistance of a resister as per the color code:



Example 1
(Brown=1),(Black=0),(Orange=3)
$10 \times 10^3 = 10k$ ohm

Color	Value	Multiplier	Tolerance (%)
Black	0	0	-
Brown	1	1	±1
Red	2	2	±2
Orange	3	3	±0.05

Tolerance(Gold) = ±5%



Yellow	4	4	-
Green	5	5	±0.5
Blue	6	6	±0.25
Violet	7	7	±0.1
Gray	8	8	-
White	9	9	-
Gold	-	-1	±5
Silver	-	-2	±10
None	-	-	±20

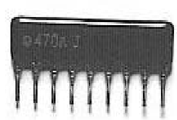
Example 2
(Yellow=4),(Violet=7),(Black=0),(Red=2)
470 x 10^2 = 47k ohm
Tolerance(Brown) = ±1%

Types of Resisters
There are two classes of resistors
- Fixed resistors
- Variable resistors.

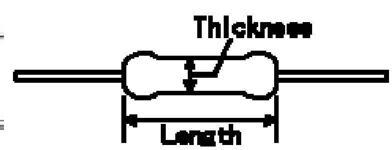
1. **Fixed Resistors**

A fixed resistor is one in which the value of its resistance cannot change. The following type of fixed resistors is used in different electronic devices:

1) *Carbon film resistors*



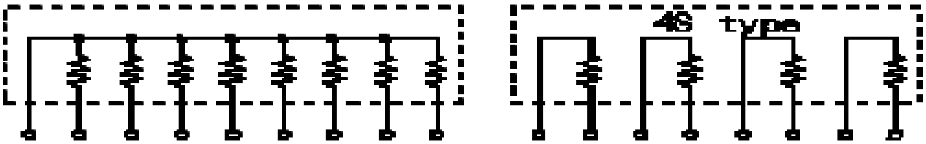
This is the most general purpose, cheap resistor. Usually the tolerance of the resistance value is ±5%. Power ratings of 1/8W, 1/4W and 1/2W are frequently used. Carbon film resistors have a disadvantage; they tend to be electrically noisy. Metal film resistors are recommended for use in analog circuits. However, I have never experienced any problems with this noise. The physical size of the different resistors is as follows.



From the top of the photograph
1/8W
1/4W
1/2W

Rough size		
Rating power (W)	**Thickness (mm)**	**Length (mm)**
1/8	2	3
¼	2	6
½	3	9

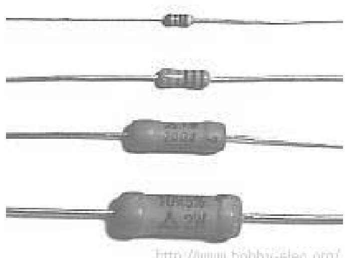
This resistor is called a Single-In-Line (SIL) resistor network. It is made with many resistors of the same value, all in one package.

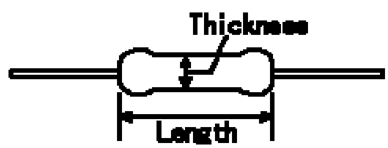


One side of each resistor is connected with one side of all the other resistors inside. One example of its use would be to control the current in a circuit powering many light emitting diodes (LEDs). In the photograph on the left, 8 resistors are housed in the package. Each of the leads on the package is one resistor. The ninth lead on the left side is the common lead. The face value of the resistance is printed. (It depends on the supplier.)

2) Metal film resistors

Metal film resistors are used when a higher tolerance (more accurate value) is needed. They are much more accurate in value than carbon film resistors. They have about ±0.05% tolerance. They have about ±0.05% tolerance. I don't use any high tolerance resistors in my circuits. Resistors that are about ±1% are more than sufficient. Ni-Cr (Nichrome) seems to be used for the material of resistor. The metal film resistor is used for bridge circuits, filter circuits, and low-noise analog signal circuits.





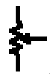
From the top of the photograph
1/8W (tolerance ±1%)
1/4W (tolerance ±1%)
1W (tolerance ±5%)
2W (tolerance ±5%)

Rough size		
Rating power (W)	**Thickness (mm)**	**Length (mm)**
1/8	2	3
¼	2	6
1	3.5	12
2	5	15

Variable Resistors

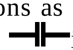
There are two general ways in which variable resistors are used. One is the variable resistor which value is easily changed, like the volume adjustment of Radio. The other is semi-fixed resistor that is not meant to be adjusted by anyone but a technician. It is used to adjust the operating condition of the circuit by the technician. Semi-fixed resistors are used to compensate for the inaccuracies of the resistors, and to fine-tune a circuit. The rotation angle of the variable resistor is usually about 300 degrees. Some variable resistors must be turned many times to use the whole range of resistance they offer. This allows for very precise adjustments of their value. These are called "Potentiometers" or "Trimmer Potentiometers."

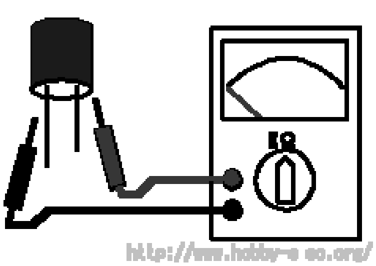
In the above photograph, the variable resistor typically used for volume controls can be seen on the far right. Its value is very easy to adjust. The four resistors at the center of the photograph are the semi-fixed type. These ones are mounted on the printed circuit board. The two resistors on the left are the trimmer potentiometers.

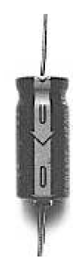
This symbol  is used to indicate a variable resistor in a circuit diagram.There is three ways in which a variable resistor's value can change according to the rotation angle of its axis. When type "A" rotates clockwise, at first, the resistance value changes slowly and then in the second half of its axis, it changes very quickly. The "A" type variable resistor is typically used for the volume control of a radio, for example. It is well suited to adjust a low sound subtly. It suits the characteristics of the ear. The ear hears low sound changes well, but isn't as sensitive to small changes in loud sounds. A larger change is needed as the volume is increased. These "A" type variable resistors are sometimes called "audio taper" potentiometers. As for type "B", the rotation of the axis and the change of the resistance value are directly related. The rate of change is the same, or linear, throughout the sweep of the axis. This type suits a resistance value adjustment in a circuit, a balance circuit and so on.

They are sometimes called "linear taper" potentiometers. Type "C" changes exactly the opposite way to type "A". In the early stages of the rotation of the axis, the resistance value changes rapidly, and in the second half, the change occurs more slowly. This type isn't too much used. As for the variable resistor, most are type "A" or type "B".

Capacitors

The capacitor's function is to store electricity, or electrical energy. The capacitor also functions as a filter, passing alternating current (AC), and blocking direct current (DC). This symbol  is used to indicate a capacitor in a circuit diagram. The capacitor is constructed with two electrode plates facing each other, but separated by an insulator. When DC voltage is applied to the capacitor, *an electric charge* is stored on each electrode. While the capacitor is charging up, current flows. The current will stop flowing when the capacitor has fully charged. The value of a capacitor (the capacitance), is designated in units called the Farad (F).



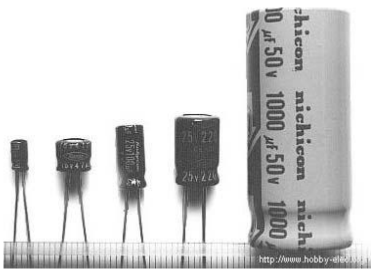


Breakdown voltage: When using a capacitor, you must pay attention to the maximum voltage which can be used. This is the " breakdown voltage." The breakdown voltage depends on the kind of capacitor being used. You must be especially careful with electrolytic capacitors because the breakdown voltage is comparatively low. The breakdown voltage of electrolytic capacitors is displayed as Working Voltage.
The breakdown voltage is the voltage that when exceeded will cause the dielectric (insulator) inside the capacitor to break down and conduct. When this happens, the failure can be catastrophic.

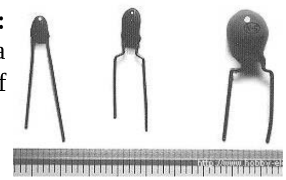
Types of capacitors

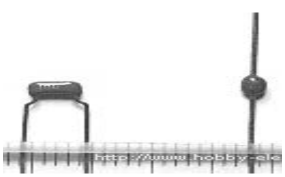
1) **Electrolytic Capacitors (Electrochemical type capacitors):** Aluminum is used for the electrodes by using a thin oxidization membrane. Large values of capacitance can be obtained in comparison with the size of the capacitor, because the dielectric used is very thin. The most important characteristic of electrolytic capacitors is that they have polarity. They have a positive and a negative electrode. [Polarized] This means that it is very important which way round they are connected. If the capacitor is subjected to voltage exceeding its working voltage, or if it is connected with incorrect polarity, it may burst. It is extremely dangerous, because it can quite literally explode. Make absolutely no mistakes.

The picture is an example of the different values of electrolytic capacitors in which the capacitance and voltage differ. From the left to right: 1µF (50V) [diameter 5 mm, high 12 mm], 47µF (16V) [diameter 6 mm, high 5 mm], 100µF (25V) [diameter 5 mm, high 11 mm], 220µF (25V) [diameter 8 mm, high 12 mm], 1000µF (50V) [diameter 18 mm, high 40 mm]. The size of the capacitor sometimes depends on the manufacturer. So the sizes shown here on this page are just examples. In the photograph to the right, the mark indicating the negative lead of the component can be seen. You need to pay attention to the polarity indication so as not to make a mistake when you assemble the circuit.



2) **Tantalum Capacitors:** Tantalum Capacitors are electrolytic capacitors that are use a material called tantalum for the electrodes. Large values of capacitance similar to aluminum electrolytic capacitors can be obtained.

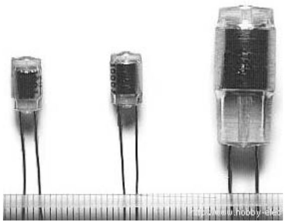




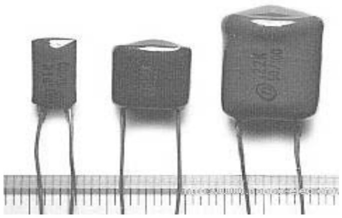
3) **Ceramic Capacitors:** Ceramic capacitors are constructed with materials such as titanium acid barium used as the dielectric. Internally, these capacitors are not constructed as a coil, so they can be used in high frequency applications. Typically, they are used in circuits which bypass high frequency signals to ground. These capacitors have the shape of a disk. Their capacitance is comparatively small.
The capacitor on the left is a 100pF capacitor with a diameter of about 3 mm. The capacitor on the right side is printed with 103, so 10 x 10^3pF becomes 0.01 µF. The diameter of the disk is about 6 mm. Ceramic capacitors have no polarity.
Ceramic capacitors should not be used for analog circuits, because they can distort the signal.

4) **Multilayer Ceramic Capacitors**

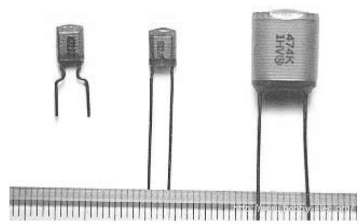
the multilayer ceramic capacitor has a many-layered dielectric. These capacitors are small in size, and have good temperature and frequency characteristics. Square wave signals used in digital circuits can have a comparatively high frequency component included. This capacitor is used to bypass the high frequency to ground.



5) **Electric Double Layer Capacitors (Super Capacitors):** This is a "Super Capacitor," which is quite a wonder. The capacitance is 0.47 F (470,000 µF). I have not used this capacitor in an actual Circuit. Care must be taken when using a capacitor with such a large capacitance in power supply circuits, etc. The rectifier in the circuit can be destroyed by a huge rush of current when the capacitor is empty. For a brief moment, the capacitor is more like a short circuit. A protection circuit needs to be set up. The size is small in spite of capacitance. Physically, the diameter is 21 mm, the height is 11 mm. Care is necessary, because these devices do have polarity.

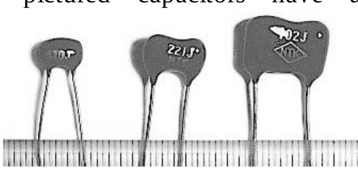


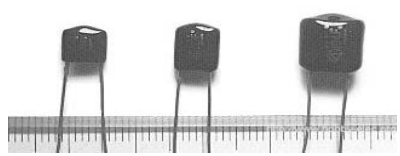
6) **Polyester Film Capacitors:**



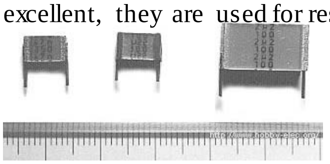
This capacitor uses thin polyester film as the dielectric. They are not high tolerance, but they are cheap and handy. Their tolerance is about ±5% to ±10%. Care must be taken, because different manufacturers use different methods to denote the capacitance values. Here are some other polyester film capacitors. These capacitors have no polarity.

7) **Polypropylene Capacitors:** This capacitor is used when a higher tolerance is necessary than polyester capacitors offer. Polypropylene film is used for the dielectric. It is said that there is almost no change of capacitance in these devices if they are used with frequencies of 100 KHz or less. The pictured capacitors have a tolerance of ±1%. These capacitors have no polarity.

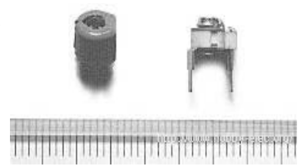




8) **Mica Capacitors:** These capacitors use Mica for the dielectric. Mica capacitors have good stability because their temperature coefficient is small. Because their frequency characteristic is excellent, they are used for resonance circuits, and high frequency filters. Also, they have good insulation, and so can be utilized in high voltage circuits. It was often used for vacuum tube style radio transmitters, etc.

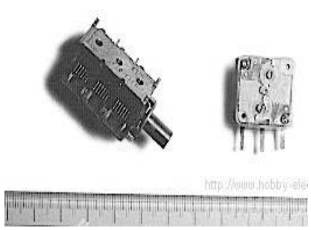


Mica capacitors do not have high values of capacitance, and they can be relatively expensive. These capacitors have no polarity.



9) **Metallized Polyester Film Capacitors:** These capacitors are a kind of a polyester film capacitor. Because their electrodes are thin, they can be miniaturized. These capacitors have no polarity.

Variable Capacitors: Variable capacitors are used for adjustment etc. of frequency mainly.



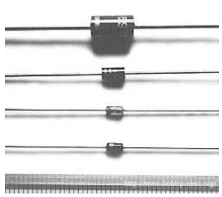
On the left in the photo graph is a "trimmer," which uses ceramic as the dielectric. Next to it on the right is one that uses polyester film for the dielectric. The pictured components are meant to be mounted on a printed circuit board.

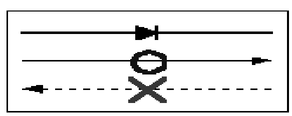
When adjusting the value of a variable capacitor, it is advisable to be careful.

One of the component's leads is connected to the adjustment screw of the capacitor. This means that the value of the capacitor can be affected by the capacitance of the screwdriver in your hand. It is better to use a special screwdriver to adjust these components. The components in the photograph on the right are used for radio tuners, etc. They are called "Varicons" but this may be only in Japan. The variable capacitor on the left in the photograph uses air as the dielectric.

Diodes

a diode is a semiconductor device which allows current to flow through it in only one direction. Although a transistor is also a semiconductor device, it does not operate the way a diode does. A diode is specifically made to allow current to flow through it in only one direction. Some ways in which the diode can be used are listed here.





1) A diode can be used as a rectifier that converts AC (Alternating Current) to DC (Direct Current) for a power supply device.
2) Diodes can be used to separate the signal from radio frequencies.
3) Diodes can be used as an on/off switch that controls current. This symbol is used to indicate a diode in a circuit diagram. The meaning of the symbol is (Anode) (Cathode). Current flows from the anode side to the cathode side.

Although all diodes operate with the same general principle, there are different types suited to different applications. For example, the following devices are best used for the applications noted.

- Voltage regulation diode (Zener Diode)

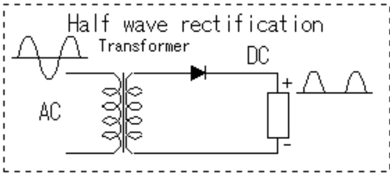
The circuit symbol is .

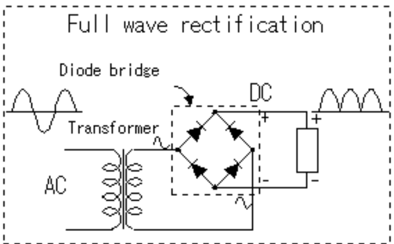
It is used to regulate voltage, by taking advantage of the fact that Zener diodes tend to stabilize at a certain voltage when that voltage is applied in the opposite direction.

- Light emitting diode

the circuit symbol is . This type of diode emits light when current flows through it in the forward direction. (Forward biased.)

- Variable capacitance diode the circuit symbol is .The current does not flow when applying the voltage of the opposite direction to the diode. In this condition, the diode has a capacitance like the capacitor. It is a very small capacitance. The capacitance of the diode changes when changing voltage. With the change of this capacitance, the frequency of the oscillator can be changed.





Rectification / Switching / Regulation Diode: The stripe stamped on one end of the diode shows indicates the polarity of the diode. The stripe shows the cathode side. The top two devices shown in the picture are diodes used for rectification. They are made to handle relatively high currents. The device on top can handle as high as 6A, and the one below it can safely handle up to 1A. However, it is best used at about 70% of its rating because this current value is a maximum rating.
The third device from the top (red color) has a part number of 1S1588. This diode is used for switching, because it can switch on and off at very high speed. However, the maximum current it can handle is 120 mA. This makes it well suited to use within digital circuits. The maximum reverse voltage (reverse bias) this diode can handle is 30V.
The device at the bottom of the picture is a voltage regulation diode with a rating of 6V. When this type of diode is reversing biased, it will resist changes in voltage. If the input voltage is increased, the output voltage will not change. (Or any change will be an insignificant amount.) While the output voltage does not increase with an increase in input voltage, the output current will. This requires some thought for a protection circuit so that too much current does not flow. The rated current limit for the device is 30 mA.
Generally, a 3-terminal voltage regulator is used for the stabilization of a power supply. Therefore, this diode is typically used to protect the circuit from momentary voltage spikes. 3 terminal regulators use voltage regulation diodes inside.

***Diode Bridge*:** Rectification diodes are used to make DC from AC. It is possible to do only 'half wave rectification' using 1 diode. When 4 diodes are combined, 'full wave rectification occurs. Devices that combine 4 diodes in one package are called diode bridges. They are used for full-wave rectification. The photograph on the right shows two examples of diode bridges.

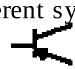
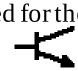
Transistors

the transistor's function is to amplify an electric current. Many different kinds of transistors are used in analog circuits, for different reasons. This is not the case for digital circuits. In a digital circuit, only two values matter; on or off. The amplification ability of a transistor is not relevant in a digital circuit. In many cases, a circuit is built with integrated circuits (ICs). Transistors are often used in digital circuits as buffers to protect ICs. For example, when powering an electromagnetic switch (called a 'relay'), or when controlling a light emitting diode.

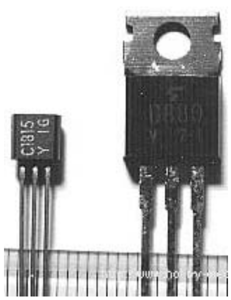
The name (standard part number) of the transistor, as well as the type and the way it is used is shown below.

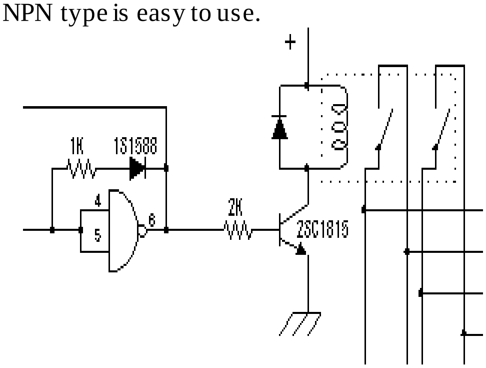
2SAXXXX PNP type high frequency
2SBXXXX PNP type low frequency
2SCXXXX NPN type high frequency
2SDXXXX NPN type low frequency.

Two different symbols are used for the transistor.

PNP type  and NPN type 

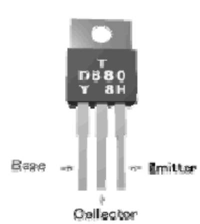
The direction of the current flow differs between the PNP and NPN type. When the power supply is the side of the positive (plus), the NPN type is easy to use.





Appearance of the Transistor:

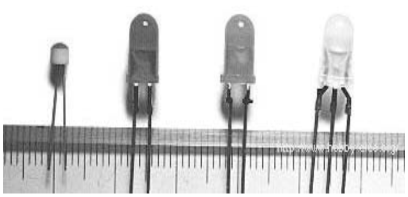
The outward appearance of the transistor varies. Here, two kinds are shown.On the left in the photograph is a 2SC1815 transistor, which is good for use in a digital circuit. They are inexpensive when I buy them in quantity. In Japan it costs 2,000 yen for a pack of 200 pieces. (About 10 US cents/piece in 1998) On the right is a device which is used when a large current is to be handled. Its part number is 2SD880.



Example of 2SC1815 transistor Part number is printed on the flat face of the transistor, and indicates the front. Right side: Base Center: Collector Left side: Emitter. Example of 2SD880 transistor Part number is printed on the flat face of the transistor, and indicates the front. Right side: Emitter Center: Collector Left side: Base 2SC1815 is opposite.

LED

- Light emitting diodes are components, which produces light when they are subjected to an electrical current or voltage. In other words they simply convert electrical energy into light energy.
- LED is similar to a PN junction diode. A PN junction diode can also emit light in response to an electric current.
- In LED the light energy is produced because holes and electrons are forced to recombine.
- When electron and holes recombines, energy may be released in the form of photon.
- LED is simply PN junction diode that emits light through the recombination of electrons and holes when current is forced through its junction.
- In Silicon and Germanium the greater percentage is given up in the form of heat and the emitted light is insignificant.



- In materials, such as gallium arsenide phosphide (GaAsP) or Gallium Phosphide (GaP), the number of photons of light energy emitted is sufficient to create a visible light source.

OPERATION OF LED

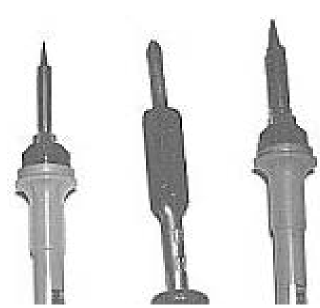
- The manner in which the LED operates is shown in Figure 15.1
- For the LED to operate it must be forward-biased so that the negative terminal of the battery will inject electrons into the N-layer (the cathode) and these electrons will move towards the junction.
- Corresponding holes will appear at the P-type or anode end of the diode and they will appear to move towards the junction. The electrons and holes merge towards the junction where they combine.
- If an electron possesses sufficient energy when it fills a hole, it can produce a photon of light energy.
- Many such combinations result in a substantial amount of light which is radiated from the device in the various directions.

WHY THE LED EMITS LIGHT AND ORDINARY DIODE DOES NOT?

- Most ordinary diodes are made from silicon and since it is opaque or impenetrable material hence any photons that are produced in an ordinary diode cannot escape whereas LEDs are made from semiconductor materials that are semi-transparent to light energy. Hence some of the light energy is able to escape from that device and hence emit light.

SOLDERING

The soldering is the basic work for electronic circuit engineering. I will introduce the tools for soldering below. The sufficient attention is necessary during work, because soldering handles a



high temperature. Pay attention to the handling of the soldering iron sufficiently, because it becomes burn, fire more, carelessly.

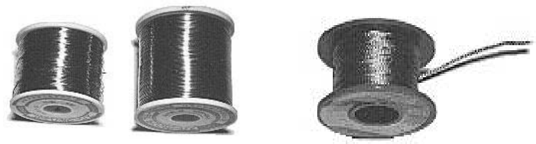
- When you are about to make or repair a fine piece of Electronic equipment which has been carefully engineered, but it must be made or repaired with just as much care if the unit is to operate at the rated specifications.
- The most important factor in making or repairing equipment is Soldering. An electronic unit will not work unless it is soldered properly.
- Proper soldering is most important to learn, since 90% of all service problems are due to bad solder connections. If you are not experienced at soldering, a few minutes practice with some odd lengths of wire on any PCB (Printed Circuit Board) will be helpful.
- The PCB has two sides-one plain or marked and the other a copper foil side. You have to fit all the components on the plain side and solder the leads on the copper foil side.
- A good solder connection will form an electrical connection between the copper foil and the component lead. Read the following instructions and study the pictorials of soldering.

RULES FOR GOOD SOLDERING

- Use the right type of soldering iron. A small efficient soldering iron (about 10 to 25 W atts with a 1/8" or 1/4" tip) is ideal for circuit board work. Pencil Bit soldering iron made by Sold Ron works best. The soldering iron will reach its operating temperature within 3 to 5 minutes after it is switched 'ON' and should be left 'ON' during the working period.
- Keep the hot tip of the soldering iron on a piece of metal so that excess heat is dissipated.
- Make sure that the connection to be soldered is clean. Wax frayed isolations and other foreign substances cause poor connections. Clean the component leads, wires, lugs, etc. with a blade or a knife to remove the rust and dust before soldering.
- Use just enough solder to cover the lead and the copper foil area of the connection to be soldered. Excess solder can bridge across from one foil path to another and cause a short circuit.
- Use sufficient heat. This is the essence of good soldering. Apply enough heat to the foil and the lead to allow the solder to spread freely. You are not using enough heat, if the solder barely melts and forms a round ball of rough flaky solder. A good soldered joint will look smooth, shining and solder spreader. The difference between good (sufficiently heated) and poor soldering (insufficiently heated) is just a few extra seconds with a lot iron applied firmly.
- Check the connection. Compare it with the illustration or with the solder joints made at the factory. A well soldered joint should look smooth and bright and the solder should adhere evenly to both the wire and the circuit board foil.
- Remember larger metal surfaces take longer time to heat.

Disordering wire

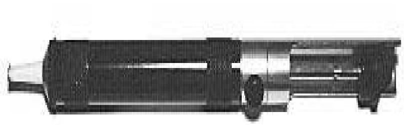
This is made of thin copper net wire like a screen cable in a co axial cable. Like water inhales to cloth, the solder is absorbed to the net wire by a capillary tube phenomenon. The usage is shown below. Apply the disordering wire to the part that wants to take solder. Apply the soldering iron from the top and Melt the solder. The melted solder is absorbed to disordering wire with a capillary tube phenomenon. At this time you absorb solder while shifting disordering wire.



Solder pump

This is the tool that can be absorbed the melted solder with the repulsion power of the spring that was built in with the principle of the piston. The usage is shown below.

Push down the knob of the upper part of the pump against to spring until it is locked. Melt the solder of the part that wants to absorb solder with iron. Apply the nozzle of the pump to the melted solder part. Push the release knob of pump. Then the plunger of the pump is pushed up with the power of spring and solder is absorbed inside the pump. You need to do this operation quickly; otherwise the part gets damage by the heat. A little practice is needed.



Cautions:

- Do not use excess solder because it might block the other unused holes or may form a solder bridge between two copper foil tracks.
- Does not use or spread on copper foil lines on the PCB as these lines function as connection wire?
- Do not sit under a fan while soldering.
- Position the PCB so that gravity tends to keep the solder where you want it.
- Do not overheat the components or the PCB . Excess heat may spoil the PCB or damage the components.
- The PCB or components should not vibrate while soldering otherwise you will have a dry or a cold joint.
- In case of dry solder, re-weld the joint to get a shiny bright finish.

STEPS FOR SOLDERING

- As a general guide, the soldering time for Circuit Board Connection is 2 to 3 minutes. Does not use flux as solder supplied contains flux. If extra solder is needed, be sure to use 60% tin-40% lead composition solder. Never use sand paper or other cleaning material on the board.
- Notice how the parts are mounted in the given illustration and held in place by bending the leads a little on the copper foil side. Do not bend the leads flat against the foil because they may cross-over the brown plastic to another foil-path bend them at 45 degrees angle with the PCB.
- Push the clean and hot soldering iron tip against both, the leads and the circuit board foil. Heat both for two or three seconds. Do not remove the soldering iron.
- Touch the solder tip to the other side of the connection. Important: Let the heated lead and the circuit board foil melt the solder. Do not touch the solder directly onto the soldering tip.
- Remove the solder as soon as it begins to melt. Allow it to flow around the connection, then remove the iron and let the connection cool.

- After the solder has hardened clip off the wire close to the circuit board foil.

Electronic Instruments

Those instruments which employ electronic devices for measuring various electrical quantities (e.g. voltage, current, resistance etc.) are known as **electronic instruments.**

There are a large number of electronic instruments available for completion of various tests and measurements. However, in this chapter, we shall confine our attention to the following electronic instruments:

(i) Multimeter (ii) Vacuum tube voltmeter (VTVM)

(iii) Cathode ray oscilloscope.

The knowledge of the manner in which each instrument is used plus an understanding of the applications and limitations of each instrument will enable the reader to utilize such instruments successfully.

Multimeter: A multimeter is an electronic instrument which can measure resistances, currents and voltages. It is an indispensable instrument and can be used for measuring d.c. as well as a.c. voltages and currents. Multimeter is the most inexpensive equipment and can make various electrical measurements with reasonable accuracy.

Construction: A multimeter consists of an ordinary pivoted type of moving coil galvanometer. This galvanometer consists of a coil pivoted on jeweled bearings between the poles of a permanent magnet. The indicating needle is fastened to the coil. When electric current is passed through the coil, mechanical force acts and the pointer moves over the scale.

Functions: A multimeter can measure voltages, currents and resistances to achieve this objective. Proper circuits are incorporated with the galvanometer. The galvanometer in a multimeteris always of left zero type i.e. normally its needle rests in extreme left position as compared to center zero position of ordinary galvanometers.

Applications of Multimeter

A multimeter is an extremely important electronic instrument and is extensively used for carrying out various tests and measurements in electronic circuits. It is used:

(i) For checking the circuit continuity. When the multimeter is employed as continuity checking device, the ohmmeter scale is utilized and the equipment to be checked is shut off or disconnected from the power mains.

(ii) For measuring d.c. current flowing through the cathode, plate, screen and other vacuum tube circuits.

(iii) For measuring d.c. voltage across various resistors in electronic circuits.

(iv) For measuring a.c. voltages across power supply transformers.

(v) For ascertaining whether or not open or short circuit exists in the circuit under study.

Sensitivity of Multimeter

The resistance offered per volt of full scale deflection by the multimeter is known as *multimeter sensitivity.*

Merits and Demerits of Multimeter

Although multimeter is widely used for manufacturing and servicing of electronics equipment, it has its own merits and demerits.

Merits

(i) It is a single meter that performs several measuring functions.
(ii) It has a small size and is easily portable.
(iii) It can make measurements with reasonable accuracy.

Demerits

(i) It is a costly instrument. The cost of a multimeter having sensitivity of 20 per volt is about Rs.1000.
(ii) It cannot make precise and accurate measurements due to the loading effect.
(iii) Technical skill is required to handle it.

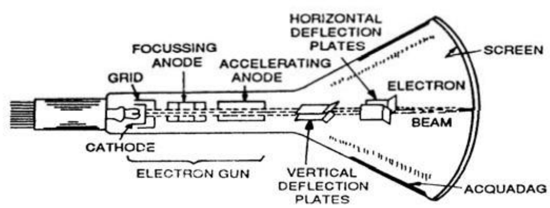
Cathode Ray Oscilloscope (CRO)

The cathode ray oscilloscope (commonly abbreviated as CRO) is an electronic device which is capable of giving a visual indication of a signal wave form. No other instrument used in the electronic industry is as versatile as the cathode ray oscilloscope. It is widely used for trouble shooting radio and television receivers as well as for laboratory work involving research and design. With an oscilloscope, the wave shape of a signal can be studied with respect to amplitude distortion and deviation from the normal. In addition, the oscilloscope can also be used for measuring voltage, frequency and phase shift.

In an oscilloscope, the electrons are emitted from a cathode accelerated to a high velocity, and brought to focus on a fluorescent screen. The screen produces a visible spot where the electron beam strikes. By deflecting the electron beam over the screen in response to the electrical signals, the electrons can be made to act as an electrical pencil of light which produces a spot of light wherever if strikes. An oscilloscope obtains its remarkable properties as am measuring instrument form the fact that it uses as an indicating needle a beam of electrons. As electrons have negligible mass, therefore they respond almost instantaneously when acted upon by an electrical signal and can trace almost any electrical variation no matter how rapid. A cathode ray oscilloscope contains a cathode ray tube and necessary power equipment to make it operate.

Cathode Ray Tube

A cathode ray tube (commonly abbreviated as CRT) is the heart of the oscilloscope. It is a vacuum tube of special geometrical shape and converts an electrical signal into visual one. A cathode ray tube makes availability plenty of electrons. These electrons are accelerated to high velocity and are brought to focus on a fluorescent screen. The electron beam produces a spot of light wherever it strikes. The electron beam is deflected on its journey in response to the electrical signal under study. The result is that electrical signal waveform is displayed visually. Fig. Shows the various parts of cathode ray tube.



(i) **Glass envelope.** It is conical highly evacuated glass housing and maintains vaccum inside and supports the various electrodes. The inner walls of CRT between neck and screen are usually coated with a conducting material, called aquadag. This coating is electrically connected to the accelerating anode so that electrons which accidentally strike the walls are returned to the anode. This prevents the walls of the tube form charging to a high negative potential.

(ii) **Electron gun assembly.** The a rrangement of electrod es which produce a focused beam of electrons is called the electron gun. It essentially consists of an indire ctly heated cathode, a control grid, a focusing anode and an accelerating anode. The control grid is held at neg ative potential w.r.t. cathode whereas the two anodes are maintained at hi gh positive potential w.r.t. cathode.

The cathode consists of a nickel cylinder coated with oxide coating and provides plent y of electrons. The control grid encloses the cathode and consists of a metal c ylinder with a tin y circular opening to keep the electron beam small in size. The focusing anode focuses the electron beam into a sharp pin-point by controlling the positive potential on it. The positive potential (about 10,000V) on the acc elerating anode is much hi gher than on the focusing anode. For this reason, this anode accelerates the n arrow beam to high velocity. Therefore, the el ectron gun assembly forms a narro w, accelerated beam of electrons which produces a spot of l ight when i t strikes the screen.

(iii) **Deflection plate assembly.** The deflection of the beam is accomplished by two sets of d eflecting plates placed within the tube beyond the accelerating anode as shown in Fig. 24.17. One set is the vertical deflection plates and the other set is the horizontal deflection plates.

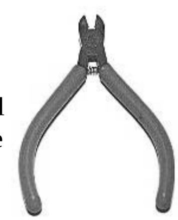
The vertical deflection plates are mounted horiz ontally in the tube. By applying proper potential to these plates, the electron beam can be made to move up and down vertically on the fluoresc ent screen. The horizontal deflection plates are mounted in the v ertical plane. An appropriate potential on t hese plate can caus e the electron beam to move right and l eft horizontally on the screen.

(iv) **Screen.** The scre en is the inside face of t he tube and i s coated with some fluorescent material such as zinc orthosilicate, zinc oxide etc. When high velocity electron beam strikes the screen, a spot of light is produced at the point of impact. The colour of the spot dep ends upon the nature of fluorescent material. If zinc orthosilicate is used as t he fluorescent material, green light spot is produced.

(v) **Action of CRT.** When the cathode is heated, it emits pl enty of el ectrons. These electrons pass through control grid on their way to screen. The control grid influences the amount of currents flow as in standard vacuum tubes. If negative potential on the control grid is high, fewer electrons will pass through it and the electron beam on striking the screen will produce a dim spot of light. Reverse will happen if the negative potential on the control grid sis reduced. Thus, the intensity of light spot on the screen can be changed by changing the negative potential on the control g rid. As the electron b eam leaves the control grid, it comes under the influ ences of fo cusing and accelerating anode. As t he two anodes are maintained at hi gh positive potential, therefore, they produce a field which acts as an electrostatic lens to converge the electron beam at a point on the screen.

ELECTRONIC TOOLS

When you make an electronic circuit, the work which does the component lead of parts straight or bends the lead or cuts the lead is needed. When handling a small part, the tool tha t the tip is sha rp is ne eded. The following are some of the example of frequently used tools for repairing or making a electronics circuit.



Needle Pliers: This is the pliers with thin cutting tip. It is very convenient to restrain, and also to hold the parts at narrow place. It is used to make straight the component lead. I think that a smaller one is Convenient than a big one. This tool is necessary to electronic circuit making.

Wire Cutter (Nipper): This tool is used when cut the wire or cut the component lead.
The one that the top is pointed is good. Even this, the small one is convenient. There is a type that a ditch for the wire cut is put to the blade. It isn't possible to use when the thickness of the wire doesn't fit. Be careful so as not to be injured because the blade is sharp. This tool is necessary to electronic circuit making.

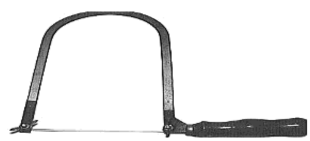
Screwdriver

The tip of the screwdriver has various shapes. Plus, Minus, Box, Gimlet.... Recently, the plus screw is often used. But the usage of a screwdriver is not only tightens, loosen a screw. I might do the case force open. In that case, the minus style screwdriver is useful. There are several kinds of sizes at the tip of driver. In the case of a plus screw, it is necessary to use the driver suitable for size especially. Otherwise, the slot of the head of a screw may be broken. The screwdriver of the photograph right edge is a screwdriver for adjustment frequency. It is called "Trimming screwdriver ". Only the top is made with the metal. Other is acrylic. Therefore the trimmer or, the coil can be adjusted without influence of the static electricity of the human body.

Tweezer

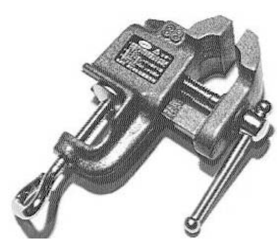
this is a convenient tool to hold small part. I use the top bending type. It is your selection as you like.

Small size saw: This is the tool that cuts the aluminum, acrylic of the case and also cut the print board.



The one that is about 6 mm of the width about 15 cm of the length of the edge is convenient when you want to cut the length of some extent like a straight line. The thread saw is the thing of the thickness of about 0.3 mm, the width of about 1 mm, the length of about 13 cm of the edge. It is convenient when you want to cut it like a curve. The tool of this category has a lot of kinds.

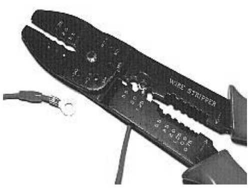
Vise



this is used to fix firmly when you shave the case and also shave the print board. It is convenient when a small vise is prepared. The photograph thing is a small vise; the maximum width which can be fixed is about 40 mm.

Hex key wrench: In the general screw, there is a ditch with plus or minus However; there is a screw which has a hex hole. This wrench is the tool to strangle or to loosen such screw.

Picking-up tool: This tool is to pick up the part which had rolled on the narrow place. The four thin wires go out from the tip when pushing the red knob. When remove the power which pushes the knob, the wire returns to the case with the spring and can grasp the part.



The crimp-style terminal press: This is the tool which connects the crimp-style terminal and the wire. The tool which I am using can use the terminal of 1.25 mm, 2.0 mm, 5.5 mm. The crimp-style terminal has the various kinds according to the thickness of the wire, the size of hole of the terminal and so on. The tool which I am using can do the cutting of the screw, the cut of the wire cover as well as the press work of the crimp-style terminal.

DIGITAL ELECTRONICS

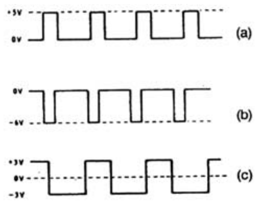
The branch of electronics which deals with digital circuits is called *digital electronics*. When most of us hear the term digital, we immediately think of "digital calculator" or "digital computer". This is attributed to the dramatic way the low-cost, powerful calculators and computers have become accessible to an average person. Now digital circuits are being used many electronics products such as video games, microwave ovens, and oscilloscopes. Digital techniques have also replaced a lot of older "analog circuits" used in consumer products such as radios, TV sets and high-fidelity sound recording and playback equipment. In this chapter, we shall discuss the fundamental aspects of digital electronics.

ANALOG SIGNALS:

- There are two basic types of electronic signals and techniques, analog and digital.
- Analog signals are the most familiar type. An analog signal is an ac or dc voltage or current that varies smoothly or continuously. It is one that does not change abruptly or changes in steps.
- An analog signal can exist in a wide variety of forms. Several types of analog signals are shown in Figure 1.1.
- Figure 1.1a shows the most common type of analog signal, a sine wave. A significant number of electronics signals are sinusoidal in nature. Radio signals and audio tones are examples of such analog signals.
- A fixed dc voltage is also an analog signal. Figure 1.1b shows a constant positive dc voltage.
- Another type of analog signal is a/ varying dc voltage or current. A changing negative dc voltage is illustrated in Figure1.1c.
- Any random but continuously varying waveform is considered to be analog signal. The signal shown is Figure 1.1d is one of an infinite variety of such signals. Electronic circuits that process these analog signals are called linear circuits.

DIGITAL SIGNALS:

- Digital signals are essentially a series of pulses or rapidly changing voltage levels that vary in discrete steps or increments.
- Digital signals are pulses of voltage that usually switch between two fixed levels. Figure 1.2 shows several types of digital signals. Notice how these signals switch between two distinct voltage levels.
- In figure the two levels are 0 (ground) and +5 volts.



WHY USE DIGITAL TECHNIQUES?

- The primary reason for use of digital techniques has been the availability of low cost, digital integrated circuits (ICs).
- Advancement in integrated circuit technology has produced many excellent low cost digital circuits. Such circuits are small, inexpensive and very reliable.
- Medium and Large scale (MSI AND LSI) integrated devices can replace entire circuits and instruments. As a result electronic equipment designers have recognized the availability of such devices and have begun to take advantage of them.
- Basically there are two types of devices: bipolar and unipolar. Digital ICs are fabricated by employing either the bipolar or the unipolar technologies and are accordingly referred to as bipolar logic family or unipolar logic family.

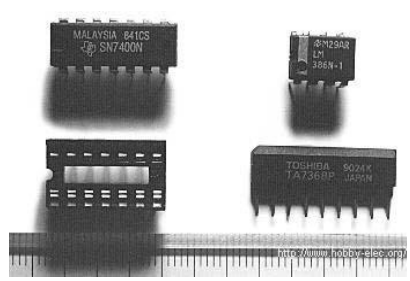
INTEGRATED CIRCUITS (IC's)

The circuits discussed so far in the next consisted of separately manufactured components (e.g. resistors, capacitors, diodes, transistors etc.) joined by wires or plated conductors or printed boards. Such circuits are known as *discrete circuits* because each component added to the circuit is discrete distinct or separate) from the others. Discrete circuits have two main disadvantages, Firstly, in a large circuit (e.g. TV circuits, computer circuits) there may be hundreds of components and consequently discrete assembly would occupy a large space. Secondly, there will be hundreds of soldered points posing a considerable problem of reliability. To meet these problems of space conservation and reliability, engineers started a drive for miniaturized circuits. This led to the development of micro-electronics in the late 1950s.

Micro-electronics is the branch of electronics engineering which deals with micro-circuits. A micro-circuit is simply a miniature assembly of electronic components. One type of such circuit is the *integrated circuit*, generally abbreviated as IC. An integrated circuit has various components such as resistors, diodes, transistors etc. fabricated on a small semiconductor chip. How circuits containing hundreds of components are fabricated on a small semiconductor chip to produce an IC is a fascinating feat of micro-electronics. This has not only fulfilled the ever-increasing demands of industries for electronic equipment of smaller size, lighter weight and low power requirements, but it has also resulted in high degree of reliability. In this chapter, we shall focus our attention on the various aspects of integrated circuits.

Integrated Circuits

An **integrated circuit** *is one in which circuit component such as transistor, diodes; resistor, capacitors, etc. are automatically part of a semiconductor chip*.



An integrated circuits consist of a number of circuit components (e.g. transistor, diodes, resistor etc.) and their inter connections in a signal small package to perform a complete electronic function. These components are formed and connected within a small chip of semi-conductor material. The following points are worth noting about integrated circuits:

i. In an IC, the various components are automatically part of a small semi-conductor chip and the individual components cannot be removed or replaced. This is in contrast to discrete assembly in which individual components can be removed or replaced if necessary.
ii. The size of an *IC is externally small. In fact ICs are so small that you normally need a microscope to see the connections between the components. Fig. 25.1. Shows a typical semi-conductor chip having dimensions 0.2 mm × 0.2 mm × 0.001 mm. It is possible to produce circuits containing many transistors, diodes, resistors etc. on the surface of this small chip.
iii. No components of an IC are seen to project above the surface of the chip. This is because all the components are formed within the chip.

Advantage and Disadvantages of Integrated Circuits

Integrated circuits free the equipment designer from the need to construct circuits with Individual discrete components such as transistors, diodes, and resistors. Which the exception of a few very simple circuits, the available of a charge, number of low-cost integrated circuits has largely rendered discrete circuitry obsolete. It is, therefore, desirable to mention the significant advantages of integrated circuits over discrete circuits. However, integrated circuits have some disadvantages and continuous efforts are on to overcome them.

Advantages. Integrated circuits possess the following advantages over discrete circuits:

i. Increased reliability due to lesser number of connections.
ii. Extremely small size due to the fabrication of various circuit elements in a signal chip of semi-conductor material.
iii. Lesser weight and **space requirement due to miniaturized circuit.
iv. Low power requirement.
v. Greater ability to operate at extreme values of temperature.
vi. Low cost because of simultaneous production of hundreds of alike circuits on a small semi-conductor wafer.
vii. The circuit lay out is greatly simplified because integrated circuits are constrained to use minimum number of external connections.

Disadvantages The disadvantages of integrated circuits are :

i. If any component is an IC goes out of order, the whole IC has to be replaced by the new one.
ii. In an IC, it is neither convenient nor economical to fabricate capacitances exceeding 30pF. Therefore, for high values of capacitance, discrete components exterior to IC chip are connected.
iii. It is not possible to fabricate inductors and transformers on the surface of semi-conductor chip. Therefore, these components are connected exterior to IC chip are connected.
iv. It is not possible to fabricate inductors and transformers on the surface of semi-conductors chip. Therefore, these components are connected exterior to IC chip are connected.
v. There is a lack of flexibility is an IC i.e., it is generally not possible to modify the parameters within which an integrated circuit will operate.

IC Classifications

Four basic types of constructions are employed in the manufacture of integrated circuits, namely

i. Mono-lithic
ii. Thin-film
iii. Thick-film
iv. Hybrid.

Monotype ICs are by far the most common t ype used in practice. Therefore, in this chapter we shall confirm our attention to the construction of this type of ICs only. It may be worthwhile to mention here that regardless of the type of method used to fabricate active and passive components, the basic characteristics and circuits operation of an IC are the same as for any of their counterparts in a similar circuit using separate circuit components.

Making monolithic IC

A **monolithic IC** is one in which all circuit components a nd their inter-connections are formed on a single wafer called the substrate.

Fabrication of Component on Monolithic IC

The notable feature of an IC is that it comprises a number of circuit elements inseparably associated in a sing le small pack age to pe rform a complete electronics fun ction. This differs from discr ete assembly where separately manufactured components are joined by virus. We shall now

IC Packing

In order to protect ICs form external environment and to provide mechanical protection, various form of encapsulation are used for integrated circuits. Just as with semi-conductor devices, IC packages are of two types viz.

i. Hermatic (metal or ceramic with glass)
ii. Non-hermatic (plastics)

IC Symbols

In general, no standard symbols exist for ICs. Often the circuits diagram merely shows a block with numbered terminals. However, sometimes standard symbols are used for operational amplifiers or digital logic gates. Some of the symbols used with ICs are shown below.

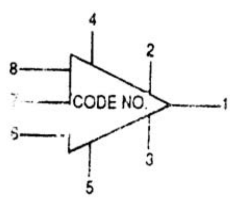


Fig. 25.13

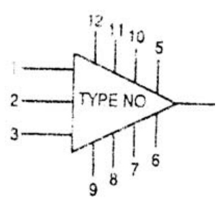


Fig. 25.14

Shows the symbol of a n IC r-f am plifier containing 3 t ransistors, 3 resi stors, and 8 t erminals. Similarly, Fig. shows an IC audio amplifier which contains 6 transistors 2 diodes, 17 resistors and has 12 terminals.

Scale of Integration

An IC chip may contain as large as 100,000 semiconductor device or other components. The relative number of these components within the chip is given by referring to its scale of integration. The following terminology is commonly used.

Scale of integration	Abbreviation	Number of components
Small	*SSI	1 to 20
Medium	MSI	20 to 100
Large	LSI	100 to 1000
Very large	VLSI	1000 to 10,000
Super large	SLSI	10,000 to 100,000

Microprocessors:

- A microprocessor is a multipurpose, programmable logic device that reads binary instructions from a storage device called memory accepts binary data as input and processes data according to those instructions and provides results as output.
- A typical programmable machine can be represented with three components i.e. microprocessor, memory and I/O. These three components work together or interact with each other to perform a given task; thus, they comprise a system.
- The physical components of this system are called **hardware.**
- A set of instructions written for the microprocessor to perform a task is called a program, and a group of programs is called **software.**

Binary Digits:

- The microprocessor operates in binary digits, 0 and 1, also known as bits.
- Bit is an abbreviation for the term binary digit. These digits are represented in terms of electrical voltages in the machine: generally, 0 represents low voltage level and 1 represents high voltage level.

WHAT MICROPROCESSOR MEANS?

- Each microprocessor recognizes and processes a group of bits called the word.
- The microprocessor is classified according to their word length. For example a processor with an 8-bit word is known as an 8-bit microprocessor and a processor with a 32-bit word is known as a 32-bit microprocessor.

A Microprocessor as a Programmable Device:

- The microprocessor is programmable means it can be instructed to perform given tasks within its capability.
- A piano is a programmable machine i.e. it is capable of generating various kinds of tones based on the number of keys it has. A musician selects keys depending upon the musical score printed on a sheet.
- Similarly, today's microprocessor is designed to understand and execute many binary instructions. It is a multipurpose machine i.e. it can be used to perform various sophisticated computing functions, as well as simple tasks such as turning devices on or off.
- A programmer can select appropriates instructions and ask the microprocessor to perform various task on a given set of data.

Memory:

- Memory is like the pages of a notebook with space for a fixed number of binary numbers on each line.
- These pages are generally made of semiconductor material.
- Typically, each line is an 8-bit register that can store eight binary bits, and several of these registers are arranged called memory. These register are always grouped together in powers of two.
- For example. A group of 1024 (2^{10}) 8-bit registers on a semiconductor chip is know as 1K byte of memory; 1K is the closest approximation in thousand. The user writes the necessary instructions and data in memory; 1K is the closest approximation is thousand. The user writes the necessary instruction and data in memory through an input device and asks the microprocessor to perform the given task and find an answer. The answer is generally displayed at an output device or stored in memory.

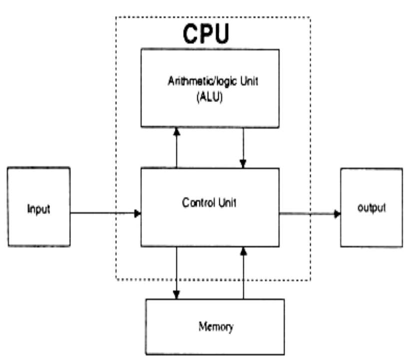
Input/Output:

- The user can enter instructions and data into memory through device such as a keyboard or simple switches. These devices are called **input devices.**
- The microprocessor reads the instruction from the memory and processes the data according to those instructions.
- The results can be displayed by a device such as seven-segment LEDs (Light Emitting Diodes) or Printed by a printer. These devices are called **output devices.**

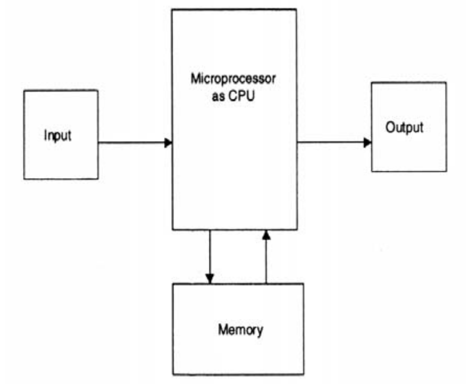
MICROPROCESSOR AS A CPU

- The microprocessor is a primary component of a computer.
- The block diagram shows that the computer has four components: Memory, Input, Output, and the Central Processing Unit (CPU), which consists of the Arithmetic/Logic Unit (ALU) and Control Unit.
- The CPU contains various registers to store data, the ALU to perform arithmetic and logical operations, instruction decoder, counters and controls lines.
- The CPU reads instructions from the memory and performs the tasks specified.
- CPU communicates with input/output devices either to accept or to send data. These devices are known as peripherals.
- The CPU is the primary device in communicating with devices such as memory, input and output. However, the group of circuits called the control the timing of the communication process.

BLOCK DIAGRAM OF A COMPUTER



BLOCK DIAGRAM OF A COMPUTER WITH MICROPROCESSOR



MICROPROCESSOR INSTRUCTION SET AND COMPUTER LANGUAGES

- Microprocessor recognizes and operates in binary numbers.
- Each microprocessor has its own binary words, meanings and language.
- The words are formed by combining a number of bits for a given machine.
- **WORD:** is defined as t he number of bits the microprocessor recognizes and processes at a time. The word length ranges from four bits for small, microprocessor-based systems to 64 bits for high-speed large computers. Another term commonly used to express word length is **byte.**

- **BYTE:** is defined as a g roup of 8 bits. F or e.g. a 16 bit m icroprocessor has a word leng th equal to two bytes.
- **NIBBLE:** which stands for a group of 4 bits? A byte has two nibbles.
- Each machine has its o wn set of instructions based on the d esign of its CPU or of its microprocessor. To com municate with the computer, one must give instructions in binar y language (Machine language)**.**
- It is difficult for most people to write programs in sets of 0s and 1s, computer manufacturers have devised English-like words to represent language programs, using these words.
- An assembly language is specific to a given machine; programs written in assembly language are not tr ansferable from one machine to a nother. To ove rcome this limitation general-purpose languages as BASIC and FORTRAN have been devised; a program written in these languages can be machine independent. These languages are called high-level languages**.**

Machine Language:

The number of bits in a word for a given machine is fixed and words are formed throug h various combinations of these bits. For example, a machine with a word length of eight bits can have 256 (2^8**)** a combination of eight bits-thus a l anguage of 256 words. However, not all of these words need to be used in the machine. The microprocessor design engineer selects combinations of bit patterns and gives a specific meaning to each combination by using electronic logic circuits; this is called an instruction. Instructions are made up of one word or sev eral words. The set of instructions designed into the machine makes up its ma chine language - a binary language composed of 0s and 1s – that is specific to each computer.

- Machine language and assembly language are microprocessor-specific and both are considered as low-level language.
- The machine language is in binary and the assembly language is in English-like words; however, the microprocessor understands only the binary. Hence all the assembly language mnemonics are to be translated into the machine language or binary code.
- The mnemonics can be written electronically on a computer using a program called an editor in the ASCII code and translated into a binary code by using the program called an assembler.

- The assembler is a program that translates the mnemonics entered by the ASCII keyboard into the corresponding binary machine codes of the microprocessor. Each microprocessor has its own assembler because the mnemonics and machine codes are specific to the microprocessor being used and each assembler has rules that must be followed by the programmer.

High Level Languages:

- Programming languages that are machine independent are called high level languages.
- These includes languages like FORTRAN, BASIC, PASCAL, C.C++ all of which have certain set of rules, symbols and conventions from English.
- Instructions written in high level languages are known as statements rather than mnemonics in the case of assembly language.
- Now the question arises is how the words in English is converted into binary languages of different microprocessors? The answer is through a program called as Interpreter or a Compiler.
- Interpreter or Compiler accepts English-like statements as their input called the source code.
- The compiler or interpreter then translates the source code into the machine language compatible with the microprocessor being used in the system. This translation in the machine language is called the object code.
- Each microprocessor needs of its own compiler or an interpreter for each high level language.
- The primary difference between a compiler and a interpreter lies in the process of generating machine code.
- The Compiler reads the entire program first and translated it into the object code that is executed by the microprocessor.
- The interpreter reads one instruction at a time, produces its object code and executes the instruction before reading the next instruction.
- Compiler and Interpreters require large memory space because instruction in English requires several machine codes to translate it into binary. On the other hand, there is one to one correspondence between the assembly language mnemonics and the machine code. Thus, assembly language programs are compact and require less memory space. They are more efficient than the high level language programs.
- The primary advantage of high-level languages is a trouble shooting part. It is much easier to find errors in a program written in high level language than to find them in a program written in an assembly language.

MICROPROCESSOR ARCHITECTURE AND ITS OPERATIONS

- The microprocessor is a programmable logic device, designed with register, flip-flops and timing elements.
- The microprocessor has set of instructions, designed internally, to manipulate data and communicate with peripherals.

- The process of data manipulation and communication is determined by the logic design of the microprocessor, called the architecture.
- The microprocessor can be programmed to perform functions on given data by selecting necessary instruction from its set. These instructions are given to the microprocessor by writing them into its memory.
- Writing instruction and data is done through an input device such as a keyboard.
- The microprocessor reads or transfers on instruction at a time, matches it with its instruction set and performs the data manipulation indicated by the instruction.
- The result can be stored in memory or sent to such output devices as LEDs or a CRT terminal.
- In addition, the microprocessor can respond to external signals. It can be interrupted, reset or asked to wait to synchronize with slower peripherals.
- All the various functions performed by the microprocessor can be classified in three general categories.
- Microprocessor-initiated operations.
- Internal data operations.
- Peripheral (or externally initiated) operations.
- To perform the above functions the microprocessor requires a group of logic circuits and a set of signals called control signals.
- Early processors did not have the necessary circuitry on one chip; the complete units were made up of more than one chip. Therefore, the term microprocessor unit (MPU) is defined here as a group of devices that can perform these functions with the necessary set of control signals. This term is similar to the term central processing unit (CPU).
- However, later microprocessor includes most of the necessary circuitry to perform these operations on a single chip. Therefore, the terms MPU and microprocessor are often used synonymously.

MICROPROCESSOR INITIATED OPERATIONS AND ITS BUS ORGANIATION

- The MPU performs primarily four operations:
  1: Memory Read: Reads data (or instructions) from memory.
  2: Memory Write: Writes data (or instructions) into memory.
  3: I/O Read: Accepts data from input devices.
  4: I/O Write: Sends data to output devices.
  All these operations are part of the communications process between the MPU and the peripheral devices (including memory).
- To communicate with the peripheral or a memory location the MPU needs to perform the following steps :
  1: Identify the peripheral or the memory location (with its address)
  2: Transfer data.
  3: Provide timing or synchronization signals.
- The 8085 MPU performs the above functions using three sets of communication lines called buses: the address bus, the data bus and control bus.

Address Bus:

- The address bus is group of 16 lines generally identified as A_0 to A_{15}. The address bus is **unidirectional:** bits flow in one direction – from the MPU to peripheral devices.
- The MPU uses the address bus to perform the **first function :** identifying a peripheral or a memory locations.

- In a computer system, each peripheral or memory location is identified by a binary number, called an **address,** and the address bus is used to carry a 16-bit address.
- The number of address lines of the MPU determines its capacity to identify different memory locations (or peripherals).
- The 8085 MPU with its 16 address lines is capable of addressing 2^{16} = 65,536 (generally known as 64K) memory locations. (1K = 1024).

Data Bus:

- The data bus is a group of eight lines used for data flow. These lines are bidirectional data flow in both directional between the MPU and memory and peripheral devices.
- The MPU uses the data bus to perform the **second function** i.e. transferring data
- The eight data lines enable the MPU to manipulate 8-bit data ranging from 00 to FF.
- The largest number that can appear on the data bus is 11111111.
- The 8085 is also known as 8-bit microprocessor.
- Microprocessor such as the Intel 8086, Zilog Z80 and Motorola 68000 have 16 data lines thus they are known as 16-bit microprocessor and the Intel 80386/486 have 32 data lines thus the y are called as 32-bit microprocessor.

Control Bus:

- The control bus is comprised of various lines that carry synchronization signals.
- The MPU uses such lines to perform the **third function:** providing timing signals.
- The MPU generates specific control signals for every operation (such as Memory Read or I/O Write) it performs.
- Control signals are used to identify a device type with the MPU intends to communicate.
- **To communicate with a memory –** For example: To read an instruction from a memory location – the MPU places the 16-bit address on the address bus.

TYPES OF TRANSMISSON AND OTHER RELATED TERMS

- A transmission format is concerned with issues such as synchronization, direction of data flow, speed errors, and medium of transmission (telephone lines for example). These topics are described briefly below.
- Serial communication occurs either in Synchronous or asynchronous format.
- In the **synchronous format,** a receiver and a transmitter are synchronized; a block of characters is transmitted along with the synchronization information. This format is generally used for high speed transmission (more than 20K bits/second).
- The **asynchronous format** is character-oriented.
- Each character carriers the information of the start and the stop bits.
- When no data are being transmitted, a receiver stays high at logic 1, called mark; logic 0 is called space.
- Transmission begins with the one START bit.
- In the transmission of eleven bits for an ASCII character in the asynchronous format, there will be one START bit, eight character bits and two STOP bits.
- The Asynchronous format is generally used in law speed transmission (less than 20 K bits/second).

Simplex and Duplex Transmission:

Serial Communication is classified on the direction and simultaneous flow of data.

Simplex Transmission: Data is transmitted only in one direction.

Duplex Transmission: Data flows in both directions.
However if the transmission goes one way at a time it is called **half duplex;** however if it goes both ways simultaneously it is called **full duplex.**

Parity check:

- During transmission, data bit may change (e.g. because of noise) and a wrong character may be received by a receiver. The MSB bit in the ASCII code can be to check an error; this process is called parity check.
- To check the Parity, the transmitter simply counts whether the number of 1s in a character is odd or even, and transmits that information to the receiver as the MSB bit.
- The receiver checks the MSB bit and the number of 1s in the received character, if there is an error, the receiver send back an error message to the transmitter.
- The parity check can be either odd or even, depending on the system.
- When the number of 1s is odd then the system has odd parity.
- When the number of 1s is even then the system has even parity.
- The parity check cannot detect multiple errors in a given character.
- The 8085/8080A microprocessor sets a parity flag when the number of 1s in the accumulator is even. This flag can be used for the parity check in the 8085/8080A system.

Baud:

- The rate at which the bits are transmitted in bits/second is called a **baud** in serial I/O.
- Technically it is defined as the number of signal changes/second.
- Each equipment has its own baud rate.
- For example, a teletype generally runs on 110 baud.

COMMUNICATION DEVICE (MODEM)

- **A Modem** (Modulator/Demodulator) is a circuit that translates digital data into audio tone frequencies for transmission over telephone and converts audio frequencies into digital data for reception.
- The modulation technique generally used is called frequency shift keying (FSK); it converts logic 1 (MARK) and logic 0 (SPACE) in to audio tones around 1200 and 2200 Hz frequencies.
- Computers can exchange information over telephone lines by using two modems – one on each side.
- A calling computer (or a terminal) contacts a receiving computer through a telephone number, and a communication link is established after control signals have been exchanged between computers and modems.
- A typical process of communication is explained as :
- First a parallel word is converted into serial bits; is turn they generate two audio frequencies according to logic 0 or 1 and these audio frequencies are transmitted over telephone lines.
- At the receiving end, audio frequencies are converted back into 0s and 1s, and the serial bits are converted into a parallel word that can be read by the receiving computer.

Chapter - 3
BIOS (Basic Input Output System)

Objective of Learning

- BIOS and its function
- Different types of BIOS on Motherboard
- Configuring Phoenix & AMI BIOS functions
- Resetting BIOS configuration
- BIOS beep error codes

BIOS are short for Basic Input Output System. The BIOS is actually software that is stored in a ROM (Read Only Memory) chip on your motherboard. Most systems today use a Flash EPROM (Erasable Programmable ROM) so that the user can update them. The BIOS is responsible for controlling or managing the POST (Power on Self Test), the boot process, and the interaction of components on the motherboard. These are all low-level processes that the BIOS are responsible for, but still extremely important to your system. The BIOS Program is always located in a special reserved memory area. The 64 K of the first MB of System Memory (RAM)—(Address from F000h to FFFFh). When we turn on Computer System, BIOS initializes all the Hardware connected to the system. One of the most common uses of Flash memory is for the **basic input/output system** of your computer, commonly known as the BIOS (pronounced "bye-ose"). On virtually every computer available, the BIOS makes sure all the other chips, hard drives, ports and CPU function together.

Every desktop and laptop computer in common use today contains a microprocessor as its central processing unit. The microprocessor is the hardware component. To get its work done, the microprocessor executes a set of instructions known as software you are probably very familiar with two different types of software:

- **Operating system** - The operating system provides a set of services for the applications running on your computer, and it also provides the fundamental user interface for your computer. Windows 98 and Linux are examples of operating systems.
- **Applications** - Applications are pieces of software that are programmed to perform specific tasks. On your computer right now you probably have a browser application, a word processing application, an e-mail application and so on. You can also buy new applications and install them.

What BIOS Does

The BIOS software has a number of different roles, but its most important role is to load the operating system. When you turn on your computer and the microprocessor tries to execute its first instruction, it has to get that instruction from somewhere. It cannot get it from the operating system because the operating system is located on a hard disk, and the microprocessor cannot get to it without some instructions that tell it how. The BIOS provides those instructions. Some of the other common tasks that the BIOS perform include:

- A power-on self-test (POST) for all of the different hardware components in the system to make sure everything is working properly
- Activating other BIOS chips on different cards installed in the computer - For example, SCSI and graphics cards often have their own BIOS chips.
- Providing a set of low-level routines that the operating system uses to interface to different hardware devices - It is these routines that give the

BIOS its name. They manage things like the keyboard, the screen, and the serial and parallel ports, especially when the computer is booting.

- Managing a collection of settings for the hard disks, clock, etc.

BIOS use Flash memory, type of ROM.

The BIOS is special software that interfaces the major hardware components of your computer with the operating system. It is usually stored on a Flash memory chip on the motherboard, but sometimes the chip is another type of ROM.

When you turn on your computer, the BIOS do several things. This is its usual sequence:

1. Check the CMOS Setup for custom settings
2. Load the interrupt handlers and device drivers
3. Initialize registers and power management
4. Perform the power-on self-test (POST)
5. Display system settings
6. Determine which devices are bootable
7. Initiate the bootstrap sequence

The first thing the BIOS do is check the information stored in a tiny (64 bytes) amount of RAM located on a **complementary metal oxide semiconductor** (CMOS) chip. The CMOS Setup provides detailed information particular to your system and can be altered as your system changes. The BIOS uses this information to modify or supplement its default programming as needed.

Interrupt handlers are small pieces of software that act as translators between the hardware components and the operating system. For example, when you press a key on your keyboard, the signal is sent to the keyboard interrupt handler, which tells the CPU what it is and passes it on to the operating system.

Device drivers are other pieces of software that identify the base hardware components such as keyboard, mouse, hard drive and floppy drive. Since the BIOS are constantly intercepting signals to and from the hardware, it is usually copied, or **shadowed**, into RAM to run faster.

Booting the Computer

Whenever you turn on your computer, the first thing you see is the BIOS software doing its thing. On many machines, the BIOS displays text describing things like the amount of memory installed in your computer, the type of hard disk and so on. It turns out that, during this boot sequence, the BIOS are doing a remarkable amount of work to get your computer ready to run. This section briefly describes some of those activities for a typical PC.

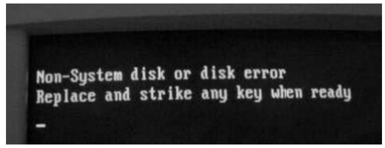
After checking the CMOS Setup and loading the interrupt handlers, the BIOS determine whether the video card is operational. Most video cards have a miniature BIOS of their own that initializes the memory and graphics processor on the card. If they do not, there is usually video driver information on another ROM on the motherboard that the BIOS can load.

Next, the BIOS checks to see if this is a **cold boot** or a **reboot**. It does this by checking the value at memory address 0000:0472. A value of 1234h indicates a reboot, and the BIOS skip the rest of POST. Anything else is considered a cold boot.

If it is a cold boot, the BIOS verify RAM by performing a read/write test of each memory address. It checks the PS/2 ports or USB ports for a keyboard and a mouse. It looks for a peripheral component interconnects (PCI) bus and, if it finds one, checks all the PCI cards. If the BIOS find any errors during the POST, it will notify you by a series of beeps or a text message displayed on the screen. An error at this point is almost always a hardware problem.

The BIOS then displays some details about your system. This typically includes information about:

- The processor
- The floppy drive and hard drive
- Memory
- BIOS revision and date
- Display



This is the message you receive if a disk is in the drive when you restart your computer.

Any special drivers, such as the ones for small computer system interface (SCSI) adapters, are loaded from the adapter and the BIOS displays the information. The BIOS then looks at the sequence of storage devices identified as boot devices in the CMOS Setup. "Boot" is short for "bootstrap," as in the old phrase, "Lift yourself up by your bootstraps." Boot refers to the process of launching the operating system. The BIOS will try to initiate the boot sequence from the first device. If the BIOS do not find a device, it will try the next device in the list. If it does not find the proper files on a device, the startup process will halt. If you have ever left a disk when you restarted your computer, you have probably seen this message.

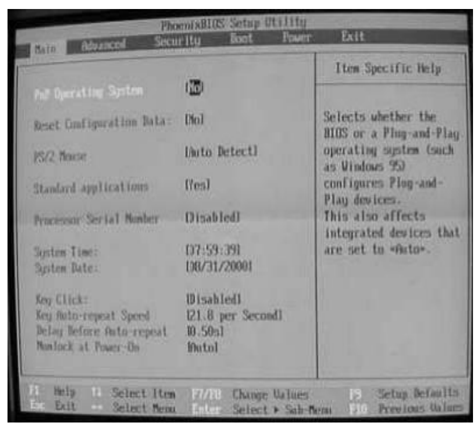
The BIOS has tried to boot the computer off of the disk left in the drive. Since it did not find the correct system files, it could not continue. Of course, this is an easy fix. Simply pop out the disk and press a key to continue.

Configuring BIOS

In the previous list, you saw that the BIOS check the CMOS Setup for custom settings. Here's what you do to change those settings. To enter the CMOS Setup, you must press a certain key or combination of keys during the initial startup sequence. Most systems use "Esc," "Del," "F1," "F2," "Ctrl-Esc" or "Ctrl-Alt-Esc" to enter setup. There is usually a line of text at the bottom of the display that tells you "Press __ to Enter Setup."

Once you have entered setup, you will see a set of text screens with a number of options. Some of these are standard, while others vary according to the BIOS manufacturer. Common options include:

- **System Time/Date** - Set the system time and date.
- **Boot Sequence** - The order that BIOS will try to load the operating system.
- **Plug and Play** - A standard for auto-detecting connected devices; should be set to "Yes" if your computer and operating system both support it.
- **Mouse/Keyboard** - "Enable Num Lock," "Enable the Keyboard," "Auto-Detect Mouse".
- **Drive Configuration** - Configure hard drives, CD-ROM and floppy drives.
- **Memory** - Direct the BIOS to shadow to a specific memory address.
- **Security** - Set a password for accessing the computer.
- **Power Management** - Select whether to use power management, as well as set the amount of time for standby and suspend.
- **Exit** - Save your changes, discard your changes or restore default settings



Be very careful when making changes to setup. Incorrect settings may keep your computer from booting. When you are finished with your changes, you should choose "Save Changes" and exit. The BIOS will then restart your

computer so that the new settings take effect.
The BIOS uses **CMOS** technology to save any changes made to the computer's settings. With this technology, a small lithium or Ni-Cad battery can supply enough power to keep the data for years. In fact, some of the newer chips have a 10-year, tiny lithium battery built right into the CMOS chip.

Updating Your BIOS

Occasionally, a computer will need to have its BIOS updated. This is especially true of older machines. As new devices and standards arise, the BIOS needs to change in order to understand the new hardware. Since the BIOS are stored in some form of ROM, changing it is a bit harder than upgrading most other types of software.
To change the BIOS itself, you'll probably need a special program from the computer or BIOS manufacturer. Look at the BIOS revision and date information displayed on system startup or check with your computer manufacturer to find out what type of BIOS you have. Then go to the BIOS manufacturer's Web site to see if an upgrade is available. Download the upgrade and the utility program needed to install it. Sometimes the utility and update are combined in a single file to download. Copy the program, along with the BIOS update, onto a floppy disk. Restart your computer with the floppy disk in the drive, and the program erases the old BIOS and writes the new one. You can find a BIOS Wizard that will check your BIOS at BIOS Upgrades.

Flashing the BIOS

In modern PCs the BIOS is stored in rewritable memory, allowing the contents to be replaced or 'rewritten'. This rewriting of the contents is sometimes termed flashing. This is done by a special program, usually provided by the system's manufacturer. A file containing such contents is sometimes termed 'a BIOS image'. BIOS might be reflashed in order to upgrade to a newer version to fix bugs or provide improved performance or to support newer hardware, or a reflashing operation might be needed to fix a damaged BIOS. A Bios may also be "flashed" by putting the file on the root of a USB drive and
EEPROM chips are advantageous because they can be easily updated by the user; hardware manufacturers frequently issue BIOS updates to upgrade their products, improve compatibility and remove bugs. However, this advantage had the risk that an improperly executed or aborted BIOS update could render the computer or device unusable. To avoid these situations, more recent BIOSes use a "boot block"; a portion of the BIOS which runs first and must be updated separately. This code verifies if the rest of the BIOS is intact (using hash checksums or other methods) before transferring control to it. If the boot block detects any corruption in the main BIOS, it will typically warn the user that a recovery process must be initiated by booting from removable media (floppy, CD or USB memory) so the user can try flashing the BIOS again. Some motherboards have backup BIOS (sometimes referred to as DualBIOS boards) to recover from BIOS corruptions.

Major BIOS manufacturers include:

- American Megatrends Inc. (AMI)
- Phoenix Technologies
- ALi
- Win bond

As with changes to the CMOS Setup, be careful when upgrading your BIOS. Make sure you are upgrading to a version that is compatible with your computer system. Otherwise, you could corrupt

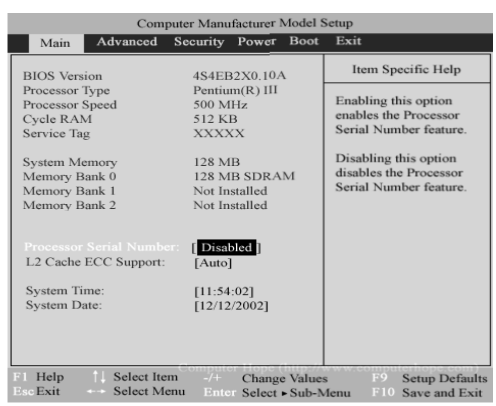
the BIOS, which means you won't be able to boot your computer. If in doubt, check with your computer manufacturer to be sure you need to upgrade.
The BIOS software is built into the PC, and is the first code run by a PC when powered on ('boot firmware'). The primary function of the BIOS is to load and start an operating system. When the PC starts up, the first job for the BIOS is to initialize and identify system devices such as the video display card, keyboard and mouse, hard disk, CD/DVD drive and other hardware. The BIOS then locates software held on a peripheral device (designated as a 'boot device'), such as a hard disk or a CD, and loads and executes that software, giving it control of the PC. This process is known as *booting*, or booting up, which is short for bootstrapping.
BIOS software is stored on a non-volatile ROM chip built into the system on the mother board. The BIOS software is specifically designed to work with the particular type of system in question, including having knowledge of the workings of various devices that make up the complementary chipset of the system. In modern computer systems, the BIOS chip's contents can be rewritten allowing BIOS software to be upgraded.
Prior to the early 1990s, BIOSes were stored in ROM or PROM chips, which could not be altered by users. As its complexity and need for updates grew, and re-programmable parts became more available, BIOS firmware was most commonly stored on EEPROM or flash memory devices According to Robert Braver, the president of the BIOS manufacturer Micro Firmware, Flash BIOS chips became common around 1995 because the electrically erasable PROM (EEPROM) chips are cheaper and easier to program than standard erasable PROM (EPROM) chips. EPROM chips may be erased by prolonged exposure to ultraviolet light, which accessed the chip via the window. Chip manufacturers use EPROM programmers (blasters) to program EPROM chips. Electrically erasable (EEPROM) chips allow BIOS reprogramming using higher-than-normal voltage. BIOS versions are upgraded to take advantage of newer versions of hardware and to correct bugs in previous revisions of BIOSes.

How is the Phoenix BIOS different?

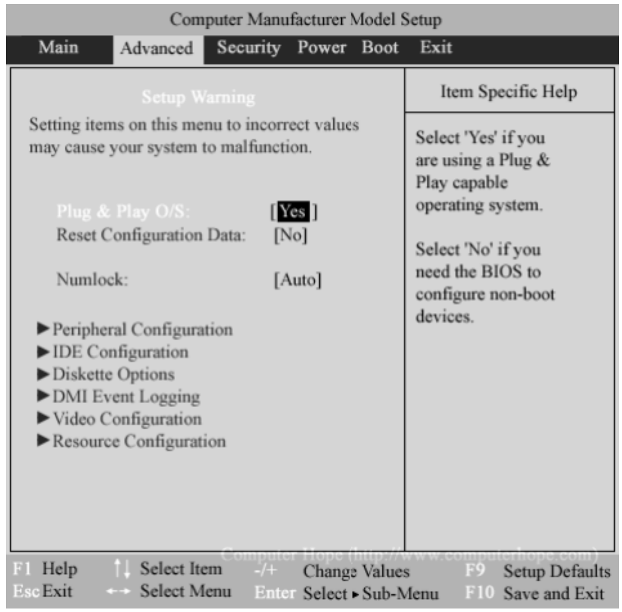
- Arrow keys are used to navigate.
- Plus and minus keys are used to change values.
- Users must save values before exiting.

Navigation information

The Phoenix BIOS is a very intuitive BIOS setup and is fairly easy to navigate. To navigate the Phoenix BIOS, the user uses the up and down arrow keys to navigate the current screen they are on. If the user wishes to change menus, pressing the right or left arrow keys will switch between each of the available menus.



Once an item is selected that the user wishes to change, a user can either press the Enter key or the + or - key to change between the available options. Below are example illustrations of the Phoenix BIOS setup screens. As can be seen from the below pictures, this BIOS is broken up into several different menus. In the below illustration of the Main menu portion of the BIOS, a user can see the computer specifications as well as easily change the time, date, and other system specific settings. The **Advanced menu**, as shown below, is most likely the section of the BIOS the user is most likely going to be entering to change their settings. As can be seen, this menu is broken down into an additional six more sub-menus that enable the user to change settings for each of the different categories. To the right of the illustration is a brief description of what is found in each of these categories.



The **security** section enables the user to set BIOS passwords on the computer. In this case, the user can set a user password, which will cause a password prompt each time the computer boots or set a setup password that will prompt for a password each time someone enters the BIOS setup. If a user sets a BIOS password and forgets that password, he or she must clear the CMOS or jump the BIOS jumper on the motherboard.

Peripheral Configuration

The Peripheral Configuration section of the BIOS enables the user to setup and change the settings for the computer's Serial Ports and Parallel ports as well as enable or disable Legacy USB Support.

IDE Configuration

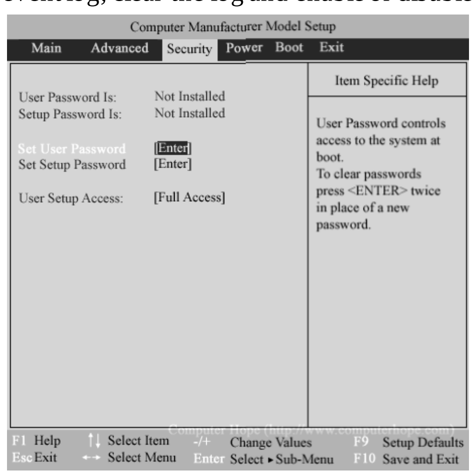
The IDE configuration allows a user to define or change any values relating to IDE devices connected to the computer. This includes you hard disk drive, CD-ROM drives and any other IDE drives.

Diskette Options

The Diskette Options enables the user to enable, disable, and change settings relating to the diskette drive connected to the computer.

DMI Event Logging

The DMI Event Logging enables a user to view the DMI event log, clear the log and enable or disable this feature.



Video Configuration

The Video Configuration allows the user to set settings related to the video including the Palette Snooping, AGP Aperture Size, and the default adapter.

Resource Configuration

The Resource Configuration enables a user to reserve or make available any memory or IRQ resources.

Power menu, enables a user to enable and disable the power management options on the computer. Because this section really has no more than disabling and

enabling power management and the hardware with power management features.
The next and final section in this example of the Phoenix BIOS is the Boot menu; this section enables a user to setup how the computer and its peripherals should load during the boot process. As seen below, users can define the boot sequence of bootable devices. This section is important for when the user wishes to boot from a floppy diskette or CD-ROM. In addition to the available options in this menu, there are three sub-menus that enable a user to select from a listing of available hard drives or other removable devices.

POST

The computer *power-on self-test (POST)* tests the computer to make sure it meets the necessary system requirements and that all hardware is working properly before starting the remainder of the boot process. If the computer passes the POST the computer will have a single beep (*with some computer BIOS manufacturers it may beep twice*) as the computer starts and the computer will continue to start normally. However, if the computer fails the POST, the computer will either not beep at all or will generate a beep code, which tells the user the source of the problem.
If you're receiving an irregular POST or a beep code not mentioned below follow the POST troubleshooting steps to determine the failing hardware component.

Computer POST / beep codes

Below are the BIOS Beep codes that can occur. However, because of the wide variety of different computer manufacturers with these BIOS, the beep codes may vary.

Beep Code	Descriptions
1 short	DRAM refresh failure
2 short	Parity circuit failure
3 short	Base 64K RAM failure
4 short	System timer failure
5 short	Process failure
6 short	Keyboard controller Gate A20 error
7 short	Virtual mode exception error
8 short	Display memory Read/Write test failure
9 short	ROM BIOS checksum failure
10 short	CMOS shutdown Read/Write error
11 short	Cache Memory error
1 long, 3 short	Conventional/Extended memory failure
1 long, 8 short	Display/Retrace test failed

1 long, 2 short	Indicates a video error has occurred and the BIOS cannot initialize the video screen to display any additional information
Any other beep(s)	RAM problem.
Beep Code	Description
No Beeps	No Power, Loose Card, or Short.
1 Short Beep	Normal POST, computer is ok.
2 Short Beep	POST error, review screen for error code.
Continuous Beep	No Power, Loose Card, or Short.
Repeating Short Beep	No Power, Loose Card, or Short.
One Long and one Short Beep	Motherboard issue.

One Long and Two Short Beeps	Video (Mono/CGA Display Circuitry) issue.
One Long and Three Short Beeps.	Video (EGA) Display Circuitry.
Three Long Beeps	Keyboard / Keyboard card error.
One Beep, Blank or Incorrect Display	Video Display Circuitry.

Resetting the BIOS

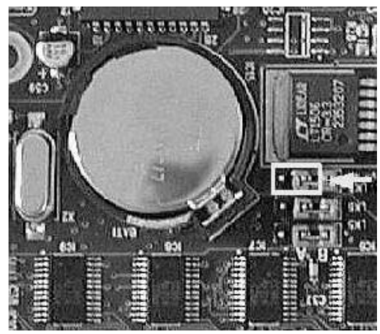
Why would you need to reset the BIOS?

- You forgot your BIOS password.
- You are having trouble booting into your OS, due to BIOS corruption.

These are a couple of reasons that could warrant a BIOS reset, you may have your own reasons. Moving forward, BIOS reset can happen in two ways:

1. Reset through Jumpers
2. Remove CMOS battery.

(Note: You will need to open your computer case in both instances and should have your computer turned off.)



Reset via Jumpers

You can reset your BIOS by finding the 3 pin connection associated with the CMOS and moving the jumper from the current location to the neighboring location, so as to short the CMOS circuit. The three pin connection should be located directly above the CMOS battery, which is a round button cell battery on the motherboard. Once the jumper is securely on pins 1&2, turn your computer on for about a minute. (Your system will not POST) Now you can shut down your system, place the jumper back on pins 2&3 and your BIOS should be reset.

Reset via Battery

This is an equally effective solution. In this instance we are going to reset the CMOS memory by removing the charge (or the battery). The battery clip is a little tricky so you might need a small flat head screwdriver to gently pry the battery from its case. Once the battery is out of its holding, you will need to press and hold the power button on your computer for about 30 seconds. This will drain the charge from the chip and the factory defaults will be restored. Put your battery back in and fire up your computer to see the changes.

Chapter - 4
Partition & Formatting of disk

Objective of learning

- Introduction to Partition & Formatting
- Different types of partitions
- File system and its types
- Features of different file system
- Performing partition and formatting in windows xp

In a computer, a partition is a logical division of a hard disk created so that you can have different operating systems on the same hard disk or to create the appearance of having separate hard drives for file management, multiple users, or other purposes. A partition is created when you *format* the hard disk. Typically, a one-partition hard disk is labelled the "C:" drive ("A:" and "B:" are typically reserved for diskette drives).A two-partition hard drive would typically contain "C:" and "D:" drives. (CD-ROM drives typically are assigned the last letter in whatever sequence of letters have been used as a result of hard disk formatting, or typically with a two-partition, the "E:" drive.). When you partition a hard drive, you make it available to an operating system. Multiple partitions on a single hard drive appear as separate drives to the operating system.
For example, when you install an operating system like Windows XP, part of the process is to define a partition on the hard drive. This partition serves to define an area of the hard drive that Windows XP can use to install all of its files. In Windows operating systems, this primary partition is usually assigned the drive letter of "C" Also Known As: disk partition.

Types of hard drive partitions

1. **Primary Partition** is a partition that is needed to store and boot an operating system, though applications and user data can reside there as well, and what's more, you can have a primary partition without any operating system on it. There can be up to a maximum of four primary partitions on a single hard disk, with only one of them set as active (see "Active partition").

2. **Active (boot) partition** is a primary partition that has an operating system installed on it. It is used for booting your machine. If you have a single primary partition, it is regarded as active. If you have more than one primary partition, only one of them is marked active (in a given PC session).

3. **Extended partition** can be sub-divided into logical drives and is viewed as a container for logical drives, where data proper is located. An extended partition is not formatted or assigned a drive letter. The extended partition is used only for creating a desired number of logical partitions.

4. **Logical drive** is created within an extended partition. A logical partition is a way to extend the initial limitation of four partitions. An extended partition can contain up to 24 logical partitions (you're limited by the number of drive letters and the amount of hard drive space available for creating drives; of course, it's senseless to use 24 partitions on a system in most cases, because it will be a data organization nightmare). Logical partitions are used for storing data mainly, they can be formatted and assigned drive letters; their details are listed in the extended partition's table - EMBR (Extended Master Boot Record).

How to partition and format the hard disk using the Windows XP Setup program

You can use the Windows XP Setup program to partition and format the hard disk. To do this, use the following steps:

Step 1: Partition the hard disk

a. Insert the Windows XP CD into your CD or DVD drive, or insert the first Windows XP Setup disk into the floppy disk drive, and then restart the computer to start the Windows XP Setup program.

Note If you are using the Windows XP Setup disks, insert each additional disk when you are prompted, and then press ENTER to continue after you insert each disk.

b. If you are prompted, select any options that are required to start the computer from the CD or DVD drive.

c. If your hard disk controller requires a third-party original equipment manufacturer (OEM) driver, press F6 to specify the driver. For more information about how to use F 6 to supply a third-party OEM device driver while the Windows Setup program is running, click the following article number to view the article in the Microsoft Knowledge Base: Limited OEM driver support is available with F 6 during Windows XP Setup.

d. At the **Welcome to Setup** page, press ENTER.

Note If you are using the Setup disks (six bootable disks), the setup prompts you to insert the Windows XP CD.

e. Press F8 to accept the Windows XP Licensing Agreement.
f. If an existing Windows XP installation is detected, you are prompted to repair it. To bypass the repair, press ESC.
g. All existing partitions and non-partitioned spaces are listed for each physical hard disk. Use the ARROW keys to select an existing partition, or create a new partition by selecting the non-partitioned space where you want to create a new partition. You can also press C to create a new partition using non-partitioned space.

   Note If you want to create a partition where one or more partitions already exist, you must first delete the existing partition or partitions, and then create the new partition. You can press D to delete an existing partition, and then press L (or press ENTER, and then press L if it is the System partition) to confirm that you want to delete the partition. Repeat this step for each existing partition that you want to include in the new partition. When all the partitions are deleted, select the remaining non-partitioned space, and then press C to create the new partition.

h. To create the partition with the maximum size, press ENTER. To specify the partition size, type the size in megabytes (MB) for the new partition, and then press ENTER.
i. If you want to create additional partitions, repeat steps g. and h.
j. To format the partition and install Windows XP, go to step 2.

Formatting

In order for storage media, such as a hard drive, to be recognized by your computer, it needs to be formatted. Formatting a disk involves testing the disk and writing a new directory structure, or "address table," onto the disk. If you would like to erase or initialize a hard drive, you can use a disk utility program to reformat it. This will create a blank, empty disk for storing your files. While the disk appears to be empty, most of the files on the disk are actually untouched by the formatting process. When you format a disk, it creates a new address table, making the entire disk available for writing. However, the files are still on the disk - they just don't show up since are no longer part of the director y structure. So if you accidentally format a disk (which is pretty hard to do), you can still retrieve most of your files using an advanced disk utility such as Norton Disk Doctor or Disk Warrior etc.

The term "format" can also be used to describe the layout or style of text in a text document. When you format the la yout, you choose the page margins and the line spacing. When you format the text, you choose the font, the size, and the styles, such as bold, italic, and underlined. If you do not want to install Windows XP, press F3 two times to exit the Windows Setup program.

File System:

The method for storing and retrieving files on a disk. It is system software that takes commands from the Operating system to read and write the disk clusters (groups of sectors). The file system manages a folder/directory structure, which provides an index to the files, and it defines the Syntax used to access them (how the "path" to the file is coded). File systems dictate how files are named as well as the maximum size of a file or volume. There are numerous file systems in use; for example, FAT32 and NTFS is Windows file Systems and HFS is used on Macs. Linux uses ext2, ext3 and F AT32. UNIX systems use UFS, Ext2, ext3 and ZFS.

FAT32

The 32-bit version of the FAT file system. In wide use on PCs that run Windows 95/98, FAT32 Was Introduced with the OEM Service Release 2 (OSR2) version of Windows 95 in 1996. It supports larger disk Partitions and file sizes and has more safeguards than the earlier FAT (FAT16). In the event of disk failure, FAT32 can r elocate the root director y on the disk and use the backup copy of the F AT table. FAT32 also reduced cluster waste. Starting with Windows NT, FAT32 was superseded by NTFS.

Drive Size	Default FAT16 Cluster Size	Default FAT32 Cluster Size
260 MB–511 MB	8 KB	Not supported
512 MB–1,023 MB	16 KB	**4 KB**
1,024 MB–2 GB	32 KB	**4 KB**
2 GB–8 GB	Not supported	**4 KB**
8 GB–16 GB	Not supported	**8 KB**
16 GB–32 GB	Not supported	**16 KB**
> 32 GB	Not supported	**32 KB**

There are additional differences between FAT32 and FAT16:

FAT32 allows finer allocation granularity (approximately 4 million allocation units per Volume).
FAT32 allows the root directory to grow (FAT16 holds a maximum of 512 entries and the limit can be even lower due to the use of long file names in the root folder).

Advantages of FAT16

a. MS-DOS, Windows 95, Windows 98, Windows NT, Windows 2000, and some UNIX Operating systems can use it.
b. There are many tools available to address problems and recover data.
c. If you have a startup failure, you can start the computer with an MS-DOS bootable floppy disk.

d. It is efficient, both in speed and storage, on volumes smaller than 256 MB.

Disadvantages of FAT16

a. The root folder can manage a maximum of 512 entries. The use of long file names can significantly reduce the number of available entries.
b. FAT16 is limited to 65,536 clusters, but because certain clusters are reserved, it has a practical Limit of 65,524. Each cluster is fixed in size relative to the logical drive. If both the maximum number of clusters and their maximum size (32 KB) are reached, the largest drive is limited to 4 GB on Windows 2000. To maintain compatibility with MS-DOS, Windows 95, and Windows 98, a FAT16 volume should not be larger than 2 GB.
c. The boot sector is not backed up.
d. There is no built-in file system security or file compression with FAT16.
e. FAT16 can waste file storage space in larger drives as the size of the cluster increases.
f. The space allocated for storing a file is based on the size of the cluster allocation granularity, not the file size. A 10-KB file stored in a 32-KB cluster wastes 22 KB of disk space.

Advantages of FAT32

a. FAT32 allocates disk space much more efficiently than previous versions of FAT. Depending on the size of your files, there is a potential for tens and even hundreds of megabytes more free disk space on larger hard disk drives. In addition, FAT32 provides the following enhancements:
b. The root folder on a FAT32 drive is now an ordinary cluster chain, so it can be located Anywhere On the volume. For this reason, FAT32 does not restrict the number of entries in the root folder. It uses space more efficiently than FAT16. FAT32 uses smaller clusters (4 KB for drives up to 8 GB), resulting in 10 to 15 percent more efficient use of disk space relative to large FAT16 drives.
c. FAT32 also reduces the resources necessary for the computer to operate.
d. FAT32 is more robust than FAT16. FAT32 has the ability to relocate the root directory and use the Backup copy of the FAT instead of the default copy. In addition, the boot record on FAT32 drives has been expanded to include a backup of critical data structures. This means that FAT32 volumes are less susceptible to a single point of failure than FAT16 volumes.

Disadvantages of FAT32

a. The largest FAT32 volume Windows 2000 can format is limited in size to 32 GB.
b. FAT32 volumes are not accessible from any other operating systems other than Windows 95 OSR2 and Windows 98.
c. The boot sector is not backed up.
d. There is no built-in file system security or compression with FAT32.

NTFS (New Technology File System)

An optional file system for Windows NT, 2000, XP and Vista. NTFS is the more advanced file system, compared to FAT32. It improves performance and is required in order to implement numerous security and administrative features in the OS. For example, NTFS supports Active Directory domain names and provides file encryption. Permissions can be set at the file level rather than by folder, and individual users Can be assigned disk space quotas. NTFS is designed to log activity and recover on the fly from hard disk Crashes. It also supports the Unicode character set and allows file names up to 255 characters in length.

Difference between FAT and NTFS

FAT

1) Fat stands for File Allocation Table
2) There are two categories in Fat File System
I) Fat 16
II) Fat 32
3) In Fat up To Folder Level Security is available
4) Compression Option is not available
5) Encryption Option is not available
6) Disk Quota Option is not available
7) FAT Supported By All of the Microsoft Based Operating System

NTFS

1) NTFS stands for New Technology File System
2) There are three categories in NTFS file System
I) NTFS 4.0 - NT O/S
II) NTFS 5.0 - 2000 O/S
III) NTFS 6.0 - 2003O/S
3) In NTFS Up-to File Level Security is available
4) Compression Option is available
5) Encryption Option is available
6) Disk Quota Option is Available
7) NTFS Supported By only Limited Microsoft Based Operating System

Step 2: Format the hard disk and install Windows XP

- **a.** Use the ARROW keys to select the partition where you want to install Windows XP, and then press ENTER.
- **b.** Select the format option that you want to use to format the partition. You can select from the following options:
  - **a.** Format the partition by using the NTFS file system(Quick)
  - **b.** Format the partition by using the FAT file system(Quick)
  - **c.** Format the partition by using the NTFS file system
  - **d.** Format the partition by using the FAT file system
  - **e.** Leave the current file system intact (no changes)

Notes:

- **f.** If the selected partition is a new partition, the op tion to leave the current file system intact is not available.
- **g.** If the selected partition is larger than 32 gigabytes (GB), the FAT file system option is not available.
- **h.** If the selected partition is larger than 2 GB, the Windows Setup program uses the FAT32 file system(you must press ENTER to confirm).
- i. If the partition is smaller than 2 GB , the Windows Setup program uses the F AT16 file system.
- j. If you deleted and created a new System partition, but you are installing Windows XP on a different partition, you are prompted to select a file system for both the System and Startup partitions.

- **c.** Press ENTER.

d. After the Windows Setup program formats the partition, follow the instructions that appear on the screen to install Windows XP. After the Windows Setup program is finished and you have restarted the computer, you can use the Disk Management tools in Windows XP to create or format more partitions. For additional information about how to use the Windows XP Disk Management tools to partition and format your hard disk.

Chapter – 5
Operating System

Objective of learning

- Introduction to OS and it architecture
- Basics function of an OS
- Minimum hardware requirements for installing window 7
- Performing Windows 7 installation & windows activation
- Installing software application

An operating system (OS) is software, consisting of programs and data, that runs on computers and manages computer hardware resources and provides common services for efficient execution of various application software.
For hardware functions such as input and output and memory allocation, the operating system acts as an intermediary between application programs and the computer hardware, although the application code is usually executed directly by the hardware and will frequently call the OS or be interrupted by it. Operating systems are found on almost any device that contains a computer—from cellular phones and video game consoles to supercomputers and web servers.
Examples of popular modern operating systems for personal computers are (in alphabetical order): GNU/Linux, Mac OS X, Microsoft Windows and UNIX.

Types of Operating Systems

1. **Real-time Operating System**: It is a multitasking operating system that aims at executing real-time applications. Real-time operating systems often use specialized scheduling algorithms so that they can achieve a deterministic nature of behavior. The main object of real-time operating systems is their quick and predictable response to events. They either have an event-driven or a time-sharing design. An event-driven system switches between tasks based on their priorities while time-sharing operating systems switch tasks based on clock interrupts.

2. **Multi-user and Single-user Operating Systems**: The operating systems of this type allow a multiple users to access a computer system concurrently. Time-sharing system can be classified as multi-user systems as they enable a multiple user access to a computer through the sharing of time. Single-user operating systems, as opposed to a multi-user operating system, are usable by a single user at a time. Being able to have multiple accounts on a Windows operating system does not make it a multi-user system. Rather, only the network administrator is the real user. But for a Unix-like operating system, it is possible for two users to login at a time and this capability of the OS makes it a multi-user operating system.

3. **Multi-tasking and Single-tasking Operating Systems**: When a single program is allowed to run at a time, the system is grouped under a single-tasking system, while in case the operating system allows the execution of multiple tasks at one time, it is classified as a multi-tasking operating system. Multi-tasking can be of two types namely, pre-emptive or co-operative. In pre-emptive multitasking, the operating system slices the CPU time and dedicates one slot to each of the programs. Unix-like operating systems such as Solaris and Linux support pre-emptive multitasking. Cooperative multitasking is achieved by relying on each process to give

time to the other processes in a defined manner. MS Windows prior to Windows 95 used to support cooperative multitasking.

4. **Distributed Operating System**: An operating system that manages a group of independent computers and makes them appear to be a single computer is known as a distributed operating system. The development of networked computers that could be linked and communicate with each other, gave rise to distributed computing. Distributed computations are carried out on more than one machine. When computers in a group work in cooperation, they make a distributed system.

5. **Embedded System**: The operating systems designed for being used in embedded computer systems are known as embedded operating systems. They are designed to operate on small machines like PDAs with less autonomy. They are able to operate with a limited number of resources. They are very compact and extremely efficient by design. Windows CE and Minix 3 are some examples of embedded operating systems.

Components of Operating System:

The components of an operating system all exist in order to make the different parts of a computer work together. All software—from financial databases to film editors—needs to go through the operating system in order to use any of the hardware, whether it be as simple as a mouse or keyboard or complex as an Internet connection.

The user interface:

A screenshot of the Bourne Again Shell command line. Each command is typed out after the 'prompt', and then its output appears below, working its way down the screen. The current command prompt is at the bottom. A screenshot of the KDE graphical user interface. Programs take the form of images on the screen, and the files, folders, and applications take the form of icons and symbols. A mouse is used to navigate the computer.

Every computer that receives some sort of human input needs a user interface, which allows a person to interact with the computer. While devices like keyboards, mice and touch screens make up the hardware end of this task, the user interface makes up the software for it. The two most common forms of a user interface have historically been the Command-line interface, where computer commands are typed out line-by-line, and the Graphical user interface, where a visual environment (most commonly with windows, buttons, and icons) is present.

Graphical user interfaces

Most of the modern computer systems support graphical user interfaces (GUI), and often include them. In some computer systems, such as the original implementation of Mac OS, the GUI is integrated into the kernel.

While technically a graphical user interface is not an operating system service, incorporating support for one into the operating system kernel can allow the GUI to be more responsive by reducing the number of context switches required for the GUI to perform its output functions. Other operating systems are modular, separating the graphics subsystem from the kernel and the Operating System. In the 1980s UNIX, VMS and many others had operating systems that were built this way. GNU/Linux and Mac OS X are also built this way. Modern releases of Microsoft Windows such as Windows Vista implement a graphics subsystem that is mostly in user-space; however the graphics drawing

routines of versions between Windows NT 4.0 and Windows Server 2003 exist mostly in kernel space. Windows 9x had very little distinction between the interface and the kernel.
Many computer operating systems allow the user to install or create any user interface they desire. The X Window System in conjunction with GNOME or KDE is a commonly found setup on most UNIX and UNIX-like (BSD, GNU/Linux, Solaris) systems. A number of Windows shell replacements have been released for Microsoft Windows, which offer alternatives to the included Windows shell, but the shell itself cannot be separated from Windows.
Numerous Unix-based GUIs have existed over time, most derived from X11. Competition among the various vendors of UNIX (HP, IBM, and Sun) led to much fragmentation, though an effort to standardize in the 1990s to COSE and CDE failed for various reasons, and were eventually eclipsed by the widespread adoption of GNOME and KDE. Prior to free software-based toolkits and desktop environments, Motif was the prevalent toolkit/desktop combination (and was the basis upon which CDE was developed).
Graphical user interfaces evolve over time. For example, Windows has modified its user interface almost every time a new major version of Windows is released, and the Mac OS GUI changed dramatically with the introduction of Mac OS X in 1999.

The kernel

A kernel connects the application software to the hardware of a computer. With the aid of the firmware and device drivers, the operating system provides the most basic level of control over all of the computer's hardware devices. It manages memory access for programs in the RAM, it determines which programs get access to which hardware resources, it sets up or resets the CPU's operating states for optimal operation at all times, and it organizes the data for long-term non-volatile storage with file systems on such media as disks, tapes, flash memory, etc.

Program execution

The operating system acts as an interface between an application and the hardware. The user interacts with the hardware from "the other side". The operating system is a set of services which simplifies development of applications. Executing a program involves the creation of a process by the operating system. The kernel creates a process by assigning memory and other resources, establishing a priority for the process (in multi-tasking systems), loading program code into memory, and executing the program. The program then interacts with the user and/or other devices and performs its intended function.

Interrupts

Interrupts are central to operating systems, as they provide an efficient way for the operating system to interact with and react to its environment. The alternative — having the operating system "watch" the various sources of input for events (polling) that require action — can be found in older systems with very small stacks (50 or 60 bytes) but are unusual in modern systems with large stacks. Interrupt-based programming is directly supported by most modern CPUs. Interrupts provide a computer with a way of automatically saving local register contexts, and running specific code in response to events. Even very basic computers support hardware interrupts, and allow the programmer to specify code which may be run when that event takes place.
When an interrupt is received, the computer's hardware automatically suspends whatever program is currently running, saves its status, and runs computer code previously associated with the interrupt; this is analogous to placing a bookmark in a book in response to a phone call. In modern operating

systems, interrupts are handled by the operating system's kernel. Interrupts may come from either the computer's hardware or from the running program.
When a hardware device triggers an interrupt, the operating system's kernel decides how to deal with this event, generally by running some processing code. The amount of code being run depends on the priority of the interrupt (for example: a person usually responds to a smoke detector alarm before answering the phone). The processing of hardware interrupts is a task that is usually delegated to software called device driver, which may be either part of the operating system's kernel, part of another program, or both. Device drivers may then relay information to a running program by various means.
A program may also trigger an interrupt to the operating system. If a program wishes to access hardware for example, it may interrupt the operating system's kernel, which causes control to be passed back to the kernel. The kernel will then process the request. If a program wishes additional resources (or wishes to shed resources) such as memory, it will trigger an interrupt to get the kernel's attention.

Modes

Privilege rings for the x86 available in protected mode. Operating systems determine which processes run in each mode.Modern CPUs support multiple modes of operation. CPUs with this capability use at least two modes: protected mode and supervisor mode. The supervisor mode is used by the operating system's kernel for low level tasks that need unrestricted access to hardware, such as controlling how memory is written and erased, and communication with devices like graphics cards. Protected mode, in contrast, is used for almost everything else. Applications operate within protected mode, and can only use hardware by communicating with the kernel, which controls everything in supervisor mode. CPUs might have other modes similar to protected mode as well, such as the virtual modes in order to emulate older processor types, such as 16-bit processors on a 32-bit one, or 32-bit processors on a 64-bit one.
When a computer first starts up, it is automatically running in supervisor mode. The first few programs to run on the computer, being the BIOS, bootloader and the operating system have unlimited access to hardware - and this is required because, by definition, initializing a protected environment can only be done outside of one. However, when the operating system passes control to another program, it can place the CPU into protected mode.
In protected mode, programs may have access to a more limited set of the CPU's instructions. A user program may leave protected mode only by triggering an interrupt, causing control to be passed back to the kernel. In this way the operating system can maintain exclusive control over things like access to hardware and memory.The term "protected mode resource" generally refers to one or more CPU registers, which contain information that the running program isn't allowed to alter. Attempts to alter these resources generally cause a switch to supervisor mode, where the operating system can deal with the illegal operation the program was attempting (for example, by killing the program).

Memory Management

Among other things, a multiprogramming operating system kernel must be responsible for managing all system memory which is currently in use by programs. This ensures that a program does not interfere with memory already used by another program. Since programs time share, each program must have independent access to memory.
Cooperative memory management, used by many early operating systems, assumes that all programs make voluntary use of the kernel's memory manager, and do not exceed their allocated memory. This system of memory management is almost never seen any more, since programs often contain bugs

which can cause them to exceed their allocated memory. If a program fails, it may cause memory used by one or more other programs to be affected or overwritten. Malicious programs or viruses may purposefully alter another program's memory, or may affect the operation of the operating system itself. With cooperative memory management, it takes only one misbehaved program to crash the system.

Memory protection enables the kernel to limit a process' access to the computer's memory. Various methods of memory protection exist, including memory segmentation and paging. All methods require some level of hardware support (such as the 80286 MMU), which doesn't exist in all computers.

In both segmentation and paging, certain protected mode registers specify to the CPU what memory address it should allow a running program to access. Attempts to access other addresses will trigger an interrupt which will cause the CPU to re-enter supervisor mode, placing the kernel in charge. This is called a segmentation violation or Seg-V for short, and since it is both difficult to assign a meaningful result to such an operation, and because it is usually a sign of a misbehaving program, the kernel will generally resort to terminating the offending program, and will report the error.

Windows 3.1-I had some level of memory protection, but programs could easily circumvent the need to use it. A general protection fault would be produced indicating a segmentation violation had occurred, however the system would often crash anyway.

Multitasking

Multitasking refers to the running of multiple independent computer programs on the same computer; giving the appearance that it is performing the tasks at the same time. Since most computers can do at most one or two things at one time, this is generally done via time-sharing, which means that each program uses a share of the computer's time to execute.

An operating system kernel contains a piece of software called a scheduler which determines how much time each program will spend executing, and in which order execution control should be passed to programs. Control is passed to a process by the kernel, which allows the program access to the CPU and memory. Later, control is returned to the kernel through some mechanism, so that another program may be allowed to use the CPU. This so-called passing of control between the kernel and applications is called a context switch.

An early model which governed the allocation of time to programs was called cooperative multitasking. In this model, when control is passed to a program by the kernel, it may execute for as long as it wants before explicitly returning control to the kernel. This means that a malicious or malfunctioning program may not only prevent any other programs from using the CPU, but it can hang the entire system if it enters an infinite loop.

Modern operating systems extend the concepts of application preemption to device drivers and kernel code, so that the operating system has preemptive control over internal run-times as well.

The philosophy governing preemptive multitasking is that of ensuring that all programs are given regular time on the CPU. This implies that all programs must be limited in how much time they are allowed to spend on the CPU without being interrupted. To accomplish this, modern operating system kernels make use of a timed interrupt. A protected mode timer is set by the kernel which triggers a return to supervisor mode after the specified time has elapsed. (See above sections on Interrupts and Dual Mode Operation.)

On many single user operating systems cooperative multitasking is perfectly adequate, as home computers generally run a small number of well tested programs. Windows NT was the first version of Microsoft Windows which enforced preemptive multitasking, but it didn't reach the home user market until Windows XP, (since Windows NT was targeted at professionals.)

Disk access and file systems

File systems allow users and programs to organize and sort files on a computer, often through the use of directories (or "folders"),Access to data stored on disks is a central feature of all operating systems. Computers store data on disks using files, which are structured in specific ways in order to allow for faster access, higher reliability, and to make better use out of the drive's available space. The specific way in which files are stored on a disk is called a file system, and enables files to have names and attributes. It also allows them to be stored in a hierarchy of directories or folders arranged in a directory tree.Early operating systems generally supported a single type of disk drive and only one kind of file system. Early file systems were limited in their capacity, speed, and in the kinds of file names and directory structures they could use. These limitations often reflected limitations in the operating systems they were designed for, making it very difficult for an operating system to support more than one file system. While many simpler operating systems support a limited range of options for accessing storage systems, operating systems like UNIX and GNU/Linux support a technology known as a virtual file system or VFS. An operating system such as UNIX supports a wide array of storage devices, regardless of their design or file systems, allowing them to be accessed through a common application programming interface (API). This makes it unnecessary for programs to have any knowledge about the device they are accessing. A VFS allows the operating system to provide programs with access to an unlimited number of devices with an infinite variety of file systems installed on them, through the use of specific device drivers and file system drivers.

A connected storage device, such as a hard drive, is accessed through a device driver. The device driver understands the specific language of the drive and is able to translate that language into a standard language used by the operating system to access all disk drives. On UNIX, this is the language of block devices.

When the kernel has an appropriate device driver in place, it can then access the contents of the disk drive in raw format, which may contain one or more file systems. A file system driver is used to translate the commands used to access each specific file system into a standard set of commands that the operating system can use to talk to all file systems. Programs can then deal with these files systems on the basis of filenames, and directories/folders, contained within a hierarchical structure. They can create, delete, open, and close files, as well as gather various information about them, including access permissions, size, and free space, and creation and modification dates.

Various differences between file systems make supporting all file systems difficult. Allowed characters in file names, case sensitivity, and the presence of various kinds of file attributes makes the implementation of a single interface for every file system a daunting task. Operating systems tend to recommend using (and so support natively) file systems specifically designed for them; for example, NTFS in Windows and ext3 and ReiserFS in GNU/Linux. However, in practice, third party drives are usually available to give support for the most widely used file systems in most general-purpose operating systems (for example, NTFS is available in GNU/Linux through NTFS-3g, and ext2/3 and ReiserFS are available in Windows through FS-driver and rfstool).

Device drivers

A device driver is a specific type of computer software developed to allow interaction with hardware devices. Typically this constitutes an interface for communicating with the device, through the specific computer bus or communications subsystem that the hardware is connected to, providing commands to and/or receiving data from the device, and on the other end, the requisite interfaces to the operating system and software applications. It is a specialized hardware-dependent computer program which is also operating system specific that enables another program, typically an operating

system or applications software package or computer program running under the operating system kernel, to interact transparently with a hardware device, and usually provides the requisite interrupt handling necessary for any necessary asynchronous time-dependent hardware interfacing needs.
The key design goal of device drivers is abstraction. Every model of hardware (even within the same class of device) is different. Newer models also are released by manufacturers that provide more reliable or better performance and these newer models are often controlled differently. Computers and their operating systems cannot be expected to know how to control every device, both now and in the future. To solve this problem, operative systems essentially dictate how every type of device should be controlled. The function of the device driver is then to translate these operative system mandated function calls into device specific calls. In theory a new device, which is controlled in a new manner, should function correctly if a suitable driver is available. This new driver will ensure that the device appears to operate as usual from the operating system's point of view.

Networking

Currently most operating systems support a variety of networking protocols, hardware, and applications for using them. This means that computers running dissimilar operating systems can participate in a common network for sharing resources such as computing, files, printers, and scanners using either wired or wireless connections. Networks can essentially allow a computer's operating system to access the resources of a remote computer to support the same functions as it could if those resources were connected directly to the local computer. This includes everything from simple communication, to using networked file systems or even sharing another computer's graphics or sound hardware. Some network services allow the resources of a computer to be accessed transparently, such as SSH which allows networked users direct access to a computer's command line interface.
Client/server networking involves a program on a computer somewhere which connects via a network to another computer, called a server. Servers offer (or host) various services to other network computers and users. These services are usually provided through ports or numbered access points beyond the server's network address each port number is usually associated with a maximum of one running program, which is responsible for handling requests to that port. A daemon, being a user program, can in turn access the local hardware resources of that computer by passing requests to the operating system kernel.

Security

A computer being secure depends on a number of technologies working properly. A modern operating system provides access to a number of resources, which are available to software running on the system, and to external devices like networks via the kernel.
The operating system must be capable of distinguishing between requests which should be allowed to be processed, and others which should not be processed. While some systems may simply distinguish between "privileged" and "non-privileged", systems commonly have a form of requester identity, such as a user name. To establish identity there may be a process of authentication. Often a username must be quoted, and each username may have a password. Other methods of authentication, such as magnetic cards or biometric data, might be used instead. In some cases, especially connections from the network, resources may be accessed with no authentication at all (such as reading files over a network share). Also covered by the concept of requester **identity** is authorization; the particular services and resources accessible by the requester once logged into a system are tied to either the requester's user account or to the variously configured groups of users to which the requester belongs.

In addition to the allow/disallow model of security, a system with a high level of security will also offer auditing options. These would allow tracking of requests for access to resources (such as, "who has been reading this file?"). Internal security, or security from an already running program is only possible if all possibly harmful requests must be carried out through interrupts to the operating system kernel. If programs can directly access hardware and resources, they cannot be secured.
External security involves a request from outside the computer, such as a login at a connected console or some kind of network connection. External requests are often passed through device drivers to the operating system's kernel, where they can be passed onto applications, or carried out directly. Security of operating systems has long been a concern because of highly sensitive data held on computers, both of a commercial and military nature. The United States Government Department of Defense (DoD) created the Trusted Computer System Evaluation Criteria (TCSEC) which is a standard that sets basic requirements for assessing the effectiveness of security. This became of vital importance to operating system makers, because the TCSEC was used to evaluate, classify and select computer systems being considered for the processing, storage and retrieval of sensitive or classified information.Network services include offerings such as file sharing, print services, email, web sites, and file transfer protocols (FTP), most of which can have compromised security. At the front line of security are hardware devices known as firewalls or intrusion detection/prevention systems. At the operating system level, there are a number of software firewalls available, as well as intrusion detection/prevention systems. Most modern operating systems include a software firewall, which is enabled by default. A software firewall can be configured to allow or deny network traffic to or from a service or application running on the operating system. Therefore, one can install and be running an insecure service, such as Telnet or FTP, and not have to be threatened by a security breach because the firewall would deny all traffic trying to connect to the service on that port.
An alternative strategy, and the only sandboxstrategy available in systems that do not meet the Popek and Goldberg virtualization requirements, is the operating system not running user programs as native code, but instead either emulates a processor or provides a host for a p-code based system such as Java.
Internal security is especially relevant for multi-user systems; it allows each user of the system to have private files that the other users cannot tamper with or read. Internal security is also vital if auditing is to be of any use, since a program can potentially bypass the operating system, inclusive of bypassing auditing.
In modern operating systems, there're many in-built security modules to prevent these malicious threats. As an example, with Microsoft Windows 7 OS, there is a program called Microsoft security essentials to prevent all these security holes.

Windows 7 Installation step by step guide

The Windows 7 is finally here. It's released for beta testers a few years ago and I am here with a small step by step picture guided tour through the installation process. It is available in x 86 (32bit) versions which are 2.72 GB ISO. The x64 version is around 3.2 GB in size. The installation process was just like vista setup and to my surprise completed in just around 20 minutes in my low end hardware. This surely indicates the performance improvements Microsoft has put on this windows vista replacement.

Different Editions of Windows 7 OS.

1) Windows 7 home basic
2) Windows 7 home premium
3) Windows 7 premium

4) Windows 7 ultimate
5) Windows 7 enterprise

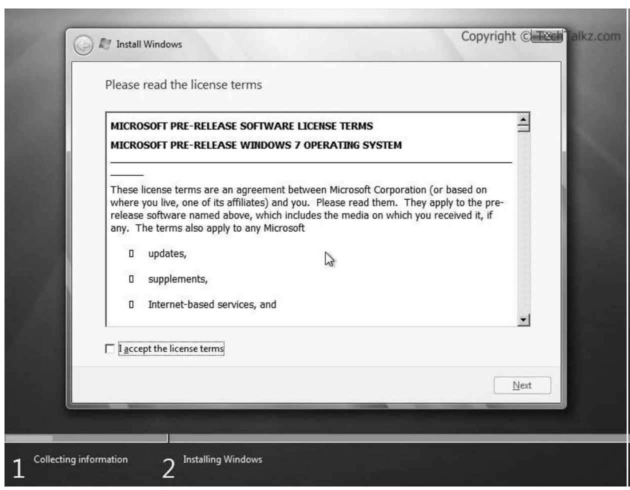
Minimum Hardware required installing Windows 7
CPU: 1 gigahertz (GHz) or faster 32-bit (x86) or 64-bit (x64) processor
RAM: 1 gigabyte (GB) RAM (32-bit) or 2 GB RAM (64-bit)
HDD: 16 GB available hard disk space (32-bit) or 20 GB (64-bit)
Graphics Card: DirectX 9 graphics device with WDDM 1.0 or higher driver

Setting up your Computer & BIOS changes (If required)
Now reboot your computer after popping in the all new Windows 7 DVD you just created in to the DVD Drive. In most cases if you do this you'll automatically boot in to the Windows 7 Installation DVD. But in some cases if the Boot device order is changed in the BIOS it may boot in to your older OS, instead of our DVD. In that case you'll need to change the BIOS settings to it done.

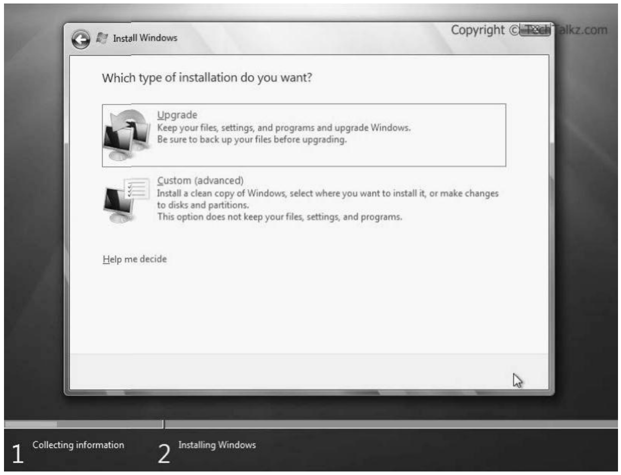
Booting Up and First Installation Steps
Steps from here are pretty straight forward. Read the descriptions in each pages before clicking the **Next** button to avoid any disasters. If there is options to choose in these steps you may find them with each image.

You may choose your Language options by selecting the dropdowns 'Language to install', 'Time and Currency format' and 'Keyboard or input method' here. I decided to leave everything to 'US' but it would be better for selecting the correct settings here for Non-English users.

This screen is where the installation wizard begins. The install now options will leads to the advanced install options. For repairing a corrupt installation the 'Repair your computer' button located at the bottom-left can be used. For fresh installs just click the **Install now** button.

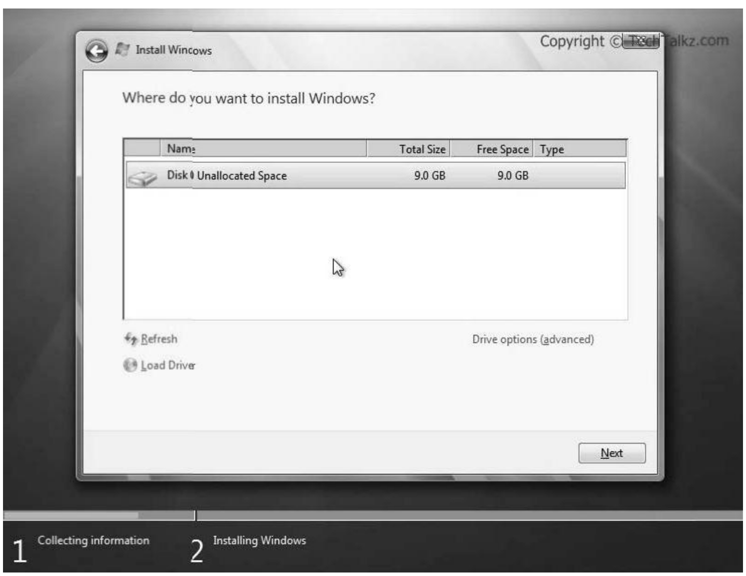


Tick the 'I accept the license terms' checkbox and click ' Next' to proce ed. Which type of installation do you want?



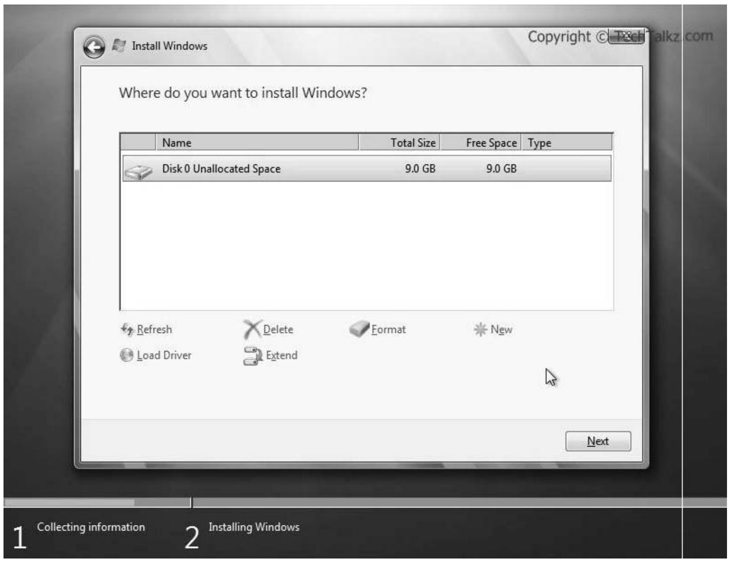
This screen provides two options, **Upgrade** and **Custom (advanced)**. The upgrade option is for those who wish to upgrade an existing installation of older version of Windows to Windows 7. It is confirmed that Windows Vista can be upgraded to Windows 7 without any issues, but Windows XP is still a problem. We will opt for the second option here, the **Custom** install.

Where do you want to install Windows?

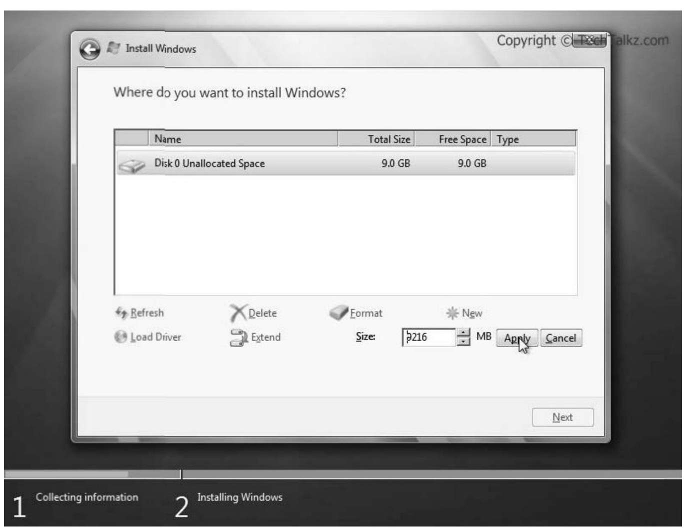


Clicking on the 'Custom' button brings the install location selection screen. In the test machine we have an un-partitioned empty disk. But in the case of a normal installation all your hard drive partitions (e.g. C:\, D:\ etc.) will be listed here. Choose the drive as you like (a 15 GB size is recommended). Make sure the drive doesn't have any important data or the Windows 7 installation will wipe-out the contents of that partition. You can back up the data to another partition (e.g. for installing in D:\ drive move important files from there to say E:\ drive or to an external USB drive) for safe keeping.

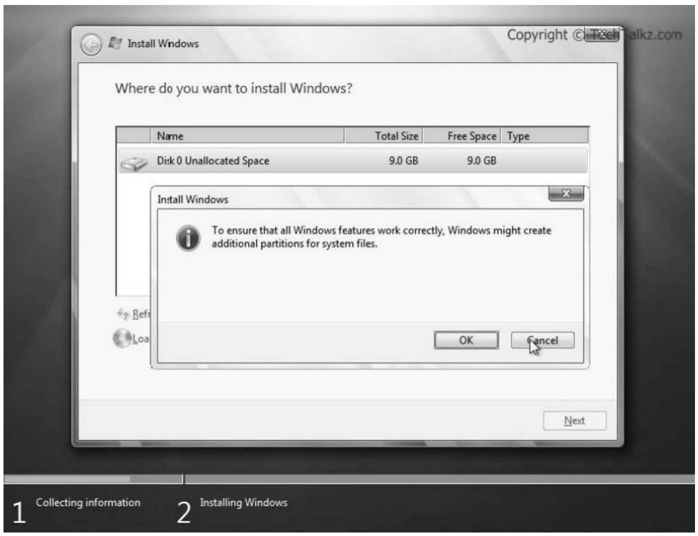
Creating partitioning or Modifying partitions



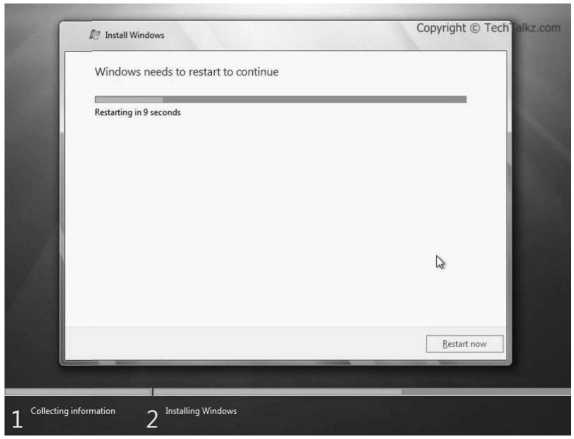
Click the **Drive options (advanced)** for advanced partition management options like 'Delete', 'Format', and 'New' and 'Extend'. To create new partitions click the **new** button. But if you have list of partitions in the previous screen, choose the one where you are planning to install windows7 and click **Format**. Then click 'Next' to proceed.



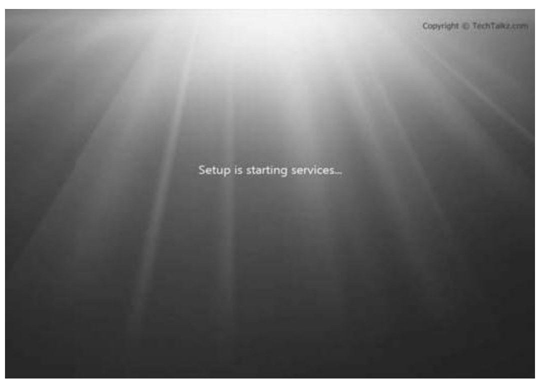
The 'New' option provides a text box to enter the size of the partition you wish to create in MBs. A 15 GB (15*1024 = 15360 MB) is recommended. In this case I opted for the full size of my virtual drive, i.e. 9216 M B. Click the **Apply** button to c ontinue. You may be greeted with a message **to ensure that all Windows features work correctly; windows might create additional partitions for system files.** . This is a new feature in W indows 7 to have a small b oot partition for system files. Click **Ok** to continue.



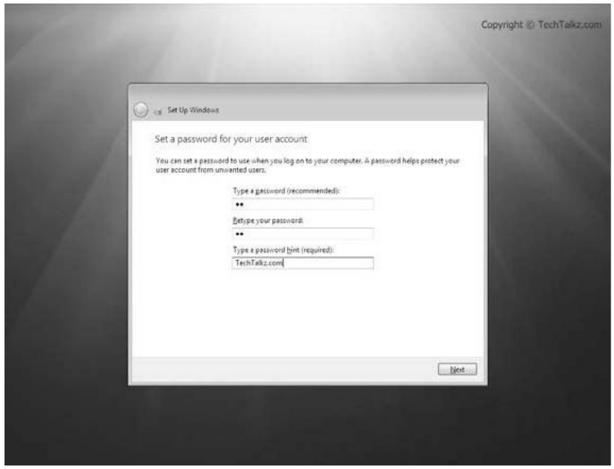
So here w e are, a new primary partition of 8.8 GB is created along with a **System** type partition of 200 MB. Select the pa rtition you just c reated and click **next** to continue.
In this session the instillation proceeds though the series of screen shots which involves a reboot. No user interaction is required for this Part.


Install Windows
Copyright © TechTalkz.com
Windows needs to restart to continue
Restarting in 9 seconds
Restart now
1 Collecting information
2 Installing Windows

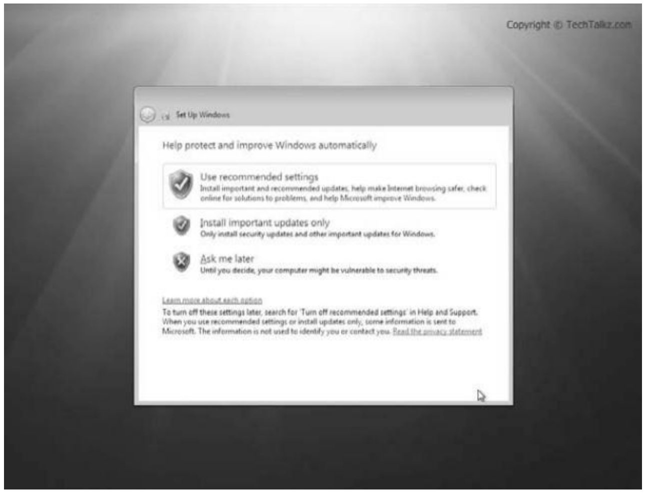

Starting Windows...

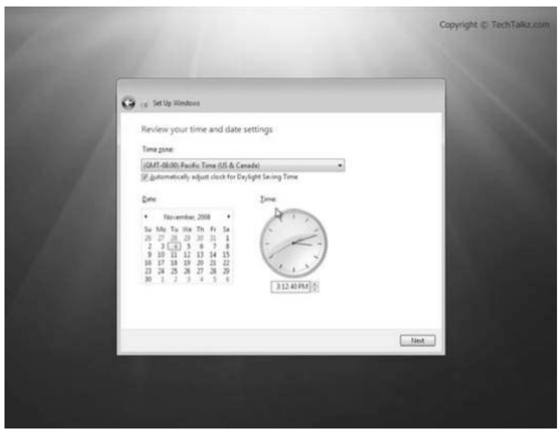

Copyright © TechTalkz.com
Setup is starting services...

The PART 3 of installation shows the basic setup like entering the **Serial Key,** setting up the computer name and user account, Time zone selection etc.This part of Windows 7 installation guide covers the Windows Product code (Serial key) input, Computer name set up, user account and password setup, time zone selection; Windows update configuration, location selection, Home group setup etc.


Copyright © TechTalkz.com
Set Up Windows
Set a password for your user account
You can set a password to use when you log on to your computer. A password helps protect your user account from unwanted users.
Type a password (recommended):
Retype your password:
Type a password hint (required):
TechTalkz.com
Next


Copyright © TechTalkz.com
Set Up Windows
Type your product key for activation
You can find your product key on your computer or on the installation disc holder inside the Windows package. Entering your product key now is optional but strongly recommended to help avoid complications during activation.
The product key sticker looks like this:
Product key (dashes will be added automatically):
Automatically activate Windows when I'm online
What is activation?
Read our privacy statement
Next


Copyright © TechTalkz.com
Set Up Windows
Help protect and improve Windows automatically
Use recommended settings
Install important and recommended updates, help make Internet browsing safer, check online for solutions to problems, and help Microsoft improve Windows.
Install important updates only
Only install security updates and other important updates for Windows.
Ask me later
Until you decide, your computer might be vulnerable to security threats.
Learn more about each option
To turn off these settings later, search for 'Turn off recommended settings' in Help and Support. When you use recommended settings or install updates only, some information is sent to Microsoft. The information is not used to identify you or contact you. Read the privacy statement


Copyright © TechTalkz.com
Set Up Windows
Review your time and date settings
Time zone:
(GMT-08:00) Pacific Time (US & Canada)
Automatically adjust clock for Daylight Saving Time
Date:
November, 2008
Time:
3:12:40 PM
Next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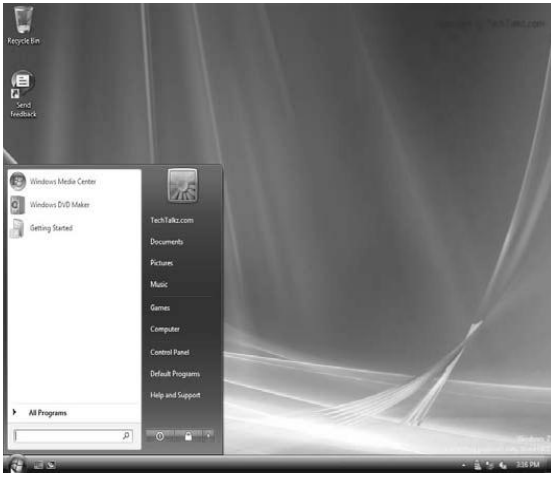
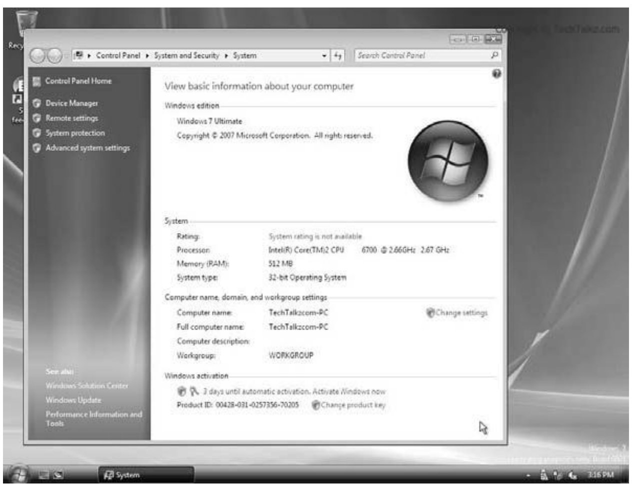
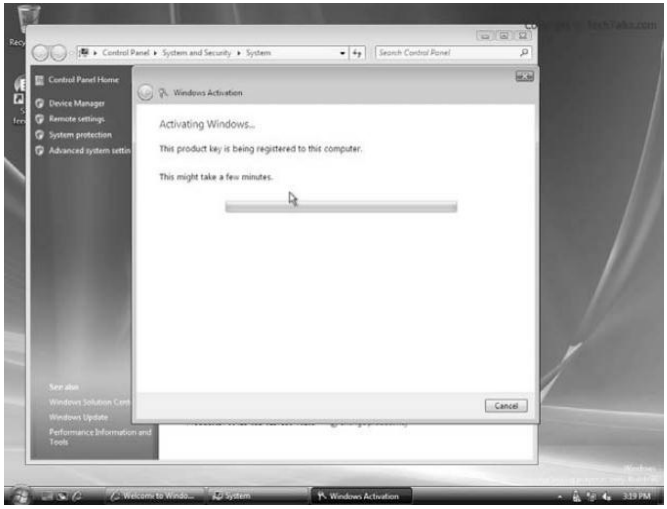
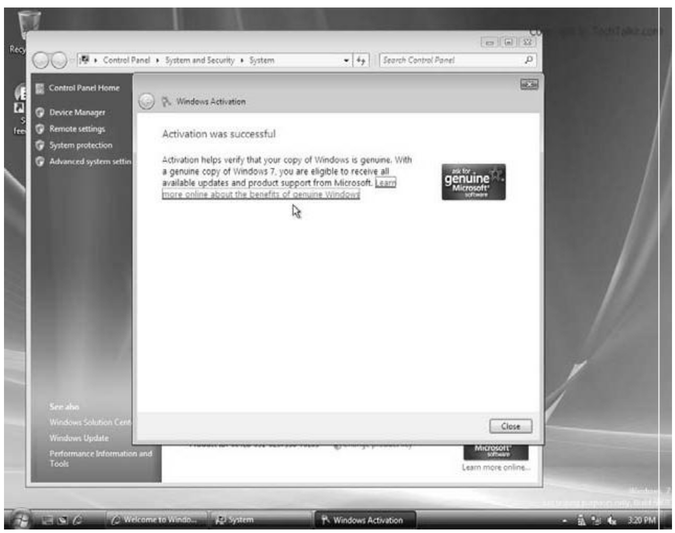
Set Up Windows
Select your computer's current location
This computer is connected to a network. Windows will automatically apply the correct network settings based on the network's location.
Home network
Choose this for a home or similar location. You can participate in a homegroup, and you can see other network computers.
Work network
Choose this for a workplace or similar location. You can't participate in a homegroup, but you can see other network computers.
Public network
Choose this for airports, coffee shops, other public places, or connections to the Internet without a router. You can't participate in a homegroup or access network computers.
If you aren't sure, select Public network.

The Windows 7 installation is now complete and we are presented with the all new Desktop. In this session, the product Activation, Internet Explorer 8 and Windows Update.


Recycle Bin
Windows Media Center
Windows DVD Maker
Getting Started
TechTalkz.com
Documents
Pictures
Music
Games
Computer
Control Panel
Default Programs
Help and Support
All Programs


Control Panel ▸ System and Security ▸ System
Search Control Panel
Control Panel Home
Device Manager
Remote settings
System protection
Advanced system settings
View basic information about your computer
Windows edition
Windows 7 Ultimate
Copyright © 2007 Microsoft Corporation. All rights reserved.
System
Rating:
Processor:
Memory (RAM):
System type:
512 MB
32-bit Operating System
Computer name, domain, and workgroup settings
Computer name:
Full computer name:
Computer description:
Workgroup:
WORKGROUP
Windows activation
See also
Windows Update
System


Windows Activation
Activating Windows...
This product key is being registered to this computer.
This might take a few minutes.
Cancel


Windows Activation
Activation was successful
Activation helps verify that your copy of Windows is genuine. With a genuine copy of Windows 7, you are eligible to receive all available updates and product support from Microsoft. Learn more online about the benefits of genuine Windows
Close

Now window 7 installations have completed and it is successfully activated. Now we can proceed with installation of other application software.

How to install software application:

General Tips

- Make sure your computer meets the requirements of the program, game, or utility you are attempting to install.
- The manuals for the program or the **readme** file located in the same directory as the install commonly contain exact instructions on how to install a program.
- After installing or during the installation, a program may need to install other programs, files, or utilities before it is able to run. If this is the case, the program will commonly prompt you to install the program or you may need to run a separate install before the program can be fully used.
- When installing a program, utility, or game, it is always a good idea first to close or disable any other programs that are running.
- After installing a new program if it prompts you to reboot the computer, do it.

Microsoft Windows users

Many software programs, games, and utilities have an AutoPlay feature that will automatically start the setup screen for the software program when the CD is placed in the computer. If your program, game, or utility contains this feature, run the installation through the screen that appears after inserting the disc.

If you are installing a program, game, or utility that does not contain this feature or you are installing a program from a floppy diskette, follow the below steps.

1. Open My Computer.
2. Within the My Computer window, open the drive that contains the installation files. For example, if the files are on a floppy diskette, open the A: drive. If they're on a CD or DVD open the D: drive or the letter of the disc drive.

3. Within the drive that contains your files, locate either a **setup** or **install** file. Double-clicking on this file should start the installation for the program, game, or utility. If you see multiple setups or install files, try to locate the **Application** file or double-click each of setup or install files until you find the file that starts the installation. Many times the icons associated with the installation files have the same name.

An alternate method of starting the installation in Microsoft Windows

1. Click Start and Run.
2. In the Run Window, type x:\setup or x:\install where x is the letter of the drive you wish to start the installation from. For example, if you are attempting to install a program from the floppy disk drive you would type a:\setup or a:\install.

Chapter – 6
Software

Objective of learning

- Software – definition
- Interaction of software's with hardware
- Different types of software's – System, application, device drivers etc.
- Different storage media
- Third party softwares,archive software

Software

The software is the information that the computer uses to get the job done. Software needs to be accessed before it can be used. There are many terms used for process of accessing software including running, executing, starting up, opening, and others. Computer programs allow users to complete tasks. A program can also be referred to as an application and the two words are used interchangeably.

Examples of software programs or applications would be the Operating System (DOS, Windows, UNIX, MacOS and various others), Word processor (typing letters), Spreadsheet (financial info), Database (inventory control and address book), Graphics program, Internet Browser, Email and many others. As well any document that you create, graphic you design, sound you compose, file you make, letter you write, email you send or anything that you create on your computer is referred to as software. All software is stored in files.

Software is stored on a disk, card, tape or one of the dozens of other storage devices available. There are millions of different pieces of software available for almost every conceivable need. Software is available commercially through stores and mail order and also available on the Internet. Software is also available through an Open Source license which allows anyone to use the Open Source software free of charge as long as the license is maintained. If you can't find the application that you need software development companies can custom design software for you.

The three basic types of software are; commercial, shareware and open source software. Some software is also released into the public domain without a license.

Commercial software comes prepackaged and is available from software stores and through the Internet.

Shareware is software developed by individual and small companies that cannot afford to market their software worldwide or by a company that wants to release a demonstration version of their commercial product. You will have an evaluation period in which you can decide whether to purchase the product or not. Shareware software often is disabled in some way and has a notice attached to explain the legal requirements for using the product.

Open Source software is created by generous programmers and released into the public domain for public use. There is usually a copyright notice that must remain with the software product. Open Source software is not public domain in that the company or individual that develops the software retains ownership of the program but the software can be used freely. Many popular Open Source applications are being developed and upgraded regularly by individuals and companies that believe in the Open Source concept.

Operating Systems

All computers need some sort of Operating System (OS). The majority of modern home computers use some form of Microsoft's operating systems. The original Microsoft operating system was called DOS (Disk Operating System) though most computers use Windows. Windows comes in various versions beginning with version 3.x then 95, 98, ME, XP, Vista and currently version 7. A few computers use IBM's O/S2. Apple's Mac use their own operating system beginning with OS 1 though to OS 10.x. In the past large companies and institutions would have an operating system design exclusively for them but as the commercial operating systems become more sophisticated the benefits of this practice is becoming less apparent. Some computer professionals, Internet Service Providers (ISP) and mainframe computer users use an operating system such as UNIX (or a variant such as Linux), Windows NT or 2000 (Win2k) or one of the other network or server based operating systems.

The operating system controls the input and output or directs the flow of information to and from the CPU. Much of this is done automatically by the system but it is possible to modify and control your system if you need to.

Most computer users will run Microsoft Windows, Mac OS or Linux as their operating system. These OS are Graphic User Interface (GUI) which allows the user to control or run the computer using a Mouse and Icons. The user simply moves the mouse on a flat surface, rolls the trackball, or moves their hand over the touchpad to control a pointer. They then choose the option they want by pressing a button or touching the pad. Without a GUI the user controls the computer using the keys on the keyboard. This is referred to as a Command Line Interface (CLI)

Disk and Storage

Disks and cards are used to store information. All information on computers is stored in files. The size of a file is measured in bytes. A byte is approximately one character (letter 'a', number '1', symbol '?' etc....).A byte is made up of 8 bits. A bit is simply an on or an off signal which passes through the computers circuitry. Every piece of software can be broken down into a series of on or off signals or its Binary Code.

- 4 bit equal to 1 Nibble
- 8 bit equal to 1 Byte
- 1024 bytes is a Kilobyte (Kb).
- 1024 kilobytes is a Megabyte (Mb).
- 1024 megabyte is a Gigabyte (Gb).
- 1024 gigabytes is a Terabyte (Tb)
- 1024 terabyte is a Perabyte (Pb)
- 1024 perabyte is a Exabyte (Eb)

Disk are a common way of transporting information such as bringing files home from work or sharing files. Floppy disks have become less useful as file sizes increase and Compact disks (CDs), Flash drives and Digital Video Devices (DVDs) are becoming more popular. Most software is sold on a CD. Internal Hard disks are the most common storage device.

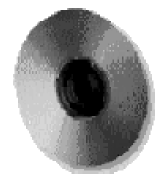
Compact disks or CDs can store large amounts of information. One disk will store 650 Mb. One type is a CD-ROM which stands for Compact Disk Read Only Memory. Another type is a CD-RW which stands for Compact Disk - Read/Write. CD drives can copy information or burn information on to a blank CD. Common Read Only CD blanks can only be written to once though more expensive Read/Write CD's can be used over and over again.

DVD disks can store 4.5 Gb on standard disk, 8 Gb on a dual layer disk and 16 Gb on a blue-ray disk. Digital recorders allow you to store large files, such as movies, on a single disk.

Hard disks store the majority of information on today's modern computer. Some of the first hard disk stored 10 to 40 Mb. Today the standard hard disk stores 150 Gb or more (this number is constantly increasing). Information can be stored and deleted as necessary. As files get larger the speed that hard disks can read and write become more important.Flash drive or thumb drives range in size.

Floppy disk or diskette comes in two basic sizes; 5.25 inch and 3.5 inch. Both have low and high density versions though 3.5 inch high density disks are the most common though many modern computers are being sold without floppy disk drives.

Disk size	Amount of storage	Approximate printed 8.5 x 11 inch pages
3.5 high density	1.44 Mb	720 pages
CD	650 Mb	a small library
DVD	4.5 Gb	a feature length movie
DVD dual layer	8 Gb	a long feature length movie with extras



There are many other storage devices including tapes, Panasonic's LS120 3.5 inch diskettes, Iomega's Zip & Jazz disks, VCR tape and many others. Innovation in storage technology is advancing rapidly and some technologies become obsolete. Information is stored in an electromagnetic form much like a cassette or video tape.

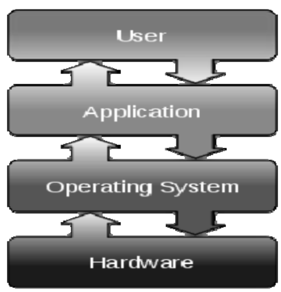
Note:
Keep disks away from strong electric or magnetic fields including x-rays? Be aware of high electromagnetic areas in the room such as televisions, speakers, high tension wires, etc... Use disks only at room temperature and keep them out of direct sunlight. If possible avoid passing electromagnetic storage devices through airport x-rays. In theory information stored on a disk will last indefinitely but the physical storage device will wear out with usage and time so be sure to back up (copy) your important files to a second storage device.

Computer software
Computer software, or just software, is a collection of computer programs and related data that provide the instructions telling a computer what to do and how to do it. We can also say software refers to one or more computer programs and data held in the storage of the computer for some purposes. In other words software is a set of programs, procedures, algorithms and its documentation. Program software performs the function of the program it implements, either by directly providing instructions to the computer hardware or by serving as input to another piece of software. The term was coined to contrast to the old term hardware (meaning physical devices). In contrast to hardware, software is intangible, meaning it "cannot be touched”. Software is also sometimes used in a more narrow sense,

meaning application software only. Sometimes the term includes data that has not traditionally been associated with computers, such as film, tapes, and records. Examples of computer software include:

- Application software includes end-user applications of computers such as word processors or video games, and ERP software for groups of users.
- Middleware controls and co-ordinates distributed systems.
- Programming languages define the syntax and semantics of computer programs. For example, many mature banking applications were written in the COBOL language, originally invented in 1959. Newer applications are often written in more modern programming languages.
- System software includes operating systems, which govern computing resources.
- Test ware is software for testing hardware or a software package.
- Firmware is low-level software often stored on electrically programmable memory devices. Firmware is given its name because it is treated like hardware and run ("executed") by other software programs.
- Shrink ware is the older name given to consumer-purchased software, because it was often sold in retail stores in a shrink-wrapped box.
- Device drivers control parts of computers such as disk drives, printers, CD drives, or computer monitors.
- Programming tools help conduct computing tasks in any category listed above. For programmers, these could be tools for debugging or reverse engineering older

Overview



A layer structure showing where operating system is located on generally used software systems on desktops

Software includes all the various forms and roles that digitally stored *data* may have and play in a computer (or similar system), regardless of whether the data is used as *code* for a CPU, or other interpreter, or whether it represents other kinds of information. Software thus encompasses a wide array of products that may be developed using different techniques such as ordinary programming languages, scripting languages, microcode, or an FPGA configuration.

The types of software include web pages developed in languages and frameworks like HTML, PHP, Perl, JSP, ASP.NET, XML, and desktop applications like OpenOffice.org, Microsoft Word developed in languages like C, C++, Java, C#, or Smalltalk. Application software usually runs on an underlying software operating systems such as Linux or Microsoft Windows. Software (or firmware) is also used in video games and for the configurable parts of the logic systems of automobiles, televisions, and other consumer electronics.

Computer software is so called to distinguish it from computer hardware, which encompasses the physical interconnections and devices required to store and execute (or run) the software. At the lowest level, executable code consists of machine language instructions specific to an individual processor. A machine language consists of groups of binary values signifying processor instructions that change the state of the computer from its preceding state. Programs are an ordered sequence of instructions for changing the state of the computer in a particular sequence. It is usually written in high-level programming languages that are easier and more efficient for humans to use (closer to natural language) than machine language. High-level languages are compiled or interpreted into machine language object code. Software may also be written in an assembly language, essentially, a mnemonic representation of a machine language using a natural language alphabet. Assembly language must be assembled into object code via an assembler.

Types of software

1. **System software**

System software provides the basic functions for computer usage and helps run the computer hardware and system. It includes a combination of the following:

- Device drivers
- Operating systems
- Servers
- Utilities
- Window systems

System software is responsible for managing a variety of independent hardware components, so that they can work together harmoniously. Its purpose is to unburden the application software programmer from the often complex details of the particular computer being used, including such accessories as communications devices, printers, device readers, displays and keyboards, and also to partition the computer's resources such as memory and processor time in a safe and stable manner.

2. **Programming software**

Programming software usually provides tools to assist a programmer in writing computer programs, and software using different programming languages in a more convenient way. The tools include:

- Compilers
- Debuggers
- Interpreters
- Linkers
- Text editors

An Integrated development environment (IDE) is a single application that attempts to manage all these functions.

3. **Application software**

Application software is developed to aid in any task that benefits from computation. It is a broad category, and encompasses software of many kinds, including the internet browser being used to display this page. This category includes:

- Business software
- Computer-aided design
- Databases
- Decision making software
- Educational software
- Image editing
- Industrial automation

- Mathematical software
- Medical software
- Molecular modeling software
- Quantum chemistry and solid state physics software
- Simulation software
- Spreadsheets
- Telecommunications (i.e., the Internet and everything that flows on it)
- Video games
- Word processing

Users often see things differently than programmers. People who use modern general purpose computers (as opposed to embedded systems, analog computers and supercomputers) usually see three layers of software performing a variety of tasks: platform, application, and user software.

- Platform software: Platform includes the firmware, device drivers, an operating system, and typically a graphical user interface which, in total, allow a user to interact with the computer and its peripherals (associated equipment). Platform software often comes bundled with the computer. On a PC you will usually have the ability to change the platform software.
- Application software: Application software or Applications are what most people think of when they think of software. Typical examples include office suites and video games. Application software is often purchased separately from computer hardware. Sometimes applications are bundled with the computer, but that does not change the fact that they run as independent applications. Applications are usually independent programs from the operating system, though they are often tailored for specific platforms. Most users think of compilers, databases, and other "system software" as applications.

The software's license gives the user the right to use the software in the licensed environment. Some software comes with the license when purchased off the shelf, or an OEM license when bundled with hardware. Other software comes with a free software license, granting the recipient the rights to modify and redistribute the software. Software can also be in the form of freeware or shareware.

4. Third-party Software

Third-party software generally falls into the following somewhat overlapping groups.

- Commercial software products are developed, distributed and maintained under a licensing agreement with a vendor or organization, generally for a fee. Commercial software products are normally installed like the vendor supplied software, but in a separate directory.
- The author of software identified as *shareware*, would normally expect some payment for downloading the software and accompanying documentation. The payment is often voluntary and made to a specified organization.
- According to the 'Free Software Foundation', *freeware* is software that everyone is free to copy, modify and redistribute. The word "free" pertains to freedom. It does not imply that it is free of charge, so anyone can sell free software so long as they don't impose any new restrictions on its redistribution or use. GNU software is an example of the freeware. The right to redistribute the software is legally bound with the condition that the distribution includes original code, complete documentation including the changes made.
- Total absence of copy right protection is the characteristic of *public domain* software. Anyone can copy, modify or use it in any way the wish. The author has no exclusive right and has no legal responsibility associated with the use of the software.

5. Archive sites

Publically accessible software, including shareware and freeware, may be accessed via anonymous FTP or the WWW from an archive site on the internet. A network search utility named *archie* may be used to search databases of Anonymous FTP host directories and locate specific software.

Some well-known archive sites in U SA include the GNU archive site and UUNET. Popular bus y archive sites often may have mirror sites which keep copies of specific directories or files to make them quickly available to local users and to reduce the load on the original site. For example, *ftp.uwsg.indiana.edu/pub* mirrors several popular software distributions including, *gnu, linux, mosaic, netscape, perl5,* and *sendmail*.

Chapter - 7
Input and Output Devices

Objective of learning

- Introduction to Input and output devices
- Different types of input devices
- Different types of output devices
- Uses of IO devices

Introduction

The computer will be of no use unless it is able to communicate with the outside world. Input /Output devices are required for users to communicate with the computer. In simple terms, input devices bring information INTO the computer and output devices bring information OUT of a computer system. These input/output devices are also known as peripherals since they surround the CPU and memory of a computer system. Some commonly used Input/ Output devices are listed in table below.

Input Devices Output Devices

1. Keyboard
2. Mouse
3. Joystick
4. Scanner
5. Light Pen
6. Touch Screen
7. Monitor
8. LCD
9. Printer
10. Plotter

II. Input Devices

(a) Keyboard

It is a text base input device that allows the user to input alphabets, numbers and other characters.
It consists of a set of keys mounted on a board.

Alphanumeric Keypad

It consists of keys for English alphabets, 0 to 9 numbers, and special characters like +
− / * ( ) etc.

Function Keys

There are twelve function keys labeled F1, F2, F3… F12. The functions assigned to these keys differ from one software package to another. These keys are also user programmable keys.

Special-function Keys

These keys have special functions assigned to them and can be used only for those specific purposes. Functions of some of the important keys are defined below.

Enter

It is similar to the 'return' key of the typewriter and is used to execute a command or program.

Spacebar

It is used to enter a space at the current cursor location.

Backspace

This key is used to move the cursor one position to the left and also delete the character in that position.

Delete

It is used to delete the character at the cursor position.

Insert

Insert key is used to toggle between insert and overwrite mode during data entry.

Shift

This key is used to type capital letters when pressed along with an alphabet key.Also used to type the special characters located on the upper-side of a key that has two characters defined on the same key.

Caps Lock

Cap Lock is used to toggle between the capital lock features. When 'on', it locks the alphanumeric keypad for capital letters input only.

Tab

Tab is used to move the cursor to the next tab position defined in the document. Also,It is used to insert indentation into a document.

Ctrl

Control key is used in conjunction with other keys to provide additional functionality on the keyboard.

Alt
Also like the control key, Alt key is always used in combination with other keys to perform specific tasks.

Esc
This key is usually used to negate a command. Also used to cancel or abort executing programs.

Numeric Keypad
Numeric keypad is located on the right side of the keyboard and consists of keys having numbers (0 to 9) and mathematical operators (+ − * /) defined on them. This keypad is provided to support quick entry for numeric data.

Cursor Movement Keys
These are arrow keys and are used to move the cursor in the direction indicated by the arrow (up, down, left, right).

(b) Mouse
The mouse is a small device used to point to a particular place on the screen and select in order to perform one or more actions. It can be used to select menu commands, size windows, start programs etc.
The most conventional kind of mouse has two buttons on top: the left one being used most frequently.

Mouse Actions

Left Click: Used to select an item.
Double Click: Used to start a program or open a file.
Right Click: Usually used to display a set of commands.
Drag and Drop: It allows you to select and move an item from one location to another. To achieve this place the cursor over an item on the screen, click the left mouse button and while holding the button down move the cursor to where you want to place the item, and then release it.

(c) Joystick
The joystick is a vertical stick which moves the graphic cursor in a direction the stick is moved. It typically has a button on top that is used to select the option pointed by the cursor. Joystick is used as an input device primarily used with video games, training simulators and controlling robots.

(d)Scanner

Scanner is an input device used for direct data entry from the source document into the computer system. It converts the document image into digital form so that it can be fed into the computer. Capturing information like this reduces the possibility of errors typically experienced during large data entry.

Figure 4: The Scanner

Hand-held scanners are commonly seen in big stores to scan codes and price information for each of the items. They are also termed the bar code readers.

(e) Bar codes

A bar code is a set of lines of different thicknesses that represent a number. Bar Code Readers are used to input data from bar codes. Most products in shops have bar codes on them. Bar code readers work by shining a beam of light on the lines that make up the bar code and detecting the amount of light that is reflected back

(f) Light Pen

It is a pen shaped device used to select objects on a display screen. It is quite like the mouse (in its functionality) but uses a light pen to move the pointer and select any object on the screen by pointing to the object.

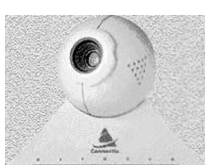
Users of Computer Aided Design (CAD) applications commonly use the light pens to directly draw on screen.

(g) Touch Screen

It allows the user to operate/make selections by simply touching the display screen. Common examples of touch screen include information kiosks, and bank ATMs.

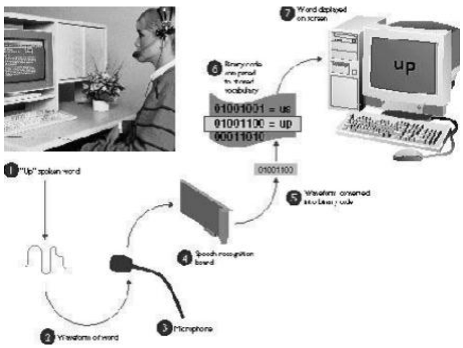
(h) gital camera

A digital camera can store many more pictures than an ordinary camera. Pictures taken using a digital camera are stored inside its memory and can be transferred to a computer by connecting the camera to it. A digital camera takes pictures by converting the light passing through the lens at the front into a digital image.



(i) The Speech Input Device

The "Microphones - Speech Recognition" is a speech Input device. To operate it we require using a microphone to talk to the computer. Also we need to add a sound card to the computer. The Sound card digitizes audio input into 0/1s .A speech recognition program can process the input and convert it into machine-recognized commands or input



III. **Output Devices**

(a) Monitor

Monitor is an output device that resembles the television screen and uses a Cathode Ray Tube (CRT) to display information. The monitor is associated with a keyboard for manual input of characters and displays the information as it is keyed in. It also displays the program or application output. Like the television, monitors are also available in different sizes.

(b) Liquid Crystal Display (LCD)

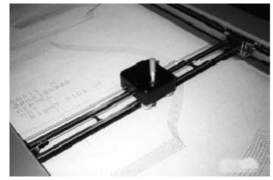
LCD was introduced in the 1970s and is now applied to display terminals also. Its advantages like low energy consumption, smaller and lighter have paved its way for usage in portable computers (laptops).

(c) Printer

Printers are used to produce paper (commonly known as hardcopy) output. Based on the technology used, they can be classified as Impact or Non-impact printers. Impact printers use the typewriting printing mechanism wherein a hammer strikes the paper through a ribbon in order to produce output. Dot-matrix and Character printers fall under this category.

Non-impact printers do not touch the paper while printing. They use chemical, heat or electrical signals to etch the symbols on paper. Inkjet, DeskJet, Laser, Thermal printers fall under this category of printers. When we talk about printers we refer to two basic qualities associated with printers: resolution, and speed. Print resolution is measured in terms of number of dots per inch (dpi). Print speed is measured in terms of number of characters printed in a unit of time and is represented as characters-per-second (cps), lines-per-minute (lpm), or pages-per-minute (ppm).

(d) Plotter



Plotters are used to print graphical output on paper. It interprets computer commands and makes line drawings on paper using multicolored automated pens. It is capable of producing graphs, drawings, charts, maps etc.Computer Aided Engineering (CAE) applications like CAD (Computer Aided Design) and CAM (Computer Aided Manufacturing) are typical usage areas for plotters.

(e) Audio Output: Sound Cards and Speakers:

The Audio output is the ability of the computer to output sound. Two components are needed: Sound card – Plays contents of digitized recordings, Speakers – Attached to sound card.

Chapter- 8
Memory

Objective of learning

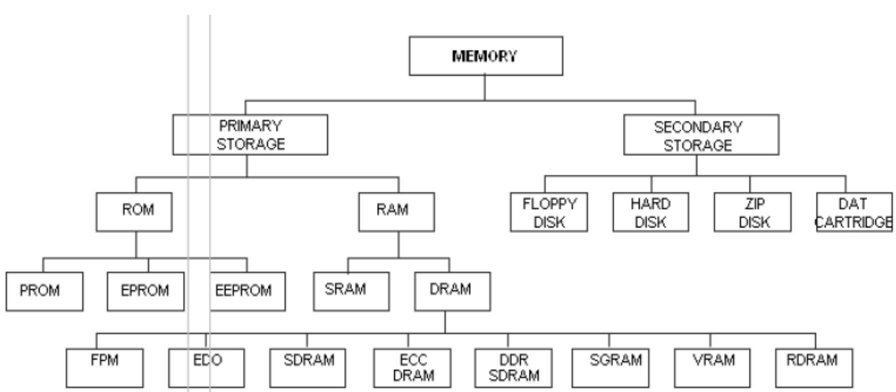
- Classification Of Memory
- Types Of Memory
- Types of Main Memory
- Memory Packaging
- Management of Memory

In computing, memory refers to the state information of a computing system, as it is kept active in some physical structure. The term "memory" is used for the information in physical systems which are fast (i.e. RAM), as a distinction from physical systems which are slow to access (i.e. data storage). By design, the term "memory" refers to temporary state devices, whereas the term "storage" is reserved for permanent data. Advances in storage technology have blurred the distinction a bit —memory kept on what is conventionally a storage system is called "virtual memory".

Colloquially, computer memory refers to the physical devices used to store data or programs (sequences of instructions) on a temporary or permanent basis for use in an electronic digital computer. Computers represent information in binary code, written as sequences of 0s and 1s. Each binary digit (or "bit") may be stored by any physical system that can be in either of two stable states, to represent 0 and 1. Such a system is called bits table. This could be an on-off switch, an electrical capacitor that can store or lose a charge, a magnet with its polarity up or down, or a surface that can have a pit or not. Today, capacitors and transistors, functioning as tiny electrical switches, are used for temporary storage and either disks or tape with a magnetic coating, or plastic discs with patterns of pits are used for long-term storage.

Computer memory is usually meant to refer to the semiconductor technology that is used to store information in electronic devices. Current primary computer memory makes use of integrated circuits consisting of silicon-based transistors.

Classification of Memory:



Primary Storage is further classified into two types i.e. ROM and RAM. Secondary storage contains the different devices such as Floppy disk, Hard disk, Zip disk and DAT cartridge. Memory normally refers to the amount of RAM installed in the computer. Leading companies which are the memory suppliers are Micron, Siemens etc.

Types of Memory:

Volatile memory: (RAM)

Volatile memory is computer memory that requires power to maintain the stored information. Most modern semiconductor volatile memory is either Static RAM or dynamic RAM. SRAM retains its contents as long as the power is connected and is easy to interface to but uses six transistors per bit. Dynamic RAM is more complicated to interface to and control, and needs regular refresh cycles to prevent its contents being lost. However, DRAM uses only one transistor and a capacitor per bit, allowing it to reach much higher densities and, with more bits on a memory chip, be much cheaper per bit. SRAM is not worthwhile for desktop system memory, where DRAM dominates, but is used for their cache memories. SRAM is commonplace in small embedded systems, which might only need tens of kilobytes or less. Upcoming volatile memory technologies that hope to replace or compete with SRAM and DRAM include Z-RAM, TTRAM, A-RAM and ETA RAM.

Non-volatile memory: (ROM)

Non-volatile memory is computer memory that can retain the stored information even when not powered. Examples of non-volatile memory include read-only memory, flash memory, most types of magnetic computer storage devices (e.g. hard disks, floppy discs and magnetic tape), optical discs, and early computer storage methods such as paper tape and punched cards. Upcoming non-volatile memory technologies include FeRAM, CBRAM, PRAM, SONOS, Racetrack memory, NRAM and Millipede.

Virtual memory:

Virtual memory is a system where all physical memory is controlled by the operating system. When a program needs memory, it requests it from the operating system. The operating system then decides what physical location to place the memory in. This offers several advantages. Computer programmers no longer need to worry about where the memory is physically stored or whether the user's computer will have enough memory. It also allows multiple types of memory to be used. For example, some memory can be stored in physical RAM chips while other memory is stored on a hard drive. This drastically increases the amount of memory available to programs. The operating system will place actively used memory in physical RAM, which is much faster than hard disks. When the amount of RAM is not sufficient to run all the current programs, it can result in a situation where the computer spends more time moving memory from RAM to disk and back than it does accomplishing tasks; this is known as thrashing. Virtual memory systems usually include protected memory, but this is not always the case.

Protected memory

Protected memory is a system where each program is given an area of memory to use and is not permitted to go outside that range. Use of protected memory greatly enhances both the reliability and security of a computer system. Without protected memory, it is possible that a bug in one program will alter the memory used by another program. This will cause that other program to run off of corrupted memory with unpredictable results. If the operating system's memory is corrupted, the entire computer system may crash and need to be rebooted. At times programs intentionally alter the memory used by other programs. This is done by viruses and malware to take over computers. Protected memory assigns programs their own areas of memory. If the operating system detects that a program has tried to alter memory that doesn't belong to it, the program is terminated. This way, only the offending program crashes, and other programs are not affected by the error. Protected memory systems almost always include virtual memory as well.

Types of Main Memory:

Volatile memory:

Volatile memory, also known as volatile storage, is computer memory that requires power to maintain the stored information, unlike non-volatile memory which does not require a maintained power supply. It has been less popularly known as temporary memory. Most forms of modern random access memory (RAM) are volatile storage, including dynamic random access memory (DRAM) and static random access memory (SRAM). Content addressable memory and dual-ported RAM are usually implemented using volatile storage. Early volatile storage technologies include delay line memory and Williams's tube.

Dynamic Random-Access Memory (DRAM):

Dynamic random-access memory (DRAM) is a type of random-access memory that stores each bit of data in a separate capacitor within an integrated circuit. The capacitor can be either charged or discharged. These two states are taken to represent the two values of a bit, conventionally called 0 and 1. Since capacitors leak charge, the information eventually fades unless the capacitor charge is refreshed periodically. Because of this refresh requirement, it is a ***dynamic*** memory as opposed to SRAM and other ***static*** memory.The main memory (the "RAM") in personal computers is Dynamic RAM (DRAM), as is the "RAM" of home game consoles (PlayStation, Xbox 360), laptop, notebook and workstation computers.The advantage of DRAM is its structural simplicity: only one transistor and a capacitor are required per bit, compared to six transistors in SRAM. This allows DRAM to reach very high densities. Unlike flash memory, DRAM is volatile memory, since it loses its data quickly when power is removed. The transistors and capacitors used are extremely small; hundreds of billions can fit on a single memory chip.DRAM is the most popular type of memory used in systems today. It is also the most popular type of memory that computer users are adding to their computers for the purpose of upgrading memory. Therefore, you must understand the different types of DRAM and what types of DRAM outperform others.

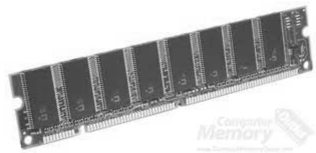
- ***Types Of DRAM:***

Standard DRAM

Memory is organized into rows and columns like a spreadsheet. The information is stored in the different cells or blocks that make up these rows and columns. With standard RAM, the CPU requests data by sending the address of the row and the address of the column for every block of data that needs to be read. The memory controller then fetches the information from that memory location.

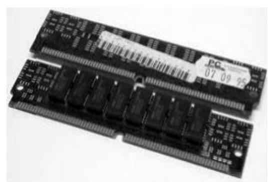
Fast Page Mode (FPM)

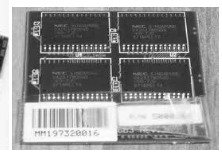
Fast Page Mode (FPM) improves on the performance of standard DRAM by not requiring a row address for each request to memory, assuming that the next block of data is on the same row (which in most cases will be true).



Extended Data Output (EDO)

Extended Data Output (EDO) memory is about 10 to 15 percent faster than FPM memory and is usually found on 66 MHz motherboards. With EDO memory, the memory controller can read data from a memory block while listening for the next instruction. This capability increases performance, because the memory controller does not have to wait for the next instruction after read ng a block of memory; while it is reading one block of memory, it is receiving the next instruction With FPM RAM, the reading of one memory block and listening for the next instruction would be done in multiple steps.

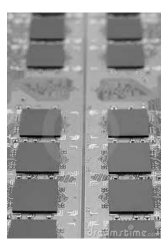


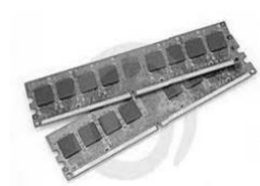


Burst Extended Data Output (BEDO)

Burst Extended Data Output (BEDO) is a bursting-type technology. The word *burst* refers to the fact that when one memory address is requested and that address is retrieved, the system bursts into the next couple of blocks and reads those as well. The theory behind BEDO is that the system has already gone through the trouble of locating that block, and chances are that the next request will be for the next block, so why not take it while we are there? If that extra block is the next requested block from the CPU, the memory controller already has the data and can pass it to the CPU immediately.

BEDO is 50 percent faster than EDO. Because of lack of support from computer manufacturers, however, BEDO has not been used in many systems. It seems that PC manufacturers are using SDRAM instead.

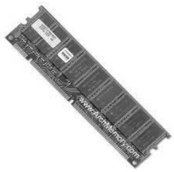


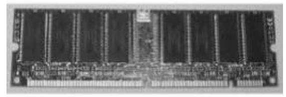


Synchronous DRAM (SDRAM)

Synchronous DRAM (SDRAM) is memory synchronized at system speed. This synchronized speed means that the data stored in memory is refreshed at the system speed and data is accessed in memory at the system speed. SDRAM is the popular RAM in systems today. Because you are running at the system speed, however, you must match the RAM with the motherboard speed. Thus, if you have a 100

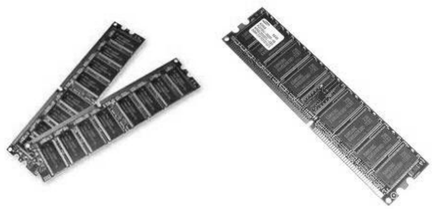
MHz motherboard, you need 100 MHz SDRAM. If you have a 133 MHz motherboard, you need 133 MHz SDRAM.





Double Data Rate Synchronous Dynamic Random Access Memory (DDR SDRAM)

Double Data Rate Synchronous Dynamic Random Access Memory (DDR SDRAM) is quite a long name when you think about it. DDR SDRAM is based on the SDRAM concept with just one exception – doubling the number of read or writes operations to two accesses per system clock cycle. This effectively doubles the memory bandwidth over conventional SDRAM. The DDR SDRAM concept is used in AGP (Advanced Graphics Port) technology to improve performance of graphics cards.

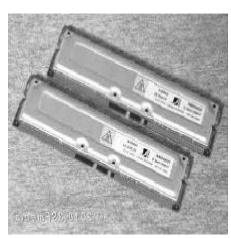


Rambus DRAM (RDRAM)

Rambus DRAM, a type of memory (DRAM) developed by Rambus, Inc. whereas the fastest current memory technologies used by PCs (SDRAM) can deliver data at a maximum speed of about 100 MHz, RDRAM transfers data at up to 800 MHz.

In 1997, Intel announced that it would license the Rambus technology for use on its future motherboards, thus making it the likely de facto standard for memory architectures. However, a consortium of computer vendors is working on an alternative memory architecture called *SyncLink DRAM (SLDRAM)*.

RDRAM is already being used in place of VRAM in some graphics accelerator boards. As of late 1999, Intel has been using RDRAM in its Pentium III Xeon processors and more recently in its Pentium 4 processors. Intel and Rambus are also working a new version of RDRAM, called ***nDRAM*** that will support data transfer speeds at up to 1,600 MHz

Error Correction Code DRAM (ECC DRAM)
Many higher-end systems use a special type of RAM called Error Correction Code (ECC) DRAM.NON-ECC is normally used by the end users. ON-ECC RAM checks out for any error occurred in parity bit but does not correct it, which is performed by ECC.ECC detects problems in RAM quite well and can fix most of them on the fly.ECC RAM are costly as compared with NON -ECC RAM.ECC DRAM memory requires special types of Motherboards that can support ECC DRAM.

Synchronous Graphics Random Access Memory (SGRAM)
It is streamlined to work with graphics cards. Enables fast read and write operation for the graphics processor when working with the information in the Video frame buffer.

Video RAM(VRAM)
Memory that is optimized for Video Cards where each memory cell is dual ported. Video data can be written to the RAM while the graphics adapter simultaneously reads from it to refresh the display.

Static Random-Access Memory (SRAM):
Static random-access memory (SRAM) is a type of semiconductor memory where the word *static* indicates that, unlike *dynamic* RAM (DRAM), it does not need to be periodically refreshed, as SRAM uses bit table latching circuitry to store each bit. SRAM exhibits data remainence but is still volatile in the conventional sense that data is eventually lost when the memory is not powered. It is also known as Cache RAM.

- **SRAM operation**

An SRAM cell has three different states it can be in: **standby** where the circuit is idle, **reading** when the data has been requested and **writing** when updating the contents. The SRAM to operate in read mode and write mode should have "readability" and "write stability" respectively.

- **Applications and uses:**

Static RAM exists primarily as:

Integrated on chip-

- As RAM or cache memory in micro-controllers (usually from around 32 bytes up to 128 kilobytes)
- As the primary caches in powerful microprocessors, such as the x86 family, and many others (from 8 kB, up to several megabytes)
- To store the registers and parts of the state-machines used in some microprocessors on application specific ICs, or ASICs (usually in the order of kilobytes)
- In FPGAs and CPLDs.

Embedded use
Many categories of industrial and scientific subsystems, automotive electronics, and similar, contain static RAM. Some amount (kilobytes or less) is also embedded in practically all modern appliances, toys, etc. that implement an electronic user interface. Several megabytes may be used in complex products such as digital cameras, cell phones, synthesizers, etc.
SRAM in its dual-ported form is sometimes used for real time digital signal processing circuits.

In computers

SRAM is also used in personal computers, workstations, routers and peripheral equipment: internal CPU caches and external burst mode SRAM caches, hard disk buffers, router buffers, etc. LCD screens and printers also normally employ static RAM to hold the image displayed (or to be printed). Small SRAM buffers are also found in CDROM and CDRW drives, usually 256 kb or more are used to buffer track data, which is transferred in blocks instead of as single values. The same applies to cable modems and similar equipment connected to computers.

Hobbyists

Hobbyists often prefer SRAM due to the ease of interfacing. It is much easier to work with than DRAM as there are no refresh cycles and the address and data buses are directly accessible rather than multiplexed. In addition to buses and power connections, SRAM usually require only three controls: Chip Enable (CE), Write Enable (WE) and Output Enable (OE). In synchronous SRAM, Clock (CLK) is also included.

- **Types of SRAM**

Non-volatile SRAM

Non-volatile SRAMs have standard SRAM functionality, but they save the data when the power supply is lost, ensuring preservation of critical information. NVSRAMs are used in a wide range of situations—networking, aerospace, and medical, among many others—where the preservation of data is critical and where batteries are impractical.

Asynchronous SRAM

Asynchronous SRAM are available from 4 Kb to 32 Mb. The fast access time of SRAM makes asynchronous SRAM appropriate as main memory for small cache-less embedded processors used in everything from industrial electronics and measurement systems to hard disks and networking equipment, among many other applications. They are used in various applications like switches and routers, IP-Phones, IC-Testers, DSLAM Cards, to Automotive Electronics.

Cache Memory

Cache memory is a relatively small amount (normally less than 1MB) of high speed memory that resides very close to the CPU. Cache memory is designed to supply the CPU with the most frequently requested data and instructions. Retrieving data from cache takes a fraction of the time that it takes to access it from main memory. Having cache memory can save a lot of time.

Caches are organized into layers. The highest layer is closest to the device (such as the CPU) using it. There are two levels of cache built right into the CPU. Any cache memory component is assigned a "level" according to its proximity to the processor. The cache that is closest to the processor is called Level 1 (L1) Cache. The next level of cache is numbered L2, then L3, and so on.

- **Hit Rate**

Whenever the CPU finds the data it needs in the cache then it is called a cache hit. When the CPU fails to find the data it needs in the cache that is called a cache miss. The ratio of cache hits to cache misses is called a cache hit ratio.

- **Level 1 (Primary) Cache**

Level 1 or primary cache is the fastest memory on the PC. It is built directly into the processor itself. It is very small, generally from 8 KB to 64 KB, but it is extremely fast and runs at the same speed as the processor.

- **Level 2 (Secondary) Cache**

Level 2 caches is a secondary cache to the level 1 cache, and is larger and slightly slower. Used to catch recent accesses that are not caught by the level 1 cache, and is usually 64 KB to 2 MB in size. Usually found either on the same package as the processor itself (though it isn't in the same circuit where the processor and level 1 cache are) or on the motherboard or as a daughter board that inserts into the motherboard.

- **Operations in Cache**

Write Through and Write Back:
When the CPU writes new data to the cache, the cache controller must update main memory with the new data. By making sure that the information in the cache is the same as that in main memory. The cache controller is said to maintain cache coherency. If the cache controller allows the data in the cache to differ from data in main memory, the data is said to be stale. Every time the CPU updates the cache, the data is automatically written through to the main memory. Which is called as Write Through Cache. If the CPU needs to access the cache or main memory before the write through is completed, the CPU must wait. This will slow the overall performance of the CPU. To prevent this problem the cache controller update a small but fast buffer instead of directly updating the main memory. Because the buffer can be faster than the main memory, the cache controller can make the cache available to the CPU sooner. This method of updating the main memory is called a Buffered or posted write through. The cache controller will keep track of which data is stale and only update the memory when it must, not immediately required after every memory write. This technique is called write back or copy back. The concept of buffering, or posting, the writes can also be applied to the write back cache to further increase its performance as well.It results in the fastest cache.

Non-volatile memory:
Non-volatile memory, NVM or non-volatile storage, in the most basic sense, is computer memory that can retain the stored information even when not powered. Examples of non-volatile memory include read-only memory, flash memory, ferroelectric RAM, most types of magnetic computer storage devices (e.g. hard disks, floppy disks, and magnetic tape), optical discs, and early computer storage methods such as paper tape and punched cards. Non-volatile memory is typically used for the task of secondary storage, or long-term persistent storage. The most widely used form of primary storage today is a volatile form of random access memory (RAM), meaning that when the computer is shut down, anything contained in RAM is lost. Unfortunately, most forms of non-volatile memory have limitations that make them unsuitable for use as primary storage. Typically, non-volatile memory either costs more or performs worse than volatile random access memory. Several companies are working on developing non-volatile memory systems comparable in speed and capacity to volatile RAM. For instance, IBM is currently developing MRAM (Magneto resistive RAM). Not only would such technology save energy, but it would allow for computers that could be turned on and off almost instantly, bypassing the slow start-up and shutdown sequence.

Non-volatile data storage can be categorized in electrically addressed systems (read-only memory) and mechanically addressed systems (hard disks, optical disc, magnetic tape, holographic memory, and such). Electrically addressed systems are expensive, but fast, whereas mechanically addressed systems have a low price per bit, but are slow. Non-volatile memory may one day eliminate the need for comparatively slow forms of secondary storage systems, which include hard disks.

- **Types Of Non-Volatile Memory:**

Mask-programmed ROM:

One of the earliest forms of non-volatile read-only memory, the mask-programmed ROM was prewired at the design stage to contain specific data; once the mask was used to manufacture the integrated circuits, the data was cast in stone (silicon, actually) and could not be changed. The mask ROM was therefore useful only for large-volume production, such as for read-only memories containing the start up code in early microcomputers. This program was often referred to as the "bootstrap", as in pulling oneself up by one's own bootstraps. Due to the very high initial cost and inability to make revisions, the mask ROM is rarely, if ever, used in new designs.

Programmable ROM

The next approach was to create a chip which was initially blank; the programmable ROM originally contained silicon or metal fuses, which would be selectively "blown" or destroyed by a device programmer or PROM programmer in order to change 0s to 1s. Once the bits were changed, there was no way to restore them to their original condition. Non-volatile but still somewhat inflexible. Early PAL programmable array logic chips used a similar programming approach to that used in the fuse-based PROMs. Newer Anti fuse-based PROMs (which are also referred to as one-time-programmable (OTP) memory) are widely used in consumer and automotive electronics, radio-frequency identification devices (RFID), implantable medical devices, and high-definition multimedia interfaces (HDMI) due to their small footprint, reliability, fast read speed, and long data retention rates.

Erasable PROMs

There are two classes of non-volatile memory chips based on EPROM technology.

- **UV-erase EPROM**

The original erasable non-volatile memories were EPROM's; these could be readily identified by the distinctive quartz window in the center of the chip package. These operated by trapping an electrical charge on the gate of a field-effect transistor in order to change a 1 to a 0 in memory. To remove the charge, one would place the chip under an intense short-wavelength fluorescent ultraviolet lamp for 20–30 minutes, returning the entire chip to its original blank (all ones) state.

- **OTP (one-time programmable) EPROM**

An OTP is electrically an EPROM, but with the quartz window physically missing. Like the fuse, PROM it can be written once, but cannot be erased.

Electrically erasable PROM

Electrically erasable PROMs have the advantage of being able to selectively erase any part of the chip without the need to erase the entire chip and without the need to remove the chip from the circuit. While an erase and rewrite of a location appears nearly instantaneous to the user, the write process is slightly slower than the read process; the chip can be read at full system speeds. The limited number of times a single location can be rewritten is usually in the 10000-100000 range; the capacity of an EEPROM also tends to be smaller than that of other non-volatile memories. Nonetheless, EEPROMs are useful for storing settings or configuration for devices ranging from dial-up modems to satellite receivers.

Flash memory

The flash memory chip is a close relative to the EEPROM; it differs in that it can only be erased one block or "page" at a time. It is a solid-state chip that maintains stored data without any external power source. Capacity is substantially larger than that of an EEPROM, making these chips a popular choice for digital cameras and desktop PC BIOS chips.
Flash memory devices use two different logical technologies—NOR and NAND—to map data. NOR flash provides high-speed random access, reading and writing data in specific memory locations; it can retrieve as little as a single byte. NAND flash reads and writes sequentially at high speed, handling data in small blocks called pages, however it’s slower on read when compared to NOR. NAND flash reads faster than it writes, quickly transferring whole pages of data. Less expensive than NOR flash at high densities, NAND technology offers higher capacity for the same-size silicon.

Magneto resistive RAM (MRAM):

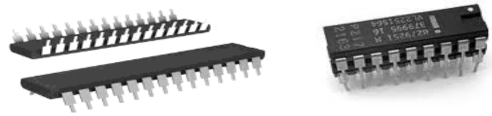
Magneto resistive RAM is one of the newest approaches to non-volatile memory and stores data in magnetic storage elements called magnetic tunnel junctions (MTJ's). MRAM has an especially promising future as it seeks to encompass all the desirable features of the other popular types of memory (non-volatility, infinite endurance, high-speed reading/writing, low cost).
The 1st generation of MRAM, such as Everspin Technologies' 4 Mbit, utilized field induced writing. The 2nd generation is being developed mainly through two approaches: Thermal Assisted Switching (TAS) which is being developed by Crocus Technology, and Spin Torque Transfer (STT) which Crocus, Hynix, IBM, and several other companies are developing.

Memory Packaging

Memory is available in various physical packaging. Roughly in order of their appearance, the major types of DRAM packaging include:

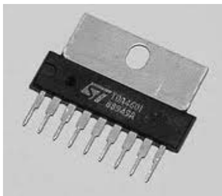
DIP (Dual Inline Pin Package)

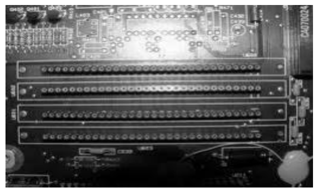
This package comprises a rectangular chip with a row of pins down each long side, making it resemble an insect. DIP was the most common DRAM package used in PCs through early 386 models. DIP chips were produced in Page Mode and Fast Page Mode, and are long obsolete. DIP packaging was also used for L2 cache memory on most 486 and some Pentium-class motherboards. DIP DRAM is useless nowadays.

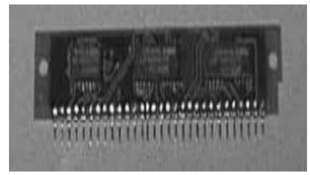


SIPP (Single Inline Pin Package)

This package turns a DIP chip on its side and extends all leads straight out one side, parallel to the plane of the chip. SIPPs were intended to allow memory to be installed more densely, and were used in a few 386SX systems, but they never caught on. SIPPs were produced in Page Mode and Fast Page Mode form, and are long obsolete.







SIMM (Single Inline Memory Module)

This package mounts multiple individual DRAM DIP chips on a small circuit board with a card-edge connector designed to fit a socket on the motherboard. Mainstream SIMMs have been manufactured in two form factors:

30-pin

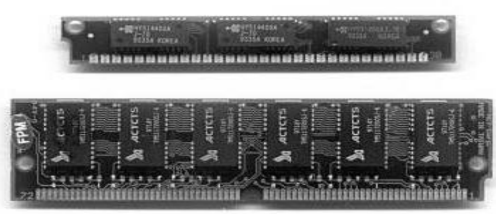
These SIMMs were used in a few 286 systems, most 386 systems, and some 486 systems, and were produced in Page Mode and Fast Page Mode form. Although they are still available, 30-pin SIMMs are obsolete. If you tear down an old system, any 30-pin SIMMs you salvage are too small and too slow to be useful. However, some laser printers do use them.

72-pin

These SIMMs were used in some 386 systems, most 486 systems, and nearly all Pentium-class systems built before the advent of DIMMs. 72-pin SIMMs was produced in Fast Page Mode, EDO form, and BEDO form. When tearing down old systems, 72-pin SIMMs may be worth salvaging, as they can be used to expand the memory on a late-model Pentium or Pentium Pro system or to expand the memory in some laser printers.

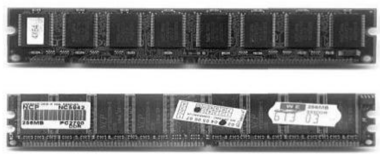
Figure shows a 72-pin SIMM (top) and a 30-pin SIMM. The 72-pin SIMM is keyed by the notch at the bottom right; the 30-pin SIMM by the notch at the bottom left. The holes on either side immediately above the bottom row of contacts are used by the slot retention mechanism to secure the SIMM in the slot. Although it may not be visible in the reproduction, the top SIMM uses gold contacts and the bottom SIMM tin contacts.

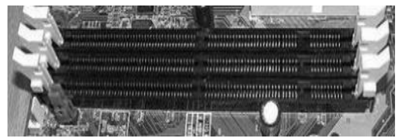
Figure 72-pin SIMM (top) and 30-pin SIMM



DIMM (Dual Inline Memory Module)

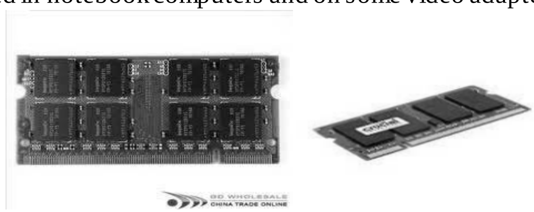
DIMMs are dual-side modules that use connectors on both sides of the circuit board. SDR-SDRAM DIMMs have 168 pins, but SDR-SDRAM is also available in 100- and 144-pin DIMMs. DDR-SDRAM is packaged in 184-pin DIMMs, which are physically similar to standard 168-pin SDR-SDRAM DIMMs, but have additional pins and different keying notch positions to prevent them from being interchanged. DDR-II DIMMs are similar to DDR DIMMs, but use a 232-pin connector. Only SDR-SDRAM, DDR-SDRAM, and EDO are commonly packaged as DIMMs.





SODIMM (Small Outline DIMM)

A special package used in notebook computers and on some video adapters.



RIMM

A Rambus RDRAM module. RIMM is a trade name rather than an acronym. RIMMs are physically similar to standard SDRAM DIMMs, except that the keying notches are in different locations. RDRAM is available in 168-pin and 184-pin modules. Early RDRAM motherboards used 168-pin RIMMs. Most current RDRAM motherboards use 184-pin RIMMs. Figure shows the most common physical packages for memory used in recent systems. The top module is a 168-pin PC133 SDRAM DIMM. The bottom module is a 184-pin PC2100 DDR-SDRAM DIMM (faster DDR-SDRAM modules use the same package). The physical dimensions of both are the same: 5.375 inches (13.6525 cm) wide by 1.375 inches (3.4925 cm) tall. The width is standardized for all memory modules to ensure they fit the standard slot. The height may vary slightly, and is a factor only in that tall modules may interfere with other components in a tightly packed system. Both of these modules use nine chips, which indicate that they are Error Checking and Correction (ECC) modules. Non parity modules use only eight chips.

The major difference between these DIMMs, other than the number of pins, is the location of the keying notches. SDRAM DIMMs use two notches, one centered and one offset. DDR-SDRAM DIMMs use only one offset keyin notch. The number and position of these keying notches ensure that only the proper memory type can be installed in a slot and that the module is oriente correctly. Rambus RIMMs use similar physical packaging, but with the keying notches in different locations. Rambus RIMMs also cover the individual chips with a metal shroud designed to dissipate heat.

DRAM Memory packaging generation:

From top to bottom: DIP, SIPP, SIMM (30-pin), SIMM (72-pin), DIMM (168-pin), DDR DIMM (184-pin).

Management of Memory:

Proper management of memory is vital for a computer system to operate properly. Modern operating systems have complex systems to properly manage memory. Failure to do so can lead to bugs, slow performance, and at worst case, takeover by viruses and malicious software. Nearly everything a computer programmer does requires him or her to consider how to manage memory. Even storing a number in memory requires the programmer to specify how the memory should store it.

- **Memory Management Bugs:**

Improper management of memory is a common cause of bugs.

- ✓ In arithmetic overflow, a calculation results in a number larger than the allocated memory permits. For example, an 8-bit integer allows the numbers −127 to +127. If its value is 127 and it is instructed to add one, the computer cannot store the number 128 in that space. Such a case will result in undesired operation, such as changing the number's value to −128 instead of +128.
- ✓ A memory leak occurs when a program requests memory from the operating system and never returns the memory when it's done with it. A program with this bug will gradually require more and more memory until the program fails as it runs out.
- ✓ A segmentation fault results when a program tries to access memory that it has no permission to access. Generally a program doing so will be terminated by the operating system.
- ✓ Buffer overflow means that a program writes data to the end of its allocated space and then continues to write data to memory that belongs to other programs. This may result in erratic program behavior, including memory access errors, incorrect results, a crash, or a breach of system security. They are thus the basis of many software vulnerabilities and can be maliciously exploited.

- **Early computer systems**

In early computer systems, programs typically specified the location to write memory and what data to put there. This location was a physical location on the actual memory hardware. The slow processing of such computers didn't allow for the complex memory management systems used today. Also, as most such systems were single-task, sophisticated systems weren't required as much. This approach has its pitfalls. If the location specified is incorrect, this will cause the computer to write the data to some other part of the program. The results of an error like this are unpredictable. In some cases, the incorrect data might overwrite memory used by the operating system. Computer crackers can take advantage of this to create viruses and malware.

Chapter – 9
Storage Devices

Objective of learning

1. Introduction to Storage Devices
2. Different types of storage devices, storage capacity
3. Floppy, CD, DVD, Blue-ray, Zipp Etc.

Introduction

We have seen that memory is an important factor in determining overall computer system power. However, memory provides on a small amount of temporary storage area for the data and instructions required by the CPU for processing. Computer systems also need to store larger amounts of data, program instruction, and information more permanently than allowed with memory. Storage serves this purpose. Storage holds data, instructions, and information for future use. Every computer uses storage to hold system software and application software.

Storage, also called secondary storage, refers to the media on which data, instructions, and information are kept, as well as the devices that record and retrieve these items. Compared with memory, storage offers the advantage of nonvolatile, greater capacity, and greater economy. Every computer stores system software and application software. To start up, a computer locates an operating system in storage, usually a hard disk, and loads it into memory (RAM). When a user issues a command to start application software, such as a word processing program or a Web browser, the operating system locates the program in storage, such as on a hard disk, CD, or DVD, and loads it into memory.

Figure: A variety of storage media

In addition to programs, users store a variety of data and information on all types of computers and digital devices. Storage requirements among these users vary greatly. Home users, small office/business, and

mobile users typically have much smaller storage requirements than the large business user or power user. For example, a h ome user may need 320 billion bytes of storage, while large businesses may require 50 quadrillion bytes of storage.
A storage medium is the physical material on which a computer keeps data, instructions, and information. There is a variety of storage media available (Figure:). Capacity is the number of bytes (characters) a storage medium can hold. F igure 5-61 identifies the terms manufacturers use t o define the capacity of storage media. For example, a reasonably priced USB flash drive can store 1GB of data (approximately one billion bytes) and a typical hard disk has 320 GB (approximately 320 billion bytes) of storage capacity.
Items on a storage medium remain intact even when power is removed form the computer. Thus, a storage medium is nonvolatile. Most memory, by contrast, holds data and inst ructions temporarily and thus is volatile. Figure illustrates the concept of volatility.
A storage device is the mechanism used to record and retrieve items to and from a st orage medium. Storage devices can function as sources of i nput and output. For example, each time a storage device transfers data, instructions, and information from a storage medium into memory, a process called rea

Storage Term	Approximate Number of Bytes	Exact Number of Bytes
Kilobyte (KB)	1 thousand	2^{10} or 1,024
Megabyte (MB)	1 million	2^{20} or 1,048,576
Gigabyte (GB)	1 billion	2^{30} or 1,073,741,824
Terabyte (TB)	1 trillion	2^{40} or 1,099,511,627,776
Petabyte (PB)	1 quadrillion	2^{50} or 1,125,899,906,842,624
Exabyte (EB)	1 quintillion	2^{60} or 1,152,921,504,606,846,976
Zettabyte (ZB)	1 sextillion	2^{70} or 1,180,591,620,717,411,303,424
Yottabyte (YB)	1 septillion	2^{80} or 1,208,925,819,614,629,174,706,176

Figure: The capacity of a storage medium is measured by the number of bytes it can hold

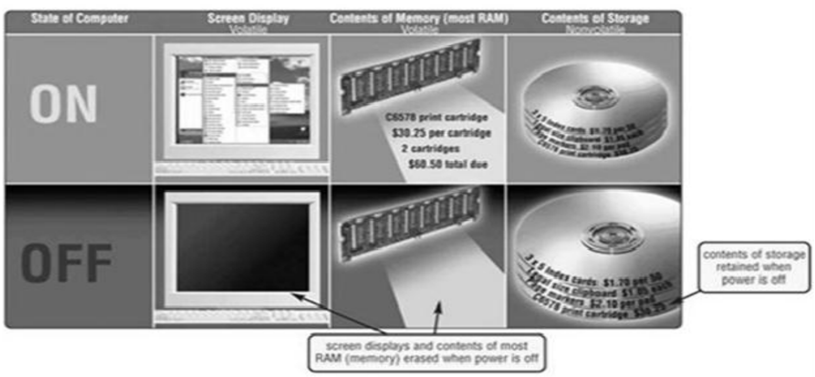


Figure: An illustration of volatility

input source. When a storage device transfers these items f rom memory to a storage medium, a process called writing, it functions as an output source. Data and information access on storage can be either sequential or direct. Sequential access means that data must be accessed consecutive. Magnetic tapes allow only sequential access; the tape must be forwarded or rewound to a s pecific point to access a specific piece of data. Direct access means that data can be accessed directly without the need to pass by other data in sequence. Magnetic disks and op tical disks provide direct access. Di rect access is usually faster than sequential access. The speed of a storage device and memory is defined by its access time, which measures (1) the amount of time it takes a storage device to locate an item on a storage medium, or (2) the time required to deliver an item from memory to the processor. Compared to memory, storage devices are slow. Some manufacturers use a storage device's transfer rate. Transfer rate is the speed with which data, instructions, and information transfer to and from a dev ice. Transfer rates for storage are stated in KBps (kilobytes per second) and Mbps (megabytes per second). Storage requirements among users vary greatly. Numerous types of storage media and storage devices are available to meet a variety of users' needs. Figure: shows how different types of storage media and memory compare in terms of transfer rates and uses. The following subsections discuss these storage media.

Magnetic Media

Magnetic media are based on a technology of representing data as magnetized spots on the tape or disk -- with a magnetized spot representing a 1 bit and the absence of such a spot representing a 0 bit. The alignment of the magnetized spots represents the data. Reading data from the media means converting the magnetized data to electrical impulses that can be sent to the processor. Writing data to the media is the opposite; it involves sending electrical impulses from the processor to be converted to magnetized spots on the media.

During the 1950s and 1960s, the foundation of many information systems was sequential processing using magnetic tape master files. Magnetic tape is a magnetically coated ribbon of plastic capable of storing large amounts of data and information at a low cost. Tape storage is an example of a sequential access storage medium. Data must be accessed in the order in which it is stored. If the computer is to read data from the middle of a reel of tape, all the tape before the desired piece of data must be passed over sequentially. This is one disadvantage of magnetic tape. For this reason, today, magnetic tape storage is no longer used for routine processing. Business and home users utilize tape most often for long-term storage and backup.

Similar to a tape recorder, a tape drive, also called tape backup units (TBUs), is used to read from and write data and information onto a tape. Although older computers used reel-to-reel tape drives, today's tape drives use tape cartridges. A tape cartridge is a small, rectangular, plastic housing for tape (Figure). Tape cartridges containing one-quarter-inch wide tape are slightly larger than audiocassette tapes and frequently are used for active PC user and for administrators of local area networks. Many large companies use robotic tape storage and retrieval unit holds hundreds of high-density tape cartridges. The tape cartridges are automatically loaded and unloaded to a tape drive as they are needed for processing.

A floppy disk, or diskette, is a portable, inexpensive storage medium that consists of a thin circular, flexible plastic disk with a magnetic costing enclosed in a square-shaped plastic shell. A standard floppy disk is 3.5-inches wide and has storage capacities up to 1.44 MB (about 500 double-space pages of text, several digital photographs, or a small audio file). When discussing a storage medium, the term portable means you can remove the medium from one computer and carry it to another computer. Floppy disks are not as widely used as they were 15 years ago because of their low storage capacity. A floppy disk drive is a device that can read from and write to a floppy disk. Because computers today do ... , you can use an external floppy disk drive, in which ... a port on the system unit (Figure). Floppy disk drive access times are about 84 milliseconds, or

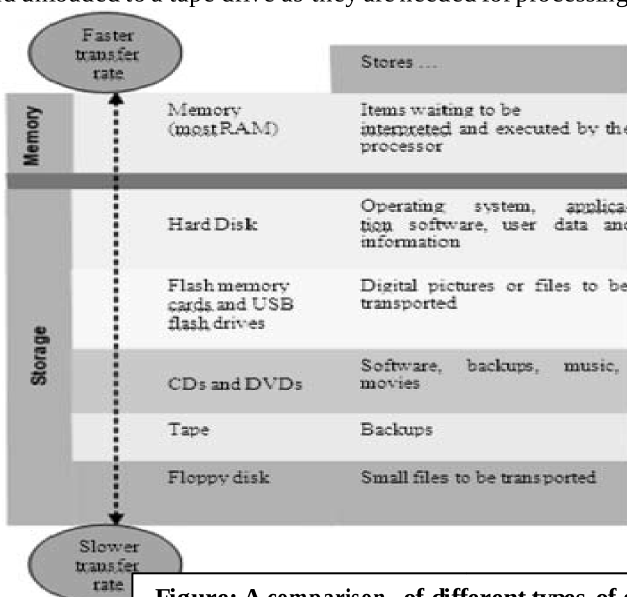


Figure: A comparison of different types of storage media and memory in terms of relative speed and uses

approximately 1/12 of a second. The transfer rates range from 250 to 500 KBps.

Figure: A tape drive and a tape cartridge

A hard disk, also called hard drive, usually consists of several inflexible, circular metal platters coated with magnetic oxide that can be magnetized to represent data. The entire device is enclosed in an air-tight, sealed case to protect it from contamination. Hard disks come in a variety of sizes. In most personal computers, the hard disk is housed inside the system unit (Figure). A hard disk that is mounted inside the system unit sometimes is called a fixed disk because it is not portable. Current personal computer hard disks have storage capacities from 160 GB to 1 TB and more.

Figure: Floppy disk and external floppy disk drive

Most magnetic disks are read/write storage media; that is, you can read from and write data on a magnetic disk any number of times. Before you can write on a new disk, it must be formatted. Formatting is the process of preparing a disk for reading and writing by organizing the disk into storage locations called tracks and sectors (Figure). A track is a narrow recording band that forms a full circle on the surface of the disk. The tracks are further divided into sectors. A sector is capable of holding 512 types of data. A typical floppy disk stores data on both sides and has 80 tracks on each side of the recording surface with 18 sectors per track. For reading and writing purpose, sectors are grouped into clusters. A cluster, also called allocation unit, consists of two to eight sectors, depending on the operating system. A cluster is the smallest unit of space used to store data. Even if a file consists of only a few bytes, an entire cluster is used for storage. Although each cluster holds data from only one file, one file can be stored in many clusters. Sometimes, a sector has a flaw and cannot store data. When you format a disk, the operating system marks these bad sectors as unusable.

Figure: A hard disk is enclosed inside an airtight, sealed case inside the system unit

If you are using the Windows operating system, the formatting process also defines the file allocation table (FAT), which is a table of information used to locate files on a disk. If you format a disk that already contains data or programs, the formatting Process erases the file location information and Redefines the FAT for these items. The actual files on the disk are not erased. For this reason, if you accidentally format a disk, you often can unformed it with special software. Most floppy disks are preformatted by the disk's manufacturer. If you must format a floppy disk by yourself, you do so by issuing a formatting command to the operating system.

In a hard disk, the circular metal platters are assembled into a disk pack. Each platter in the pack has top and bottom surfaces on which to store data. A disk pack is mounted on a hard disk drive that is device for reading data from or writing data on a disk. While your computer is running, all platters in a disk pack rotate at a high rate of speed, usually 5,400 to 15,000 revolutions per minute, although only one platter is being read from or written on at any one time. The platters typically continue to spin until power is removed from the computer. The mechanism for reading or writing data on a platter is an access arm that moves a read/write head into the proper location over a particular track (Figure 5-68). Each platter has two read/write heads, one for each side. A read/write head is the mechanism that reads items and writes items in the drive as it barely touches the disk's recording surface.

Because of the stacked arrangement of the platters, the location of the read/write heads often is referred to by its cylinder instead of its track. A cylinder is the vertical Location of a single rack through all platters (Figure). Once the read/write heads are in position, they are in the same vertical position on all platter surfaces. If a hard disk has two Platters (four sides), each with 1000 tracks, then it will have 1000 cylinders with each cylinder consisting of 4 tracks (2 tracks for each platter). The read/write head on the end of the access arm hovers just above the track but does not actually touch the surface. The distance between the read/write head and the platter is approximately two millionths of an inch. This small distance leaves no room for any type of contamination. When a read/write head does accidentally touch the platter surface, it is called a head crash and all data is destroyed. Data can also be destroyed if a read/write head encounters even minuscule foreign matter on the platter surface. Most hard disks combine the platters, access arms, and read/write heads in an airtight sealed module, thus even microscopic dust particles do not get on the platter surface. However, even internal hard disks are sealed tightly, head crashes occasionally do still occur. Thus, it is crucial that you back up your hard disk regularly. A backup is a duplicate of a file, program, or disk placed on a separate storage medium that you can use in case the original is lost, damaged, or destroyed.

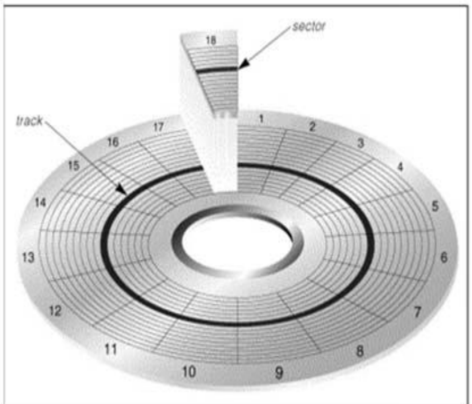


Figure: Tracks form circles on the surface of a magnetic disk. The disk's storage locations are divided into pie-shaped sections, which break the tracks into small arcs called sectors.

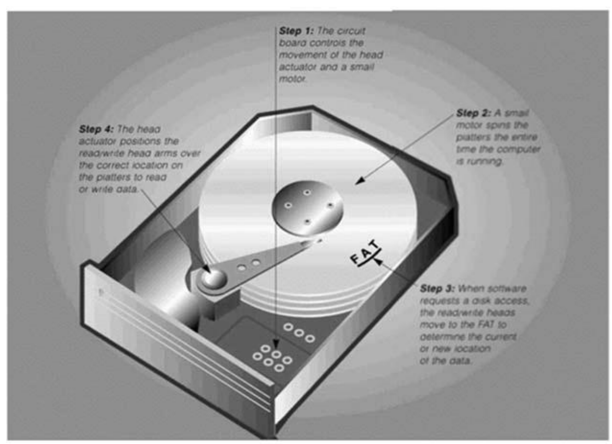
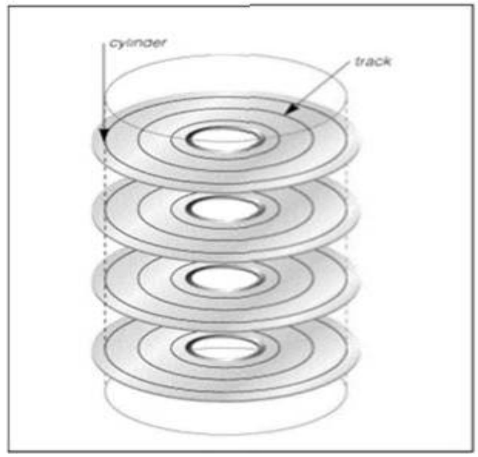


Figure: How a hard disk works

The flow of data, instructions, and information to and from a disk is managed by a special-purpose chip and its associated electronic circuits called the disk controller. Because a disk controller



controls the transfer of items from the disk to the rest of the computer, it ofte n is referred to as a type of i nterface. A cont roller for a hard disk is called hard disk controller (HDC). On a personal computer, the HDC either is built into the disk drive or is a separate expansion card that plugs into an expansion slot. In their personal computer advertisements, vendors usually state the type of hard disk int erface supported by the hard disk controller. Thus, you should understand the types of available hard disk interfaces. In addition to USB and FireWire (external hard disk interfaces), four other types of hard disk interfaces for internal use in pe rsonal computers as SATA, EIDE, SCSI, and SAS.

SATA (Serial Advanced Technology Attachment) uses serial signals to transfer dat a, instructions, and information. The primary advantage of SATA interfaces is their cables are thinner, longer, more flexible, and less susceptible to interference than cables used by hard di sks that use parallel signals. SATA interfaces have data transfer rates of up to 300 MBps. EIDE (Enhanced Integrated Drive Electronics) is a hard disk interface that uses parallel signals to transfer data, instructions and information. EIDE interfaces can support up to four hard disks at 137GB per disk. These interfaces have data transfer rates up to 100MBps. SCS I interfaces, which also use parallel signals, can support up to eight or fifteen peripheral devices. Supported devices include hard disks, CD/DVD driv es, tape drives, printers, scanners, network cards, and much more. SCSI interfaces provide up to 320 MBps data transfer rates. SAS (Serial-attached SCSI) is a newer type of SCSI that uses serial signals to transfer data, instructions, and information. SAS has man y advantages over parallel SCSI. Experts predict that SAS eventually will replace SCSI.

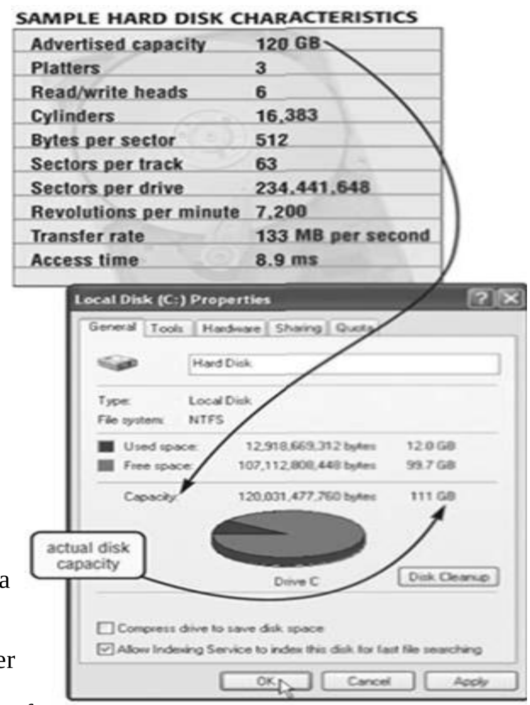


Figure: Characteristics of a sample 120 DB hard disk

Depending on the type of hard disk, transfer rates ra from 15 MBps to 320 MBps. Access time for today's disks ranges from approximately 3 to 12 milliseconds. capacity of a hard dis k is determined from the number platters it contains, together with composition of the mag costing on the platters. Figure 5-70 shows characteristics of a sample 120 GB hard disk, which include its capacity, platters, read/write heads, cylinders, sectors and tracks, revolutions per minute, transfer rate, and access time.

Hard disks improve their access time by using disk caching. Disk cache, som etimes called a b uffer, consists of a memor y chips on a hard disk that stores frequently accessed items such as data, instructions, and information. Disk cache and memory cache work i n a si milar fashion. When a proce ssor requests data, instructions, or information from the hard disk, the hard disk first checks its disk cache. If the requested item is in disk cache, the hard disk sends it to th e processor. If the hard disk does not find the requested item in the disk cache, then the processor must wait for the hard disk to locate and transfer the item from the disk to the processor (Figure).

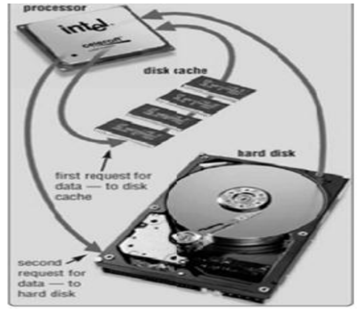


Figure: How disk cache works

Many mobile devi ces and consumer electronics include miniature hard disks, which provide users with greater storage capacities than flash memory. These tiny hard disks often have form factors of 1.8 inch, 1 inch, and 0.85 inch. Devices such as portable media players, digital cameras, and smart phones often have built-in miniature hard disks. Another type of miniature hard disk, often calle d a pocket hard drive, is a self-contained unit that you insert in and remove from a slot in a devi ce or a com puter or plug in a US B port on a computer.

An external hard disk is a separate free-standing hard disk that connects with a cable to a USB port or FireWire port on the system unit. As with the internal hard disk, the entire hard disk is enclosed in a n airtight, se aled case. External hard disks have storage capacities of up to 2TB and more.

Figure: RAID is a group of integrated hard disks

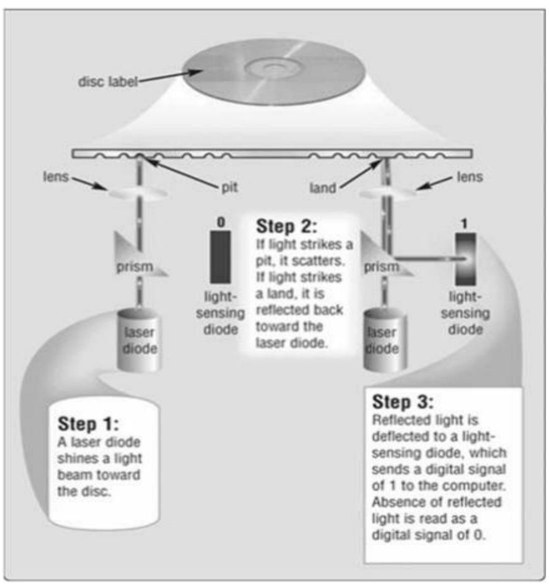


Figure: How a laser reads data on an optical disc

A removable hard disk is a hard disk that you insert and remove from either a dock or a drive. External hard disks and removable hard disks offer many advantages over internal hard disks. As their prices drop, increasingly more users will purchase one to supplement a home or office internal hard disk. Keep in mind, though, that external or removable hard disks transfer data at slower rates than internal hard disks.

Most manufacturers guarantee their hard disks to last somewhere between three and five years. Many last much longer with proper care. To prevent the loss of items store on a har d disk, you regularly should perform preventive maintenance such as defragmenting or scanning the disk for errors.

Instead of storing data locally on hard disk, you can opt to store it on an Internet hard drive. An Internet hard drive, also called online storage, is a service on the Web that provides storage to computer users, usually for a minimal monthly fee. Once users subscribe to the online storage service, they can save on the Internet hard disk in the same manner they save on their local hard disk or any other drive. Users subscribe to an online storage service for a variety of reasons. One of the major reasons is that they can access files on the Internet hard disk from any computer or device that has Internet access at any location.

For networks and other applications that depend on reliable data access, it is crucial that the data is available when a user attempts to access it. For these applications, some manufacturers developed a type of hard disk system that connects several smaller disks into a single unit that acts like a single large hard disk. A group of two or more integrated hard disks is called a RAID (redundant array of independent disks) (Figure). Reliability is improved with RAID through the duplication of data, instructions, and information. The duplication is implemented in different ways. The simplest RAID storage design is mirroring, which has one backup disk for each disk. If a drive should fail, a duplicate of the requested item is available elsewhere within the array of disks. Although quite expensive, RAID is more reliable than traditional disks and thus often used with network and Internet servers

Optical Media

The optical technology works like this way: a laser hits a layer of metallic material spread over the surface of a disk. When data is being entered, heat from the laser produces tiny spots on the disk surface. To read the data the laser scans the disk, and a lens picks up different light reflections from the various spots.

An optical disc is a flat, round, portable storage medium made of metal, plastic, and lacquer that is written and read by a laser. Optical discs used in personal computers are 4.75 inches in diameter and less than one-twentieth of an inch thick. Smaller computers and devices use mini discs that have a diameter of 3 inches or less.

Some optical disc formats are read only, meaning users cannot write (save) on the media. Others are read/write, which allows users to save on the disc just as they save on a hard disk. Nearly every personal computer today has some type of optical disc drive installed in a drive bay. With some discs, you can read and/or write on one side only. Manufacturers usually place a silk-screened label on the top layer of these single-sided discs. You insert a single-sided disc in the drive with the label side up. Other discs are double-sided. Simply remove the disc from the drive, flip it over, and reinsert it in the drive to use the other side of the disc. Double-sided discs often have no label; instead each side of the disc is identified with small writing around the center of the disc. Some drives use Light Scribe technology, which works with specially coated optical discs, to etch labels directly on the disc (as opposed to placing an adhesive label in the disc).

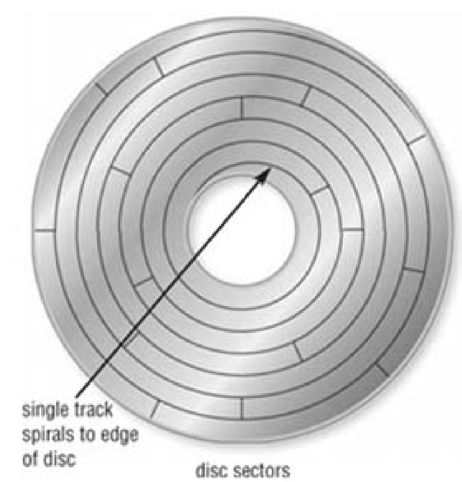


Figure: An optical disc typically stores items in a single track

Optical discs store items by using microscopic pits (indentations) and lands (flat areas) on the surface of the disc (Figure. A high-powered laser light creates the pits. A lower-powered laser light reads items from the compact disc by reflecting light through the bottom of the disc, which usually is either solid gold or silver in color. The reflected light is converted into a series of bits that the computer can process. Land causes light to reflect, which is read as binary digit 1. Pits absorb the light; this absence of light is read as binary digit 0. Items are commonly stored in a single track on an optical disc that spirals from the center of the disc to the edge of the disc. As with a hard disk, this single track is divided into evenly sized sectors on which items are stored (Figure 5-74). Manufacturers claim that a properly cared for high-quality optical disc will last 5 years but could last up to 100 years. Figure offers some guidelines for the proper care of optical discs. Many different formats of optical discs exist today. Two general categories are CDs and DVDs, with DVDs having a much greater storage capacity than CDs.

Figure: Some guidelines for the proper care of optical discs

- A CD-ROM (compact disc read-only memory) is a type of optical disc that users can read but not write or erase—hence, the name read-only. The contents of standard CD-ROMs are written by the manufacturer and only can be read and used. A typical CD-ROM holds from 650 MB to 1GB of data, instructions, and information. Because audio CDs and CD-ROMs use the same laser technology, you may be able to use a CD-ROM drive to listen to an audio CD while using the computer. Some music companies, however, configure their CDs so that the music will not play on a computer. They do this to protect themselves from customers illegally copying and sharing the music. The speed of CD-ROM drive determines how fast it installs programs and accesses the disc. A CD-ROM drive's speed is measured by its data transfer rate, which is the time it takes the drive to transmit data, instructions, and information from the CD-ROM to another device. The original CD-ROM drive was a single-speed drive with a transfer rate of 150 KB per second. Manufacturers measure all optical disc drives relative to this original CD-ROM drive. They use an X to denote the original transfer rate of 150KB per second. For example, a 48X CD-ROM drive has a data transfer rate of 7,200 (48 x 150) KB per second. Current CD-ROM drives have speeds ranging from 48X to 75X or faster. The higher the number, the faster the CD-ROM drive, which results in smoother playback of images and sounds.
- A Picture CD is a compact disc that only contains digital photographic images saved in the jpg file format. You can purchase Picture CDs that already contain pictures. A Picture CD is a multisession disc, which means you can write additional data to the disc at a later time. Thus, you can have your own pictures or negatives recorded on a Picture CD so that you have digital versions of your photographs. The images on a Picture CD can be printed, faxed, sent via electronic mail, included in another document, or posted to a Web site. The resolution of images stored on a Picture CD usually is 1024´1536 pixels. Many people use Picture CD to preserve their photos.
- CD-R (compact disc-recordable) is a technology that allows you to write on a compact disc using your own computer. Once you have recorded the CD-R, you can read from it as many times as you desire. A CD-R is a multisession optical disc which allows you to write on part of the disc at one time and another part at a later time. However, you cannot erase the disc's contents. In order to write on a CD-R, you must have a CD-R drive and CD-R software. A CD-R drive can read both audio CDs and standard CD-ROMs.

These drives read at speeds of 48X or more and write at speeds of 40X or more. Manufacturers often list the write speed first, for example, as 40/48.

- A CD-RW (compact disc-rewritable) is an erasable multisession disc that you can write on multiple times. CD-RW overcomes the major disadvantage of CD-R discs—that you can write on them only once. Reliability of the disc tends to drop, however, with each successive rewrite. To write on a CD-RW, you must have a CD-RW drive and CD-RW software. A typical CD-RW drive has a write speed of 52X or more, rewrite speed of 32X and more, and a read speed of 52X or more, stating in the order as 52/32/52.
- Although CD-ROMs have large storage capacities, it is not large enough for many business applications. A storage technology that outpaces all others is called DVD-ROM (digital video disc-ROM). A DVD-ROM is an extremely high capacity compact disc capable of storing from 4.7 GB to 17GB. Operating very much like CD-ROM technology, DVD-ROM uses a laser beam to read microscopic spots that represent data. But DVD technology uses a laser with a shorter wavelength, permitting it to read more densely packed spots, thus increasing the disk capacity. In order to read a DVD-ROM, you must have a DVD-ROM drive, which can also read CD-ROMs. DVDs are also available in a variety of formats. You also can obtain recordable and rewritable versions of DVD. DVD-R and DVD+R are competing DVD-recordable formats, each with up to 4.7 GB storage capacity. Both allow users to write on the disc once and read it many times. Instead of recordable DVDs, however, most users work with rewritable DVDs because these discs can be written on multiple times and also erased. Three competing rewritable DVD formats exist, each with storage capacities up to 4.7 GB per side: DVD+RW, DVD+RE, and DVD+RAM. You can erase and record on the disc more than 1,000 times. To write on these discs, you must have a DVD-RW drive, a DVD+RW drive, or a DVD recorder. As the cost of DVD technologies becomes more reasonable, many industry professionals expect that DVD eventually will replace all CD media.

- Two newer competing DVD formats are Blu-ray and HD DVD, both of which are higher capacity and better quality than standard DVDs. A Blu-ray Dics-ROM (BD-ROM) has storage capacities of 100 GB, with expectations of exceeding 200 GB in the future. The HD (high-density) DVD-ROM has storage capacities up to 60 GB with future projections of 90 GB capacities. Another high density format, called HD VMD (Versatile Multi-layer Disc), recently emerged as a competitor to Blu-ray and HD DVD. Current HD VMDs have capacities of 40 GB and more. With future technology, an HD VMD potentially will contain up to 20 layers, each with a capacity of 5 GB. A mini-DVD that has grown in popularity is the UMD (Universal Media Disc), which works specifically with the PlayStation Portable handheld game console. The UMD has a diameter of about 2.4 inches, and can store up to 1.8 GB of games, movies, or music.

Other Types of Storage Media

There are many other storage media available for storing data, instruction, and information. A PC Card is a thin, credit card-sized removable flash memory device that fits into a PC Card expansion slot on a personal computer (Figure 5-76). An Express Card module is a removable device, smaller than a PC Card that fits in an Express Card slot. Different types and sizes of PC Cards and Express Card modules are used to add storage, additional memory, communications, multimedia capabilities, and security capabilities to a computer. PC Cards and Express Card modules are commonly used in notebook computers. Some digital cameras also use PC Cards

called picture cards.

A smart card, which is similar in size to a credit card, stores data on a thin microprocessor embedded in the card (Figure 5-77). A smart card contains a processor and has input, process, output, and storage capabilities. When the smart card is inserted into a specialized card reader, the information on the smart card is read and, if necessary, updated. One popular use of smart cards is to store a prepaid dollar amount, as in prepaid telephone calling card. Many hotels issue smart cards instead of keys to hotel guests. With the smart card, guests gain access to their rooms and other hotel services. Other uses of smart cards include storing patient records, vaccination data, other health-care information; tracking information such as customer purchases or employee attendance; storing a prepaid amount, such as electronic money; authenticating users such as for Internet purchases or building access. Some organizations use smart cards as an ID card.

Flash memory cards are a type of solid-state media, which means they consist entirely of electronic components and contain no moving parts (Figure 5-78). Common types of flash memory cards include CompactFlash (CF), SmartMedia, Secure Digital (SD), miscroSD, miniSD, x D.Picture Card, and Memory Stick. Depending on the device, manufacturers claim these storage media can last from 10 to 100years. Transfer rates range from about 1 MBps to 20 MBps or more.

Figure¡5-77 A smart card and smart
fl r r

Figure: Flash memory cards

A USB flash drive is a flash memory storage device th a USB port on a computer or mobile device (Figure). fl drives are convenient for mobile users because they are small and lightweight enough to be transported on a keychain or in a pocket. Current USB flash drives have data transfer rates of about 12 MBps and storage capacities ranging from 256 MB to 64 GB. USB flash drives have become the mobile user' s primary portable storage device, making the floppy disk nearly obsolete because they have much greater storage capacities and are much more convenient to carry. A special type of USB flash drive, called a U3 smart drive, offers even more convenience because it includes Pre installed software accessed through a Windows-type interface. The drive designation of a USB flash drive usually follows alphabetically after all other disks. For example, if the computer has one internal hard disk (drive C) and a DVD drive (drive D) and no other disk drives, then the USB flash drive probably will be drive E.

Figure: A USB flash drive

Microfilm and Microfiche are used to store micro scopic images of documents on roll or sheet film (Figure 5-80). Microfilm is a 100- to 215-foot roll of film. Microfiche is a small sheet of film, usually about 4 × 6 inches. The images are recorded on to the film using a device called a computer output microfilm recorder. The stored images are so small they can be read only with a microfilm or microfiche reader. Micro film and microfiche have the longest life of any storage medium (Figure 5-81) and have widespread applications .Libraries use these media to store back issues of newspapers, magazines, and genealogy records. Some large organizations sue these media to archive in

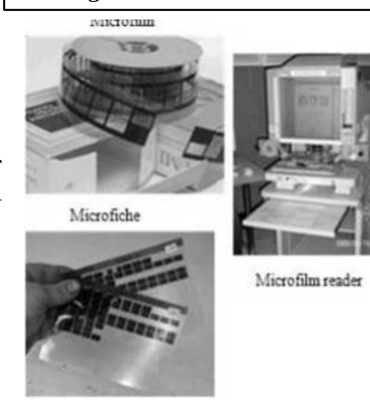


Figure 5-80 Microfilm and microfiche

activefis.Many banks use them to store transactions and canceled checks. The U.S Army uses them to store personnel records.

Media Type	Guaranteed Life Expectancy	Potential Life Expectancy
Magnetic disks	3 to 5 years	20 to 30 years
Optical discs	5 to 10 years	50 to 100 years
Microfilm	100 years	500 years

Figure: Media life expectancies when using high-quality media

Many companies store data, information and programs on the network, which must be accessi ble easily to a ll authorized users. A large business, commonly referred to as an enterprise, has hundreds or thousands of employees.
Enterprises use computers and computer networks to manage and store huge volumes of data and information about customers, suppliers, and employees. An ent erprise to rage system is a strategy that focuses on the availability, protection, organization, and backup o f storage in a company. The goal of a n enterprise storage system is to consolidate storage so operations run as efficiently as possible.

To implement an enterprise storage system, a company uses a combination of techniques. As shown in Figure 5-82, an enterprise storage system may use servers, a RAID system, a tape library, CD-ROM juke boxes, Internet backup, NAS (network-attached storage) devices, and/or a storage area network. In an enterprise, some storage systems can provide more than 185 TB of storage capacity. CD servers and DVD servers hold hundreds of CDs or DVDs. Some companies manage an enterprise storage system in-house. Other larger applications elect to offload all storage management to an outside organization or o nline Web service. An enterprise's storage needs usually grow daily. Thus, the storage solutions an enterprise chooses must be able to store its data and information requirem ents today and tomorrow.

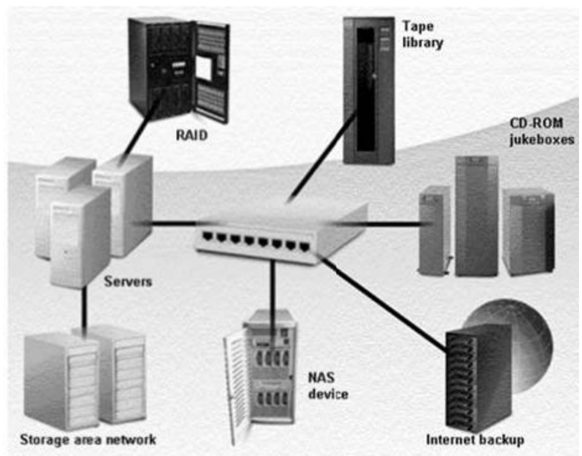


Figure: An enterprise storage system uses a variety of storage

Chapter - 10
MS DOS

Objective of learning

- Brief understanding of DOS
- Setup files of msdos & installing msdos
- Concept of conventional, extended and paged memory
- Working different internal dos and external dos commands

MS-DOS is the most well known operating system; the most commercialized version is that of Microsoft, christened "MS-DOS". MS-DOS was created in 1981 when it was used on IBM computers. DOS, as with any operating system, controls computer activity. It manages operations such as data flow, display, data entry amongst other various elements that make up a system.

The role of DOS is to interpret commands that the user enters via the keyboard. These commands allow the following tasks to be executed:

- File and folder management
- Disk upgrades
- Hardware configuration
- Memory optimization
- Program execution

These commands are typed after the prompt, in the case of MS-DOS (Microsoft DOS, the most well known): the drive letter followed by a backslash, for example: A:\ or C:\.

C:\> To execute a command type the command then hit ENTERS.

Files in MS DOS

In a computer data is stored in files. When you run a program, MS-DOS processes the data stored in the file and passes it to the system. In MS-DOS a file can be any size, however the file name is more restricted, it can only have a maximum length of 8 characters plus 3 for the extension. Furthermore, the files can only contain the following characters:

- Letters A to Z
- Numbers 0 to 9
- The following special characters: **$~! # % & - { } ( ) @ ' _ ^**

Thus filenames must not contain:

- Spaces
- Commas
- Backslash
- Dot (apart from the dot that separates the name and the extension) nor can they contain any of the following list of reserved names:
- CLOCK$
- CON
- AUX
- COM1
- COM2
- COM3
- COM4

- LPT1
- LPT2
- LPT3
- NUL
- PRN

Organizing files in directories or folders
Depending on its size a hard drive may contain several thousands of files. However, the more files there are, the more difficult it is to manage them, this is when we need to store them in directories In MS-DOS, directory names are also subject to the same name restrictions as files (8 characters for the name, and an extension with 3 characters).

Installing MS-DOS
When installing MS-DOS, make sure that in the BIOS the boot disk is set to A: first, then the hard drive (boot sequence: A:, C:) Then insert disk 1 in the A: drive, power up the computer, then follow the on-screen instructions.
You must enter the following information:
- Time and date
- Country
- The media on which to install the operating system (make sure the drive is accessible and has sufficient free disk space)
- The storage folder for MS-DOS files
- If the MS-DOS shell should appear on each start-up
- If MS-DOS should occupy a single partition taking up the entire hard drive

Creating a system boot disk
After MS-DOS has been installed you should create a system boot disk.
Once you have inserted a blank floppy disk into the drive enter the following command:
```
Format a: /s
```
The /s switch means "copy system files".
This floppy disk can be used to boot the system by inserting it in the floppy disk drive and restarting the computer.

Introduction to memory
Memory is an area where programs are stored and from where they can be executed. A PC compatible computer has three types of memory:
- Conventional
- Extended
- Paged

The amount of memory present (and available) in a system can be found by running the following command: "***mem***" (or "***mem /c |more***" for more detailed information).

Conventional memory
Conventional memory is that part of memory where programs may load without any specific instructions. The amount of conventional memory varies from 256 KB to 640 KB (on all recent computers: 386, 486, Pentium, etc.).

The amount of memory available is the memory remaining after DOS has been loaded into memory the operating system, device drivers and all commands loaded from the *config.sys* and *autoexec.bat*).

Extended memory

Extended memory enables the system to access more memory. This type of memory is available on computers equipped with an 80286 type processor or higher. Programs normally only recognise conventional memory addresses, to access the storage area located beyond the 640 KB, programs need specific instructions. A program that manages access to extended memory, for example it prevents two programs from using the same area of memory at the same time. This program is called "extended memory manager".

MS-DOS comes with the standard extended memory manager called *HIMEM.SYS* (it is also found in Windows 98). It is loaded in the *config.sys* by adding the line:

`DEVICE=path/himem.sys` where path is the access path to the file.

Paged memory

Another method of accessing memory beyond the first 640 KB is to use paged memory. Some programs (few nowadays) are optimised to use this type of memory. As with extended memory, this type of memory requires a program to manage it, it is called "paged memory manager". Programs designed to use this type of memory cannot access it directly: the memory manager must copy sections of 16 KB of memory (called pages) into an area (called frame segment) located in the high memory area. This type of memory was developed before extended memory; this memory is thus slower and only allows utilisation of one limited portion of memory at any given time.

High memory

Many systems have 384 KB of high memory (HMA, High Memory Addresses), located directly after the 640 KB of conventional memory. This area of memory can be used by hardware. Areas not used by hardware are called "upper memory blocks" (UMB), they allow programs to be run in paged memory.

Various DOS Commands:

Selecting and Copying Text from a command Prompt Window

1. Click the icon in the upper left-hand corner of the bar on top of the window, point to edit in the menu that appears, and click Mark.
2. Click at the beginning of the text you want to copy.
3. Press and hold down the <SHIFT> key, and then click at the end of the text you want to copy.
4. Click the icon again, click Edit, and then click Copy.
5. Paste the text into a document by holding the <Ctrl> key and pressing <C>, or by selecting Paste from the Edit menu. If you want to paste the text back into the command prompt window, click the icon again, point to Edit, and click Paste.

Using Wildcard Characters

Wildcard characters can be used when using Windows Search or Find, and to represent multiple files or folders when using a command prompt. Wildcard characters are as follows:

Asterisk (*): Acts as a substitute for zero or more characters. For example, to search for or make a change to any .txt file that starts with *G*, enter *G*.txt*. If you want any file that has an extension starting with *.tif*, enter **.tif*. For all files in a particular folder, enter *.*.

1. ATTRIB

In Windows, files and folders have certain properties (called *attributes)* that can be configured. If you right-click on the file or folder's icon, you'll see some check boxes that allow you to change these attributes. The ATTRIB command allows you to do this when the Windows GUI is not available. The possible attributes, which vary based on Windows version and other factors, are as follows:

Read only: When set, this allows the file to be opened and viewed, but not changed or deleted.

Archive: This attribute affects whether the file will be backed up in certain backup schemes using a backup program, or whether running the XCOPY command will copy that particular file. For more information, see Windows Backup help files.

Hidden: Windows hides certain files by default; however, any file can be hidden or displayed by changing this attribute. In 2000 and XP, when the user has enabled the showing of hidden files (in any Windows folder in Tools > Folder Options > View tab), icons for hidden folders and files appear translucent.

Use

ATTRIB uses the plus sign (+) to turn on an attribute, and the minus sign (-) to turn off an attribute. To use ATTRIB, navigate to the folder where the desired file is located.

Parameters

+r: Sets the read-only file attribute.
-r: Clears the read-only file attribute.
+a: Sets the archive file attribute.
-a: Clears the archive file attribute.
+s: Sets the system file attribute.
-s: Clears the system file attribute.
+h: Sets the hidden file attribute.
-h: Clears the hidden file attribute.

Examples

To display the attributes of a file named *chapter07.doc*, navigate to the folder and enter:

```
ATTRIB chapter07.doc
```

To assign the read-only attribute to the file, enter:

```
ATTRIB +r chapter07.doc
```

To remove the read-only, hidden, and system attributes from all .reg files on the C: drive, including in all subfolders, navigate to the C: drive and enter:

```
ATTRIB -r -h -s *.reg /s.
```

2. CD or CHDIR

This refers to *Change Directory*, and is used to change the current folder. When directions for another command say, "navigate to the ABC folder," this is the command that you would use to do that.

Use

When narrowing down to a subfolder within the current folder, type CD, followed by the subfolder name. For example, if the current folder is C:\ WINDOWS, and you want to navigate to C:\WINDOWS\DESKTOP, type:

CD Desktop

To change the current folder to a root level (a drive letter without any additional folders) (e.g., C:\Documents and Settings to C :) , make sure to enter the backslash (\) after the drive letter. For example, if the prompt says C:\Documents and Settings> and you want to navigate to the C drive, enter:

```
CD C:\.
```

3. CHKDSK (present in all versions, useful in 2000 and XP only)

CHKDSK is a program used for checking the status of magnetic drives/disks, fixing certain errors, and even recovering readable data from bad disk sectors. It isn't particularly useful in 9x, except for obtaining a report on files on the disk. To correct any disk errors on 9x, run Scandisk. In 2000, and XP, CHKDSK replaces 9x's Scandisk. In 2000 and XP, it is easier to run CHKDSK from Windows, so you might as well save the command-line version for when the computer is booted into Safe Mode, Command prompt only. When invoked with the /f and/or /r switches to run on a disk in use, CHKDSK will prompt you to run at the next boot.

Use

Type CHKDSK followed by the drive letter and colon (:), followed by any switches (each switch must be preceded by a space character).

Switches

/c: Use with NTFS-formatted drives only. Skips folder structure cycle checking, resulting in a faster completion.

/f: Fixes file system errors on the disk. If run on a disk currently in use, /f causes CHKDSK to be run on the next boot.

/i: Use with NTFS-formatted drives only. Performs a less exhaustive check of index entries, resulting in a faster completion.

/r: Recovers readable information from bad disk sectors. If run on a disk currently in use, /r causes CHKDSK to be run on the next boot. See the listing for the RECOVER command for another tool that can recover lost data.

/v: Displays the name of each file in every folder as the disk is checked.

/x: Use with NTFS-formatted drives only. Makes all necessary changes to any network-mapped drives in order for CHKDSK to work on them. /x also includes the functionality of the /r switch.

4. CLS

CLS removes all text except the main heading and prompt from the command prompt window. CLS stands for *Clear Screen*.

Use

Type CLS.

5. CONVERT (XP and 2000 only)

Converts hard drive partitions formatted as FAT and FAT32 to NTFS. CONVERT cannot convert a partition to any file system other than NTFS.

Use

Type CONVERT followed by the drive letter and colon, and then /fs:ntfs followed by any switches. If you were converting drive C to NTFS in the verbose mode (see the switch listings), you would type:

```
CONVERT C: /fs:ntfs /v
```

And then press <Enter>.

Switches

/fs: ntfs: CONVERT won't work without this switch following the drive letter. fs means *file system.*

f/nosecurity: Specifies that files and folders already on the drive are accessible to everyone who uses the computer.
/v: Verbose mode. All possible information will be displayed while the conversion is taking place.
/x: Performs all changes to network-mapped drives necessary for the conversion to take place.

6. COPY

Copies one or more files. XCOPY provides much more flexibility than does COPY.
Use
Type COPY followed by general switches, then type the path of the file(s) to be copied followed by any switches that apply to the source files, then the path of the destination, if desired, followed by any switches that apply to the destination. The source can be a path to a drive, folder, or file. If it is a drive or folder, it will copy all the files in that folder to the destination, but it will not copy subfolders or any files within subfolders. Wildcards can be used in a source. Two or more files or folders can be specified in the source by using the plus sign (+) followed by a space character before each file after the first one listed, as in:

```
COPY /v D:\Backup\*.dll + D:\Backup\Example.txt C:\Windows\System32
```

This example would copy all .dll files in the Backup folder on the D drive, but no files in subfolders of Backup, plus the file Example.txt to the C:\Windows\System32 folder. The /v switch verifies that each file is copied properly.
The destination can also be a path to a drive, folder, or file. If the destination is a path to a drive or folder, the copy will keep the name of the original file. If the destination is a file with a name different from the original, the copy will have the new filename. If the destination is not specified, the copy will be placed in the current folder, as long as the current folder isn't the same as the source folder; in which case no copying will occur.
If two or more source files are specified but only one destination file is specified, the files will be combined into a single file, assuming the file formats are compatible with each other and can handle such a change. Text files (.txt), for example, can be combined.
Switches
/d: If any of the source files are encrypted, this switch removes the encryption attribute on the copies.
/n: Causes the filename to be converted to one that complies with the DOS 8.3 filename convention.
/v: Verifies that new files are copied correctly. It is advisable to use when copying critical files. It does cause the copying to take more time than without /v.
/y: By default, Windows prompts you to confirm that you want to overwrite an existing destination file of the same name in the same folder; /y stops these prompts.
/-y: Turns off the /y switch. Restores prompts to confirm that you want to overwrite an existing destination file of the same name in the same folder.
/z: In case copies are being made over a network and the network connection is lost, or one of the computers goes off line, /z sets the copy operation to automatically resume from where it left off after the connection is reestablished.

7. DEL or ERASE

Deletes specified files.
Use
Navigate to the folder that contains the file and type DEL or ERASE followed by the filename, and by any desired switches. You can also enter the entire path at the prompt rather than navigating to the folder. Multiple filenames can be entered separated by spaces, commas, or semicolons, or wildcards

can be used. If only a folder name is entered, DEL or ERASE will delete only the files in the root of the folder. Subfolders and files within subfolders will not be affected unless the /s switch is used.

Switches

/f: Normally, files with the read-only attribute will not be deleted. /f overrides this and forces deletion.

/p: Prompts you to confirm that you want the file to be deleted.

/q: Prevents Windows from prompting you to confirm that you want the file to be deleted.

/s: Deletes specified files from the current folder and all subfolders. Displays each filename as the file is deleted.

8. DIR

Displays a list of the subfolders and files in a folder or drive with some information such as total file size, the last date and time each file was modified, and the amount of free disk space on the disk.

Use

Navigate to the desired folder and type DIR followed by any desired switches. Does not show hidden or system file unless you use the /a switch.

Switches

/p: Displays one screen at a time. To continue, press any key on the keyboard.

/q: Displays the owner of each file, if applicable.

/a: Displays all files, including files with the hidden and system attributes.

/a followed by attributes codes: displays only files or other items with attributes you specify.

Attribute Codes

a: Files ready for archiving only

d: Folders only

h: Hidden files and folders only

r: Read-only files only

s: System files and folders only

Each of these codes can be inversed by preceding it with a minus sign (-). For example, -r displays only files with the read -only attribute. In addition, using multiple attribute codes, Windows will display only files with *all* of the attributes indicated by the codes. Don't leave a space between codes when using multiple codes. For example, to display only files that are *both* read only and hidden, type:

`DIR /arh`

/s: Lists every occurrence, in the specified folder and all its subfolders, of the specified filename.

/x: Displays both long filenames and 8.3 filenames.

9. DEL or ERASE

Deletes specified files.

Use

Navigate to the folder that contains the file and type DEL or ERASE followed by the filename, and by any desired switches. You can also enter the entire path at the prompt rather than navigating to the folder. Multiple filenames can be entered separated by spaces, commas, or semicolons, or wildcards can be used. If only a folder name is entered, DEL or ERASE will delete only the files in the root of the folder. Subfolders and files within subfolders will not be affected unless the /s switch is used.

Switches

/f: Normally, files with the read-only attribute will not be deleted. /f overrides this and forces deletion.

/p: Prompts you to confirm that you want the file to be deleted.

/q: Prevents Windows from prompting you to confirm that you want the file to be deleted.

/s: Deletes specified files from the current folder and all subfolders. Displays each filename as the file is deleted.

10. DIR

Displays a list of the subfolders and files in a folder or drive with some information such as total file size, the last date and time each file was modified, and the amount of free disk space on the disk.

Use

Navigate to the desired folder and type DIR followed by any desired switches. Does not show hidden or system file unless you use the /a switch.

Switches

/p: Displays one screen at a time. To continue, press any key on the keyboard.

/q: Displays the owner of each file, if applicable.

/a: Displays all files, including files with the hidden and system attributes.

/a followed by attributes codes: displays only files or other items with attributes you specify.

Attribute Codes

a: Files ready for archiving only

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Each of these codes can be inversed by preceding it with a minus sign (-). For example, -r displays only files with the read -only attribute. In addition, using multiple attribute codes, Windows will display only files with *all* of the attributes indicated by the codes. Don't leave a space between codes when using multiple codes. For example, to display only files that are *both* read only and hidden, type: DIR /arh

/s: Lists every occurrence, in the specified folder and all its subfolders, of the specified filename.

/x: Displays both long filenames and 8.3 filenames.

11. EDIT (limited use in 2000 and XP)

Starts the MS-DOS Editor, which creates and changes ASCII text files. EDIT is an antiquated text editor that works without benefit of a mouse. It can be essential to use if you boot into DOS and need to edit a text file such as autoexec.bat or config.sys. Access menu commands by pressing and holding the <Alt> key while typing the first letter of the menu and the highlighted letter of each command. Once you have accessed a menu, the arrow keys can be used to navigate the menus. Another way to invoke a menu command is to highlight it by using the arrow keys, and then press <Enter>.

Use

Type EDIT followed by the full path to the file you want to open or create, followed by any desired switches.

12. EXIT

Closes a DOS prompt and many DOS programs. If you click the X to close the window in a DOS program, you'll get a message indicating that closing the program this way will cause any unsaved data to be lost. While you'll rarely have any unsaved data, it is probably easier to use this command to avoid the prompt.

Use

Type EXIT.

13. FDISK (DOS and 9x only)

Opens a program that allows creation and deletion of partitions, and the viewing of partition information. Once the program is open, it is no longer a command-line program, but instead is menu based.

Use

While booted into DOS, type FDISK to open the program. Two switches will also perform functions without opening the menu-based program.

Switches

/mbr: This will replace the master boot record (MBR). The MBR is the first sector on the hard disk. There is a small program in the MBR that tells the system which partition is bootable. You cannot boot without the MBR being intact. Use this switch to replace a damaged MBR. This can occur if there is a boot-sector virus, or for other reasons. Try using this if you can't boot and you can't determine another cause. Using this switch does not open the menu-based program.

/status: This will display information about the partition. Using this switch does not open the menu-based program.

/x: Ignores extended disk partition support. If you receive a disk access or stack overflow error, use this switch; /x can be used with /status, but if used by itself, the menu-based program does open.

14. FORMAT

Formats magnetic disks and partitions in specified file formats (FAT, FAT32, and NTFS). Works with floppy and hard disks.

Use

Type FORMAT followed by the drive letter and a colon, a space, then /fs: and the name of the file system(FAT, FAT32, or NTFS). For example, to format drive E: as FAT32, you would type:

FORMAT E: /fs:FAT32

Floppy disks can be formatted only as FAT. FAT is the designation for FAT16. If you omit the /fs switch, the system will use the default.

Switches

/fs: followed by the desired file system: This switch determines the file system, but if you leave it out, Windows will use the default. For example, floppies will automatically be formatted as FAT.

/q: Quick format. Skips a sector-by-sector surface scan of the disk. Use only with a disk known not to have any bad sectors.

/c: Compress newly added files. Works only with NTFS partitions.

/s: (95, 98, and DOS only) Formats a floppy and copies the three DOS files (Command.com, IO.sys, MSDOS.sys) onto it. This switch will work in 95 and 98, and any time the computer is booted into MS-DOS.

15. MD or MKDIR

Stands for "Make Directory." Creates a folder or subfolder.

Use

Type MD followed by the full path of the new folder, including the name of the new folder. Alternatively, you can navigate to the drive or folder one level above that of the new folder, and type MD followed only by the desired name of the new folder.

16. MOVE

Moves files or folders from one drive or folder to another. Similar to COPY, except that MOVE deletes the source file.

Use

Type MOVE followed by a switch, if desired, then the source folder or files name, and then the destination folder or file name. If moving more than one file, the destination must be a folder.

Switches

/y: Normally, you would be prompted to confirm if you want to overwrite an existing destination file or folder of the same name; /y turns off this prompt. It is not necessary to use unless there actually is such a destination file or folder and you want to suppress the prompt.

/-y: Turns on the prompt to confirm that you want to overwrite a destination file or folder of the same name, if present.

17. PATH

Although "path" has a more general meaning, "the path" refers to the path to all of these commands. In 9x, some of these are in the root folder of the boot drive (usually C :\), some are in the Windows folder (usually C:\Windows), and some are in the Command folder (usually C:\Windows\Command). In 2000 and XP, commands can be found in the Windows folder (usually C:\Windows or C:\Winnt), and in the System32 folder (usually C:\Windows\System32). There also might be a Command folder (usually C:\Windows\Command or C:\Winnt\Command). The PATH command sets the computer to recognize the locations of these commands. That is how Windows can find each command simply from the user entering commands at the command prompt or in the Run dialog. Run by itself, PATH displays the current path.

Use

Type PATH followed by the path that contains commands. You can enter multiple command paths by separating them with semicolons (;).

Parameter

; Separates the different paths that are to make up "the path." If you use this by itself, the existing command path will be deleted.

Example

In 9x, if you find you don't have access to all commands that should be available, type:

PATH C:\;C:\Windows;C:\Windows\Command

18. REN or RENAME

Changes the name of a file or folder.

Use

Navigate to the folder that contains the file you want to rename, or to the parent folder of the subfolder you want to rename. Type REN followed by the existing file or folder name, a space, and then the new file or folder name. REN cannot be used to move files or folders, so you cannot enter a new path for the file.

19. REPLACE

Replaces files in the destination folder with files in the source folder that have the same name. It also can be used to add files to the destination folder that don't already exist there. For example, if you need to make sure that all files on an optical disc have been copied to a folder on the hard drive, you could use another method to copy them again, and then get the prompt to overwrite existing files. Using

REPLACE with the /a switch automatically copies only files that don't exist on the destination folder while ignoring those files that do exist there.

Use

To replace files or folders, type REPLACE followed by the path to the source files or folders, then the destination files or folders, followed by any appropriate switches. You can also navigate to the source folder before running the command. If you specify neither a source nor a destination folder, the current folder is used.

Switches

/a: Adds only files to the destination folder that aren't there already; /a cannot be used at the same time as the /s or /u switches.

/p: Prompts you for confirmation before replacing or adding a file or folder.

/r: Replaces read-only, hidden or system files or folders. Files or folders in the destination folder with these attributes normally would cause the operation to stop.

/w: Waits for you to insert a disk before searching for source files or folders. Without this switch, REPLACE attempts to replace or add files immediately after the user presses <ENTER>.

/s: Includes subfolders of the destination folder (not the source folder); /s cannot be used at the same time as the /a switch.

/u: Replaces only those files in the destination folder that are older than those with the same names in the source folder; /u cannot be used at the same time as the /a switch; /u cannot be used to update hidden or system files. You'll have to remove these attributes first, using the ATTRIB command or the Windows interface.

20. RD or RMDIR

Deletes a folder. RD stands for "Remove Directory."

Use

Type RD followed by the path to the folder you want to delete, followed by any desired switches. Make sure to enter the full path, starting with the drive letter. Do not navigate first to the folder you want to delete; RD won't work if you do. Additionally, RD won't work if the folder to be deleted is a subfolder of the current folder.

Switches

/s: Includes all subfolders and their contents.

/q: Quiet mode. Normally, a confirmation is given after the deletion is complete; /q turns off this confirmation.

21. SHUTDOWN (XP only)

Allows you to shut down, restart, or log a user off the computer. Used without switches, SHUTDOWN will log off the current user.

Use

Type SHUTDOWN followed by any desired switches.

Switches

-s: Shuts down the computer.

-r: Reboots the computer.

-f: Forces any running programs to close.

-t followed by a space and a number of seconds: This sets the timer for system shutdown in the specified number of seconds. The default is 20 seconds.

-a: Aborts shutdown. If you run shutdown and then change your mind, during the timed interval before the machine shuts down you can abort the shutdown by running SHUTDOWN -a.

22. SYSTEMINFO (XP only)

Displays detailed configuration information about a computer and Windows, including operating system (OS) configuration, security information, and product ID, and hardware properties, such as memory, disk space, and network adapters.

Use

Type SYSTEMINFO. If you want to configure the format of the output, use the /fo switch. SYSTEMINFO is an ideal command to be accompanied by the MORE command.

Switches

/fo followed by one of the three possibilities: TABLE, LIST, or CSV (Comma-Separated Values). LIST is the default.

23. TASKKILL (XP only)

Terminates one or more programs or processes. Processes can be called by their process ID or by their name. View running processes by using the TASKLIST command.

Use

Run TASKLIST or Windows' Task Manager (type <Ctrl> + <Alt> + <Delete>). Once you've determined which processes to terminate, type TASKKILL followed by the appropriate switches and parameters.

Switches and Parameters

/pid followed by the process ID: Specifies the process ID of the process to be terminated.

/im followed by the process name: Specifies the process name (called *image name*) of the process to be terminated. TASKKILL will terminate all instances of a process.

/f: Terminates the process (es) by force, if necessary. Some processes will ordinarily not be terminated without this switch. Most of these are crucial to the operation of Windows, so don't be surprised if Windows shuts down if you end the wrong process.

24. TASKLIST (XP only)

Displays a list of programs and processes with their Process ID (PID) for all tasks running on the computer. Useful to compile data for the TASKKILL command.

Use

Type TASKLIST followed by any desired switches.

25. TYPE

Displays the text in a text file.

Use

Navigate to the text file's folder and type TYPE, or type TYPE followed by the path to the file or files to view. To view multiple files, separate them with spaces.

26. VER

Displays the Windows version and number.

Use

Type VER.

27. XCOPY

Copies files, folders, and subfolders. XCOPY offers great flexibility over any other way to copy, be it by command line or using the Windows graphical interface.

Use

Type XCOPY followed by the path to the source file or folder, then the destination file or folder, and then any desired switches.

Switches

/w: Prompts you to press a key before copying commences.

/p: Prompts you to confirm that you want to create each destination file.

/c: Continues copying regardless of errors.

/q: Quiet mode. XCOPY messages are not displayed.

/f: Displays filenames while copying.

/l: Displays the names of all the files that are set to be copied.

/g: Specifies that destination files not be encrypted (2000 and XP only).

XCOPY D:*.doc c:\folder /d:03-05-2006

/u: Copies only those source files with the same names as those already in the destination folder.

/i: If you have specified a folder or a file name with wildcards as the source and the destination folder doesn't already exist, /i causes XCOPY to create the new folder. The default is for XCOPY to prompt you to specify whether the destination is a folder or file.

/s: Copies folders and subfolders as long as there are files inside them.

/e: Copies all subfolders, regardless of whether there are files inside them.

/t: Copies the entire folder tree, but none of the files. Add the /e switch to copy empty folders.

/k: (2000 and XP) Causes the copied files to retain the read-only attribute if the source files had it. By default, copied files do not have the read-only attribute.

/k: (9x) Causes all attributes to be copied with the files.

/r: Copies files with the read-only attribute, but is not supposed to copy the attribute. However, it might actually copy the attribute in some cases.

/h: Copies files with hidden and system attributes. The default is for system and hidden files not to be copied.

/a: Copies only files with the archive attributes.

/m: Copies only files with the archive attributes, but removes the archive attribute from the *source* file.

/n: Applies 8.3 file and/or folder names to the copies. Necessary when copying files with long filenames to systems that can handle only 8.3 filenames.

/y: Normally, XCOPY prompts you to confirm that you want to overwrite a destination file of the same name as the one being copied; /y turns off this prompting.

/-y: Restores prompting to overwrite existing files of the same name as the one being copied.

/z: (2000 and XP only) If you are copying over a network and the network connection is lost for whatever reason, if you used /z, copying can pick up where it left off once the connection is restored; /z saves you from having to start over again; /z also displays the copying progress for each file.

28. DISKPART

Allows management of disk partitions.

Use

Type DISKPART followed by the appropriate switches and parameters. Run without switches and parameters, DISKPART starts the Windows Setup partitioning program. You'll recognize the program if you have installed NT 4.0, 2000 or XP.

Switches and Parameters

/add followed by the device name and the desired size, in MB, of the partition: Creates a new partition. For example, to add a 10-MB partition, type:

DISKPART /add \Device\HardDisk0 10

Device name is defined after the /delete switch.

Deletion Examples

DISKPART /delete \Device\HardDisk0\Partition2

DISKPART /delete E:

29. FIXBOOT

Creates a new boot sector on the system partition. Useful if the boot sector has been damaged.

Use

Type FIXBOOT. This will create a new boot sector on the partition that you are logged on to. If you want to create a boot sector on a different drive, enter the drive letter followed by a colon after FIXBOOT and a space. For example, to create a new boot sector on the E: drive, type:

FIXBOOT E:

30. FIXMBR

Creates a new MBR on a hard drive. The MBR is the first sector on a hard drive. A small program on the MBR contains information about the partitions, indicating which one is bootable, in case there are more than one.

Use

Type FIXMBR. This will create a new MBR on the existing boot disk drive. To select another drive, enter the device name after FIXMBR. Run the MAP command to find the device name. For example, to replace the MBR on the first drive on the system, you can type:

FIXMBR \Device\HardDisk\0

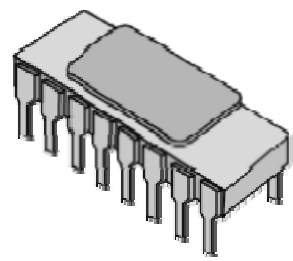
Chapter – 11
Microprocessor

Objective of learning

- Introduction
- Concept of cache memory, virtual memory, Control registers
- Microprocessor internal architecture
- Different types of processors
- Microprocessor family generations
- Comparison of latest available processor series

The processor (CPU, for Central Processing Unit) is the computer's brain. It allows the processing of numeric data, meaning information entered in binary form, and the execution of instructions stored in memory.
The first microprocessor (Intel 4004) was invented in 1971. It was a 4 -bit calculation device with a speed of 108 kHz . Since then, microprocessor power has grown exponentially. So what exactly are these little pieces of silicone that run our computers?

Operation



The processor (called CPU, for *Central Processing Unit*) is an electronic circuit that operates at the speed of an internal clock thanks to a quartz crystal that, when subjected to an electrical current, send pulses, called "peaks". The clock speed (also called cycle), corresponds to the number of pulses per second, written in Hertz (Hz). Thus, a 200 MHz computer has a clock that sends 200,000,000 pulses per second. Clock frequency is generally a multiple of the system frequency (*FSB*, *Front-Side Bus*), meaning a multiple of the motherboard frequency.
With each clock peak, the processor performs an action that corresponds to an instruction or a part thereof. A measure called CPI (Cycles Per Instruction) gives a representation of the average number of clock cycles required for a microprocessor to execute an instruction. A microprocessor power can thus be characterized by the number of instructions per second that it is capable of processing. MIPS (millions of instructions per second) is the unit used and corresponds to the processor frequency divided by the *CPI*.

Instructions

An instruction is an elementary operation that the processor can accomplish. Instructions are stored in the main memory, waiting to be processed by the processor. An instruction has two fields:

- The operation code, which represents the action that the processor must execute;
- The operand code, which defines the parameters of the action. The operand code depends on the operation. It can be data or a memory address.

Operation Code	Operand Field

The number of bits in an instruction varies according to the type of data (between 1 and 4 8-bit bytes).
Instructions can be grouped by category, of which the main ones are:

- Memory Access: accessing the memory or transferring data between registers.

- **Arithmetic Operations**: operations such as addition, subtraction, division or multiplication.
- **Logic Operations**: operations such as AND, OR, NOT, EXCLUSIVE NOT, etc.
- **Control**: sequence controls, conditional connections, etc.

Registers

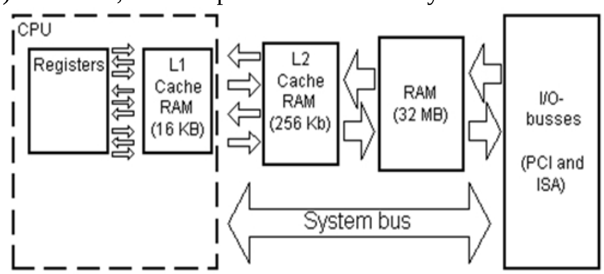
When the processor executes instructions, data is temporarily stored in small, local memory locations of 8, 16, 32 or 64 bits called **registers**. Depending on the type of processor, the overall number of registers can vary from about ten to many hundreds.

The main registers are:

- The **accumulator register** (*ACC*), which stores the results of arithmetic and logical operations;
- The **status register** (*PSW*, *Processor Status Word*), which holds system status indicators (carry digits, overflow, etc.);
- The **instruction register** (*RI*), which contains the current instruction being processed;
- The **ordinal counter** (*OC* or *PC* for *Program Counter*), which contains the address of the next instruction to process;
- The **buffer register**, which temporarily stores data from the memory.

Cache Memory

Cache memory (also called buffer memory) is local memory that reduces waiting times for information stored in the RAM (Random Access Memory). In effect, the computer's main memory is slower than that of the processor. There are, however, types of memory that are much faster, but which have a greatly increased cost. The solution is therefore to include this type of local memory close to the processor and to temporarily store the primary data to be processed in it. Recent model computers have many different levels of cache memory:



- **Level one cache memory** (called **L1 Cache**, for **Level 1 Cache**) is directly integrated into the processor. It is subdivided into two parts:
  - The first part is the instruction cache, which contains instructions from the RAM that have been decoded as they came across the pipelines.
  - The second part is the data cache, which contains data from the RAM and data recently used during processor operations.

Level 1 cache can be accessed very rapidly. Access waiting time approaches that of internal processor registers.

- **Level two cache memory** (called **L2 Cache**, for **Level 2 Cache**) is located in the case along with the processor (in the chip). The level two cache is an intermediary between the processor, with its internal cache, and the RAM. It can be accessed more rapidly than the RAM, but less rapidly than the level one cache.
- **Level three cache memory** (called **L3 Cache**, for **Level 3 Cache**) is located on the motherboard.

All these levels of cache reduce the latency time of various memory types when processing or transferring information. While the processor works, the level one cache controller can interface with the level two controllers to transfer information without impeding the processor. As well, the level two cache interfaces with the RAM (level three cache) to allow transfers without impeding normal processor operation.

Control Signals

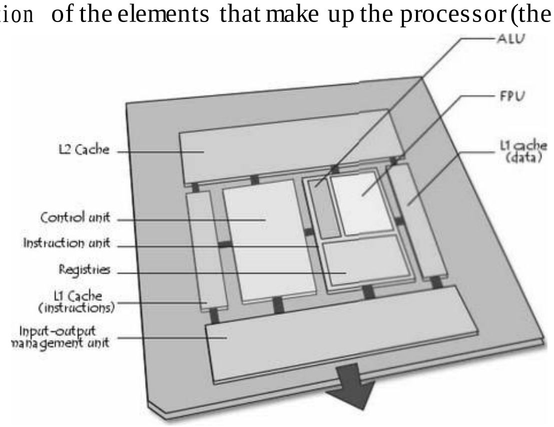
Control signals are electronic signals that orchestrate the various processor units participating in the execution of an instruction. Control signals are sent using an element called a *sequencer*. For example, the *Read / Write* signal allows the memory to be told that the processor wants to read or write information.

Functional Units

The processor is made up of a group of interrelated units (or control units). Microprocessor architecture varies considerably from one design to another, but the main elements of a microprocessor are as follows:

- A **control unit** that links the incoming data, decodes it, and sends it to the execution unit: The control unit is made up of the following elements:
  - **Sequencer** (or *monitor and logic unit*) that synchronizes instruction execution with the clock speed. It also sends control signals;
  - **ordinal counter** that contains the address of the instruction currently being executed;
  - **Instruction register** that contains the following instruction.
- An **execution unit** (or *processing unit*) that accomplishes tasks assigned to it by the instruction unit. The execution unit is made of the following elements:
  - The **arithmetical and logic unit** (written **ALU**). The ALU performs basic arithmetical calculations and logic functions (AND, OR, EXCLUSIVE OR, etc.);
  - The **floating point unit** (written **FPU**) that performs partial complex calculations which cannot be done by the arithmetical and logic unit.
  - The **status register**;
  - The **Accumulator register**.
- A **bus management unit** (or *input-output unit*) that manages the flow of incoming and outgoing information and that interfaces with system RAM;

The diagram below gives a simplified representation of the elements that make up the processor (the physical layout of the elements is different than their actual layout):

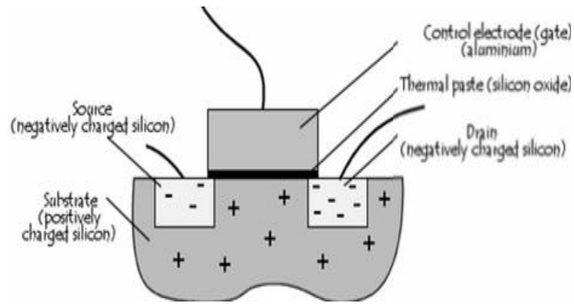


Transistor

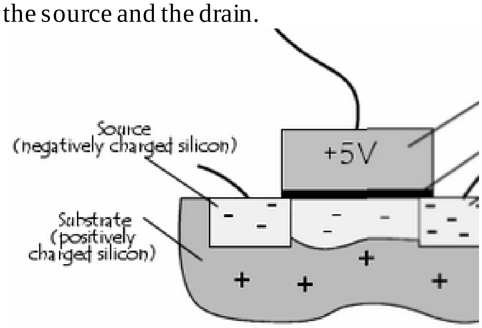
To process information, the microprocessor has a group of instructions, called the "**instruction set**", made possible by electronic circuits. More precisely, the instruction set is made with the help of semiconductors, little "circuit switches" that use the **transistor effect**, discovered in 1947 by *John Barden*, *Walter H. Brattain* and *William Shockley* who received a Nobel Prize in 1956 for it.

A **transistor** (the contraction of *transfer resistor*) is an electronic semi-conductor component that has three electrodes and is capable of modifying current passing through it using one of its electrodes (called control electrode). These are

referred to as "active components", in contrast to "passive components", such as resistance or capacitors which only have two electrodes (referred to as being "bipolar").
A MOS (*metal, oxide, silicone*) transistor is the most common type of transistor used to design integrated circuits. MOS transistors have two negatively charged areas, respectively called **source** (which has an almost zero charge) and **drain** (which has a 5V charge), separated by a positively charged region, and called a **substrate**). The substrate has a control electrode overlaid, called a **gate**, that allows a charge to be applied to the substrate.



When there is no charge on the control electrode, the positively charged substrate acts as a barrier and prevents electron movement from the source to the drain. However, when a charge is applied to the gate, the positive charges of the substrate are repelled and a negatively charged communication channel is opened between the source and the drain.



The transistor therefore acts as a programmable switch, thanks to the control electrode. When a charge is applied to the control electrode, it acts as a closed interrupter and, when there is no charge, it acts as an open interrupter.

Integrated Circuits
Once combined, transistors can make logic circuits, that, when combined, form processors. The first integrated circuit dates back to 1958 and was built by *Texas Instruments*.MOS transistors are therefore made of slices of silicone (called *wafers*) obtained after multiple processes. These slices of silicone are cut into rectangular elements to form a "**circuit**". Circuits are then placed in cases with input-output connectors and the sum of these parts makes an "**integrated circuit**". The minuteness of the engraving, written in microns (micrometers, written *Âµm*) defines the number of transistors per surface unit. There can be millions of transistors on one single processor.
Moore's Law, penned in 1965 by Gordon E. Moore, cofounder of Intel, predicted that processor performance (by extension of the number of transistors integrated in the silicone) would double every twelve months. This law was revised in 1975, bringing the number of months to 18. Moore Law is still being proven today.
Because the rectangular case contains input-output pins that resemble legs, the term "**electronic flea**" is used in French to refer to integrated circuits.

Families
Each type of processor has its own instruction set. Processors are grouped into the following families, according to their unique instruction sets:
- 80x86: the "x" represents the family. Mention is therefore made to 386, 486, 586, 686, etc.
- ARM
- IA-64

- MIPS
- Motorola 6800
- PowerPC
- SPARC

This explains why a program produced for a certain type of processor can only work directly on a system with another type of processor if there is instruction translation, called **emulation**. The term "**emulator**" is used to refer to the program performing this translation.

Instruction Set

An **instruction set** is the sum of basic operations that a processor can accomplish. A processor instruction set is a determining factor in its architecture, even though the same architecture can lead to different implementations by different manufacturers.
The processor works efficiently thanks to a limited number of instructions, hardwired to the electronic circuits. Most operations can be performed using basic functions. Some architecture does, however, include advanced processor functions.

CISC Architecture

CISC (*Complex Instruction Set Computer*) architecture means hardwiring the processor with complex instructions that are difficult to create using basic instructions.

CISC is especially popular in 80x86 type processors. This type of architecture has an elevated cost because of advanced functions printed on the silicone. Instructions are of variable length and may sometimes require more than one clock cycle. Because CISC-based processors can only process one instruction at a time, the processing time is a function of the size of the instruction.

RISC Architecture

Processors with **RISC** (*Reduced Instruction Set Computer*) technology do not have hardwired, advanced functions.
Programs must therefore be translated into simple instructions which complicates development and/or requires a more powerful processor. Such architecture has a reduced production cost compared to CISC processors. In addition, instructions, simple in nature, are executed in just one clock cycle, which speeds up program execution when compared to CISC processors. Finally, these processors can handle multiple instructions simultaneously by processing them in parallel.

Technological Improvements

Throughout time, microprocessor manufacturers (called *founders*) have developed a certain number of improvements that optimize processor performance.

Parallel Processing

Parallel processing consists of simultaneously executing instructions from the same program on different processors. This involves dividing a program into multiple processes handled in parallel in order to reduce execution time.
This type of technology, however, requires synchronization and communication between the various processes, like the division of tasks in a business: work is divided into small discrete processes which

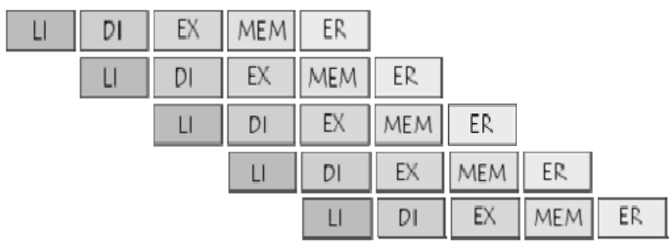
are then handled by different departments. The operation of an enterprise may be greatly affected when communication between the services does not work correctly.

Pipelining

Pipelining is technology that improves instruction execution speed by putting the steps into parallel. To understand the pipeline mechanism, it is first necessary to understand the execution phases of an instruction. Execution phases of an instruction for a processor with a 5-step "classic" pipeline are as follows:

- **FETCH**: (*retrieves* the instruction from the cache;
- **DECODE**: *decodes the instruction* and looks for operands (register or immediate values);
- **EXECUTE**: *performs the instruction* (for example, if it is an ADD instruction, addition is performed, if it is a SUB instruction, subtraction is performed, etc.);
- **MEMORY**: *accesses the memory*, and writes data or retrieves data from it;
- **WRITE BACK (retire)**: *records* the calculated value in a register.

Instructions are organized into lines in the memory and are loaded one after the other.
Thanks to the pipeline, instruction processing requires no more than the five preceding steps. Because the order of the steps is invariable (FETCH, DECODE, EXECUTE, MEMORY, WRITE BACK), it is possible to create specialized circuits in the processor for each one.
The goal of the pipeline is to perform each step in parallel with the preceding and following steps, meaning reading an instruction (FETCH) while the previous step is being read (DECODE), while the step before that is being executed (EXECUTE), while the step before that is being written to the memory (MEMORY), and while the first step in the series is being recorded in a register (WRITE BACK).



In general, 1 to 2 clock cycles (rarely more) for each pipeline step or a maximum of 10 clock cycles per instruction should be planned for. For two instructions, a maximum of 12 clock cycles are necessary (10+2= 12 instead of 10*2=20) because the preceding instruction was already in the pipeline. Both instructions are therefore being simultaneously processed, but with a delay of 1 or 2 clock cycles. For 3 instructions, 14 clock cycles are required, etc.
The principle of a pipeline may be compared to a car assembly line. The car moves from one workstation to another by following the assembly line and is completely finished by the time it leaves the factory. To completely understand the principle, the assembly line must be looked at as a whole, and not vehicle by vehicle. Three hours are required to produce each vehicle, but one is produced every minute.
It must be noted that there are many different types of pipelines, varying from 2 to 40 steps, but the principle remains the same.

Super scaling

Super scaling consists of placing multiple processing units in parallel in order to process multiple instructions per cycle.

Hyper Threading

Hyper Threading (written *HT*) technology consists of placing two logic processors with a physical processor. Thus, the system recognizes two physical processors and behaves like a multitasking system by sending two simultaneous threads, referred to as **SMT** (Simultaneous Multi Threading). This "deception" allows processor resources to be better employed by guaranteeing the bulk shipment of data to the processor.

Microprocessor Logic

To understand how a microprocessor works, it is helpful to look inside and learn about the logic used to create one. In the process you can also learn about **assembly language** -- the native language of a microprocessor -- and many of the things that engineers can do to boost the speed of a processor.

A microprocessor executes a collection of machine instructions that tell the processor what to do. Based on the instructions, a microprocessor does three basic things:

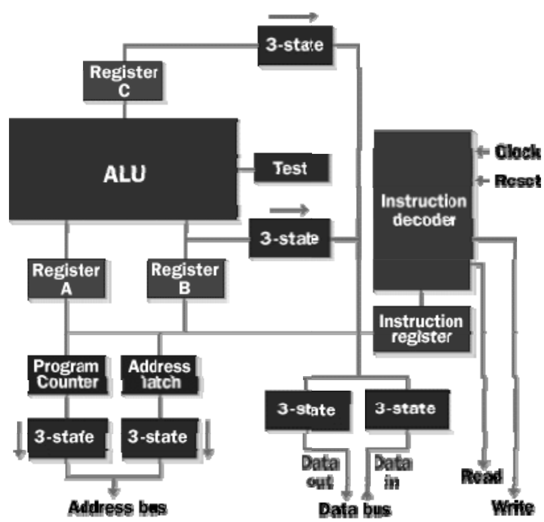
Intel P4 processor

- Using its ALU (Arithmetic/Logic Unit), a microprocessor can perform mathematical operations like addition, subtraction, multiplication and division. Modern microprocessors contain complete floating point processors that can perform extremely sophisticated operations on large floating point numbers.
- A microprocessor can move data from one memory location to another.
- A microprocessor can make decisions and jump to a new set of instructions based on those decisions.

There may be very sophisticated things that a microprocessor does, but those are its three basic activities. The following diagram shows an extremely simple microprocessor capable of doing those three things:

This is about as simple as a microprocessor gets. This microprocessor has:

- An **address bus** (that may be 8, 16 or 32 bits wide) that sends an address to memory
- A **data bus** (that may be 8, 16 or 32 bits wide) that can send data to memory or receive data from memory
- An **RD** (read) and **WR** (write) line to tell the memory whether it wants to set or get the addressed location
- A **clock line** that lets a clock pulse sequence the processor
- A **reset line** that resets the program counter to zero (or whatever) and restarts execution



Let's assume that both the address and data buses are 8 bits wide in this example.

Here are the components of this simple microprocessor:

- Registers A, B and C are simply latches made out of flip-flops.
- The address latch is just like registers A, B and C.
- The program counter is a latch with the extra ability to increment by 1 when told to do so, and also to reset to zero when told to do so.
- The ALU could be as simple as an 8-bit adder, or it might be able to add, subtract, multiply and divide 8-bit values. Let's assume the latter here.
- The test register is a special latch that can hold values from comparisons performed in the ALU. An ALU can normally compare two numbers and determine if they are equal, if one is greater than the other, etc. The test register can also normally hold a carry bit from the last stage of the adder. It stores these values in flip-flops and then the instruction decoder can use the values to make decisions.
- There are six boxes marked "3-State" in the diagram. These are **tri-state buffers**. A tri-state buffer can pass a 1, a 0 or it can essentially disconnect its output (imagine a switch that totally disconnects the output line from the wire that the output is heading toward). A tri-state buffer allows multiple outputs to connect to a wire, but only one of them to actually drive a 1 or a 0 onto the line.
- The instruction register and instruction decoder are responsible for controlling all of the other components.

Although they are not shown in this diagram, there would be control lines from the instruction decoder that would:

- Tell the A register to latch the value currently on the data bus
- Tell the B register to latch the value currently on the data bus
- Tell the C register to latch the value currently output by the ALU
- Tell the program counter register to latch the value currently on the data bus
- Tell the address register to latch the value currently on the data bus
- Tell the instruction register to latch the value currently on the data bus
- Tell the program counter to increment
- Tell the program counter to reset to zero
- Activate any of the six tri-state buffers (six separate lines)
- Tell the ALU what operation to perform
- Tell the test register to latch the ALU's test bits
- Activate the RD line
- Activate the WR line

Coming into the instruction decoder are the bits from the test register and the clock line, as well as the bits from the instruction register.

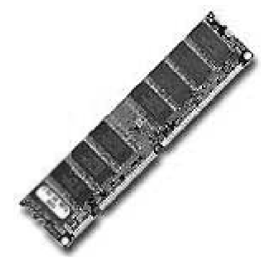
Microprocessor Memory

The previous section talked about the address and data buses, as well as the RD and WR lines. These buses and lines connect either to RAM or ROM -- generally both. In our sample microprocessor, we have an address bus 8 bits wide and a data bus 8 bits wide. That means that the microprocessor can address (2^8) 256 bytes of memory, and it can read or write 8 bits of the

memory at a time. Let's assume that this simple microprocessor has 128 bytes of ROM starting at address 0 and 128 bytes of RAM starting at address 128.
ROM stands for read-only memory. A ROM chip is programmed with a permanent ROM chip Collection of pre-set bytes. The address bus tells the ROM chip which byte to get and place on the data bus. When the RD line changes state, the ROM chip presents the selected byte onto the data bus.

RAM

RAM stands for random-access memory. RAM contains bytes of information, and the microprocessor can read or write to those bytes depending on whether the RD or WR line is signaled. One problem with today's RAM chips is that they forget everything once the power goes off. That is why the computer needs ROM.



RAM chip

Microprocessor Performance and Trends

The number of **transistors** available has a huge effect on the performance of a processor. As seen earlier, a typical instruction in a processor like an 8088 took 15 clock cycles to execute. Because of the design of the multiplier, it took approximately 80 cycles just to do one 16-bit multiplication on the 8088. With more transistors, much more powerful multipliers capable of single-cycle speeds become possible.
More transistors also allow for a technology called **pipelining**. In a pipelined architecture, instruction execution overlaps. So even though it might take five clock cycles to execute each instruction, there can be five instructions in various stages of execution simultaneously. That way it looks like one instruction completes every clock cycle.
Many modern processors have multiple instruction decoders, each with its own pipeline. This allows for multiple instruction streams, which means that more than one instruction can complete during each clock cycle. This technique can be quite complex to implement, so it takes lots of transistors.

Trends

the trend in processor design has primarily been toward full 32-bit ALUs with fast floating point processors built in and pipelined execution with multiple instruction streams. The newest thing in processor design is 64-bit ALUs, and people are expected to have these processors in their home PCs in the next decade. There has also been a tendency toward special instructions (like the MMX instructions) that make certain operations particularly efficient, and the addition of hardware virtual memory support and L1 caching on the processor chip. All of these trends push up the transistor count, leading to the multi-million transistor powerhouses available today. These processors can execute about one billion instructions per second.

Intel & AMD Processors

Currently, the two largest manufacturers of CPUs in the world are Intel and AMD. The current performance and market leader at the time of this writing is Intel, which is the only processor available in all current Apple computers (Macbook, Macbook Pro, Mini, iMac etc.). Intel's most current crop of CPUs is the Core i3, Core i5, and Core i7

while AMD's top offering is the Phenom II. Though AMD is not the market leader, many of their products are found in high performance, budget-oriented notebook and custom desktop builds as well as low-cost enthusiast-oriented desktops. AMD's highest performance processors however, have not yet been available for mobile platforms as Intel's Core iX series are at the time of this writing.
Beneath we provide a chart which compares the relative differences in performance between competing product lines within Intel's and AMD's offerings. We also organize these by the following classes: high-end, mid-range and economy. It is important to note that these comparisons give a quick visual reference as to relative absolute performance across these three categories but does not necessarily indicate absolute rankings between the Intel and AMD products within those categories (for instance, the Core i7 is on the same row in as the Phenom II series but offers superior general performance). Further, the Core iX Mobile series only indicate relative performance for notebook-oriented platforms (they are the highest performance mobile CPUs to date); it is not useful to compare them to a desktop-class processors such as the Intel Core i7 or the Phenom II series.

High-End Processors

Intensive Statistical Analysis, Profesional Video/Audio Creation, Advanced 3D Graphics

Intel Core i7	Intel Core i7 Mobile	AMD Phenom II X6
As Intel's newest flagship processor, the i7 is a 64-bit processor offering either 2, 4, or 6 cores of the highest levels of performance available. The i7 combines Hyper Threading and Turbo Boost technologies for the most demanding and advanced of applications.	Intel's Core i7 Mobile features unparalleled performance on notebooks, incorporating significant power savings while implementing the same features as the non-mobile i7, Hyper Threading and Turbo Boost. The i7 Mobile is available on notebooks with 2 or 4 cores; currently the 4 core version offers higher performance in some respects but heat and battery life are concerns.	AMD's Phenom II X6 represents the industry's first consumer class six-core processor. The X6 offers the highest levels of performance ideal for the most intensive of tasks - bolstered by AMD's new Turbo Core technology, the X6 is able to optimize performance in a variety of situations.

Intel Core i5	Intel Core i5 Mobile	AMD Phenom II X4
Based upon the same architecture as the i7, the i5 is also a 64-bit processor that features 2 or 4 cores at a similar class of performance of the i7 processor at a lower cost. The i5 features Turbo Boost and Hyper-Threading technology but do not possess as much cache memory as the i7.	The Intel Core i5 Mobile while also featuring Hyper Threading and Turbo Boost possesses a similar but lesser class of performance than the Core i7 Mobile with less cache and available in notebooks only with 2 cores. The i5 Mobile is a high performance processor with low energy requirements.	AMD's latest generation of consumer class 4 core processors, the quad-core Phenom II X4 chips are designed to deliver performance ideal for all kinds of multimedia as well as in the most demanding of applications such as virtualization.

Intel Core i3	Intel Core i3 Mobile	AMD Phenom II X3 & X2
Derived from the same architecture as the higher end i5 and i7, the i3 is available strictly as a dual core processor. Though Hyper Threading is available, it does not feature TurboBoost. The Core i3 processor presents higher levels of performance than the Core 2 at a smaller cost.	The Intel Core i3 Mobile descends similarly from the i3, presenting a fast, 64-bit computing experience with the intelligent architecture of the i5 Mobile and i7 Mobile. The i3 Mobile features 2 cores and Hyper Threading but does not include Turbo Boost technology	AMD's Phenom X3 and X2 processors boast 3 or 2 cores that offer excellent performance value; great for all around usage on a small budget all while utilizing AMD's latest architecture technology seen in the Phenom II X4 series

Intel Core 2 Quad

The Core 2 Quad features 4 processing cores to optimize gaming, video, and image processing. Built on the same architecture as the Core 2 Duo, this processor excels on multi-tasking with performance hungry applications.

Intel Core 2 Extreme

Available in both 2 and 4 core versions, distinguishing features of the Extreme series include higher bus speeds than the non-extreme versions, and an unlocked clock multiplier for further customization of your computing performance.

Mid-Range Processors

Speed & Multi-tasking, Adobe Creative Suite, All-Around Use, Basic 3D Graphics

Intel Core 2 Duo Contains two processing cores to optimize gaming, video, and image processing. Laptops with this chip tend to be thinner and more energy-efficient.	**AMD Phenom I X3 & Phenom I X4** AMD's first generation of consumer class processors featuring quad and triple core performance found in desktop builds. Features 64-bit computing performance as well as AMD's Hyper Transport bus technology.
Intel Pentium Dual Core Dual core processor based on the Core micro architecture. A class beneath the Core 2 Duo and Core Duo of Intel's processor offerings, the Pentium Dual Core is available in current desktops and laptops.	**AMD Turion II Ultra / AMD Turion II** The Turion II and Turion II Ultra are AMD's mainstream mobile processor platform; they provide excellent all-around performance for multimedia such as high definition video. As these are often paired with AMD/ATI graphics, budget configurations containing these processors are also sufficient for basic 3D graphics and gaming.
Intel Core Duo / Intel Core Solo The Intel Core Duo and Core Solo are dual and single core processors based on the Core micro architecture. The Core Duo and Core Solo offers modest performance for office and limited multimedia oriented tasks.	**AMD Athlon II X2** The AMD Athlon II X2 is a 2 core desktop processor that is 80% faster than it's single core counterpart. Great for multitasking and multimedia consumption on a budget.

Economy Processors

Internet Browsing, E-Mail, Microsoft Office, Simple Graphics and Games

Intel Centrino/Centrino Duo

A mobile-oriented processor based upon Pentium M or Core Duo architectures; the Centrino also integrates wireless networking technology allowing for smaller sized laptops. Offers slight performance boost over simply choosing a core duo and dell wireless card (which is typically less expensive.)

AMD Sempron

The AMD Sempron is a budget class processor seen in low cost notebooks and desktops and are considered a class above notebook/nettop processors such as the Intel Atom or the AMD Neo platforms.

Intel Atom

Primarily found in net books and net tops, this processor has been designed with price and power consumption in mind. As a result, it offers much less processing power than other current Intel alternatives. This processor is available in 1 or 2 cores, with the single core option being far more prevalent.

AMD Athlon Neo / Neo X2

The Athlon Neo and Neo X2 are single and dual core processors seen in ultra-mobile platforms such as net book and net tops. They are featured with ATI integrated graphics for reasonable multimedia playback performance.

Intel Celeron

Intel's economy model processor. It is the most basic, and thus the slowest. It has less cache than other Intel processors, so even if it has the same Ghz rating as another processor, it will be slower. We usually do not recommend this processor because it offers the least in terms of longevity.

Intel Processor Series			
Processor	**Year**	**Bus width**	**Description**
4004	1971	4	First microprocessor.

4040	1972	4	Enhanced version of the Intel 4004 processor.
8008	1972	8	First 8-bit microprocessor.
8080	1974	8	Successor to Intel 8008 CPU.
8085	1976	8	Enhanced version of Intel 8080 CPU.
8086	1978	16	First generation of Intel 80x86 processors.
8088	1979	8/16	8 bit (external) version of Intel 8086 CPU.
80186	1982	16	Next generation of 80x86 processors. Used mostly as embedded processor.
80188	1982	8/16	Next generation of 80x86 processors. Used mostly as embedded processor.
80286	1982	16	Second generation of 80x86 processors: new instructions, protected mode, support for 16MB of memory.
80376	1989	32	Embedded 32-bit microprocessor based on Intel 80386.
80386	1985	32	Third generation of 80x86 processors: 32 bit architecture, new processor modes.
80486	1989	32	Fourth generation of 80x86 processors: integrated FPU, internal clock multiplier.
Pentium	1993	32	Fifth generation of x86 processors: superscalar architecture, MMX .
Pentium II	1997	32	Sixth generation of x86 processors.
Celeron	1998	32	Low-cost version of Pentium II, Pentium III and Pentium 4 processors.
Pentium III	1999	32	Enhanced and faster version of Pentium II.
Pentium 4	2000	32, 64	New generation of Pentium processors.
Pentium M	2003	32	Pentium microprocessor specifically designed for mobile applications
Celeron D	2004	32, 64	Low-cost version Pentium 4 desktop processors.
Pentium D	2005	64	Dual-core CPUs based on Pentium 4 architecture.
Pentium Extreme Edition	2005	64	Dual-core CPUs based on Pentium 4 architecture.
80860	1989	32	Embedded 32-bit microprocessor with integrated 3D graphics.
80960	1988?	32	Embedded 32-bit microprocessor.
Core Duo	2006	32	32-bit dual-core microprocessor.
Pentium Dual-Core	2007	64	64-bit low-cost microprocessor.
Celeron Dual-Core	2008	64	64-bit low-cost microprocessor.
Atom	2008	32, 64	Ultra-low power microprocessor.
Core i7	2008	32, 64	64-bit microprocessor.
Core i5	2009	32, 64	64-bit microprocessor.
Core i3	2010	32, 64	64-bit microprocessor.

Chapter - 12
Motherboard

Objective of learning

- Motherboard and its farm factor
- History and evolution of motherboard
- Different components on motherboard
- Different types of processor slot/sockets
- Features of different MB

A motherboard is also known as a main board, system board and logic board. A common abbreviation is 'mobo'. They can be found in a variety of electrical devices, ranging from a TV to a computer. Generally, they will be referred to as a motherboard or a main board when associated with a complex device such as a computer, which is what we shall look at. Put simply, it is the central circuit board of your computer. All other components and peripherals plug into it, and the job of the motherboard is to relay information between them all. Despite the fact that a better motherboard will not add to the speed of your PC, it is none-the-less important to have one that is both stable and reliable, as its role is vital. A motherboard houses the BIOS (Basic Input/Output System), which is the simple software run by a computer when initially turned on. Other components attach directly to it, such as the memory, CPU (Central Processing Unit), graphics card, sound card, hard-drive, disk drives, along with various external ports and peripherals.

Difference between motherboards:

There are a lot of motherboards on the market to choose from. The big question is, how do you go about choosing which one is right for you? Different motherboards support different components, and so it is vital you make a number of decisions concerning general system specifications before you can pick the right motherboard.

If you purchase your case before the rest of the components, the first factor to think about concerning motherboards is the size, or form factor. A form factor is a standardized motherboard size. If you think about fitting a motherboard in a case, there are a number of mounting holes, slot locations and PSU connectors. The most popular motherboard form factor today is ATX, which evolved from it's predecessor, the Baby AT, a smaller version of the AT (Advanced Technology) form factor. Generally speaking, nowadays a standard computer will have an ATX form factor motherboard: only special cases require different form factors.

So now you know which size you need, what comes next? The following are all factors you need to consider.

The first important differential is which CPU the board supports. Two of the biggest makes of CPUs at the moment are Intel and AMD, yet you cannot buy motherboards that support the use of either: it will support one or the other, due to physical differences in the connectors. This is often referred to as a type of platform; for example, an 'Intel platform motherboard' means a motherboard with an Intel CPU. Furthermore, you must choose a specific type of processor; for example, an AMD Athlon 64 or Pentium 4. Therefore, you must choose which CPU you want before you can choose your motherboard. Both Intel and AMD processors are capable of running the same applications, but there are differences in price and performance depending on which one you choose.

Evolution of the motherboard

The original PC motherboard had a minimum of integrated devices, just ports for a keyboard and a cassette deck (for storage). Everything else, including a display adapter and floppy or hard disk controllers, were add-in components, connected via expansion slots.

Over time, more devices were integrated into the motherboard. It was a slow trend initially though, as I/O ports and disk controllers were often mounted on expansion cards even up to 1995. Other components - typically graphics, networking, SCSI and sound - usually remained separate. Many manufacturers have experimented with different levels of integration, building in some or even all of these components. However, there are drawbacks. It's harder to upgrade the specification if integrated components can't be removed, and at first highly integrated motherboards often required non-standard cases. Furthermore, replacing a single faulty component may mean buying an entire new motherboard.

Consequently, those parts of the system whose specification changes fastest, particularly RAM and CPU, tend to remain in sockets or slots for easy replacement. Similarly, parts that not all users need, such as SCSI, are usually left out of the base specification to keep costs down. However, it's now common for sound, video and/or network support to be included in motherboards, particularly as technology miniaturization has allowed greater space within the motherboard form factor and Flash BIOS and EPROM has allowed greater support for updated technologies.

The basic changes in motherboard form factors over the years are covered later in this section - the diagrams below provide a detailed look at the various components on two motherboards. The first is a Baby AT design, sporting the Socket 7 processor connector, circa 1995. The second is an ATX design, with a Pentium II vSlot 1 type processor connector, typical of motherboards on the market in late 1998.

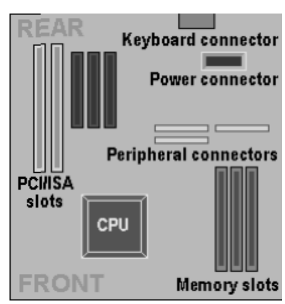
Mother Boards Form Factors:

Early PCs used the AT form factor and 12in wide motherboards. The sheer size of an AT motherboard caused problems for upgrading PCs and did not allow use of the increasingly popular slim line desktop cases. These problems were largely addressed by the smaller version of the full AT form factor, the Baby AT, introduced in 1989. Whilst this remains a common form factor, there have been several improvements since.

All designs are open standards and as such don't require certification. A consequence is that there can be some quite wide variation in design detail between different manufacturers' motherboards.however, keeping to the standards allows case manufacturers to develop for particular motherboard form factors, a boon for home builders, modelers and PC technicians.

Baby AT (BAT) Motherboard Form Factor

The Baby AT (BAT) format reduced the dimensions of the motherboard to a typical 9in wide by 10in long, and BAT motherboards are generally characterized by their shape, an AT-style keyboard connector soldered to the board and serial and parallel port connectors which are attached using cables between the physical ports mounted on the system case and corresponding connectors located on the motherboard.

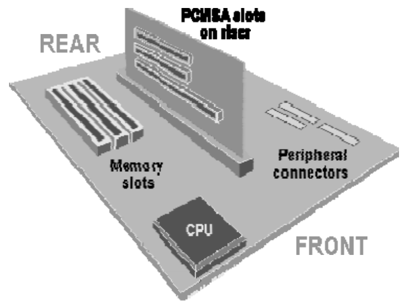


With the BAT design the processor socket is located at the front of the motherboard, and full-length expansion cards are intended to extend over it. This means that removing the processor requires the removal of some or all expansion cards first. Problems were exacerbated by the increasing speeds of Pentium-class processors. System cooling relied on the AT power supply blowing air out of the chassis enclosure and, due to the distance between the power supply and the CPU, an additional chassis fan or active heat sink became a necessity to maintain good airflow across the CPU. AT power supplies only provide 12V and 5V outputs to the motherboard, requiring additional regulators on the motherboard if 3.3V components (PCI cards or CPUs) are used. Sometimes a second heat sink was also required on these voltage regulators and together the various additional heat dissipation components caused serious obstruction for expansion slots.

Some BAT designs allow the use of either AT or ATX power supplies, and some ATX cases might allow the use of a Baby-AT motherboard.

LPX - Low Profile eXtension motherboard form factor

The LPX format is a specialized variant of the Baby-AT used in low profile desktop systems and is a loose specification with a variety of proprietary implementations.

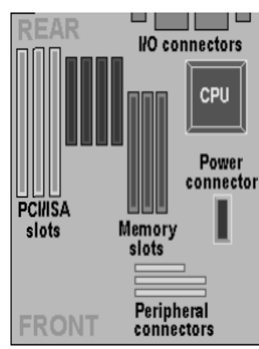


Expansion slots are located on a central riser card, allowing cards to be mounted horizontally. However, this arrangement can make it difficult to remove the motherboard, and the more complex engineering required adds to system costs. As the riser card prevents good airflow within the system case, additional chassis fans are almost always needed.Used commonly in the early 1990s, the format fell out of favor with the introduction of the Pentium I I and AGP graphics cards in 1997. The extra space and cooling required for these components highlighted the LPX's problems, so the form factor was last used in 1998.

ATX form factor

The Intel Advanced/ML motherboard, launched in 1996, was designed to solve issues of space and airflow that the Pentium II and AGP graphics cards had caused the preceding LPX form factor. As the first major innovation in form factors in years, it marked the beginning of a new era in motherboard design. Its size and layout are completely different to the BAT format, following a new scheme known as ATX. The dimensions of a standard ATX board are 12in wide by 9.6in long; the mini ATX variant is typically of the order 11.2in by 8.2in.

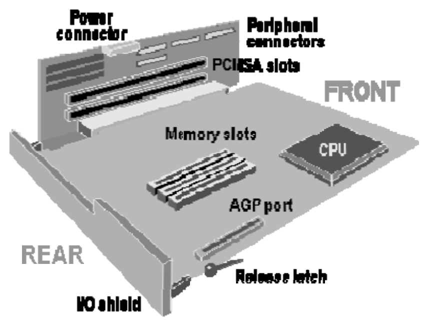
The ATX design gets round the space and airflow problems by moving the CPU socket and the voltage regulator to the right-hand side of the expansion bus. Room is made for the CPU by making the card slightly wider, and shrinking or integrating components such as the Flash BIOS, I/O logic and keyboard controller. This means the board need only be half as deep as a full size Baby AT, and there's no obstruction whatsoever to the six expansion slots (two ISA, one ISA/PCI, three PCI).



An important innovation was the new specification of power supply for the ATX that can be powered on or off by a signal from the motherboard. At a time when energy conservation was becoming a major issue, this allows notebook-style power management and software-controlled shutdown and power-up.A 3.3V output is also provided directly from the power supply. Accessibility of the processor and memory modules is improved dramatically, and relocation of the peripheral connectors allows shorter cables to be used. This also helps reduce electromagnetic interference. The ATX power supply has a side vent that blows air from the outside directly across the processor and memory modules, allowing passive heat sinks to be used in most cases, thereby reducing system noise.

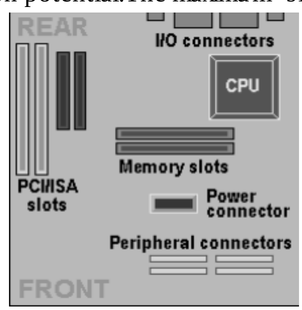
NLX - New Low profile eXtended - form factor for motherboards:

Intel's NLX design, introduced in 1997, is an improvement on the LPX design for low-profile systems, with an emphasis on ease of maintenance. The NLX format is smaller, typically 8.8in wide by 13in long, so well suited for low-profile desktop cases. All expansion slots, power cables and peripheral connectors are located on an edge-mounted riser card, allowing simple removal of the main motherboard, which is mounted on rails in the chassis. It uses a full-width I/O shield to allow for different combinations of rear-panel I/O. The design allows for use of an AGP card, but the slot must be on the motherboard, which reduces the ease of maintenance when such a card is implemented.



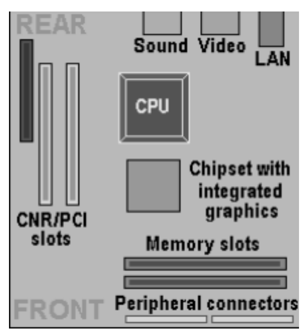
Micro ATX motherboard form factor:

Introduced in the late 1990s, the MicroATX is basically a smaller version of Intel's ATX specification, intended for compact, low-cost consumer systems with limited expansion potential. The maximum size of the board is 9.6in square, and its designed to fit into either a standard ATX case or one of the new micro-tower desktop designs. The double-decker I/O shield is the same as that on the ATX design, but there's only provision for up to four expansion slots as opposed to the seven that ATX allows. The microATX also allows use of a smaller power supply, such as the SFX design, which is reduced in both size and power output.



FlexATX motherboard form factor:

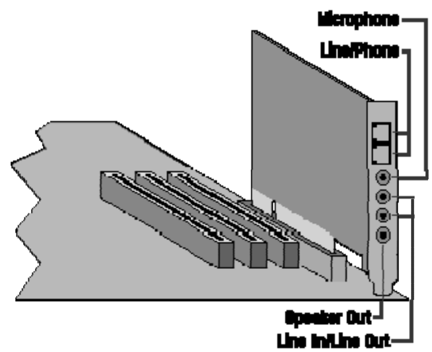
The FlexATX is a natural evolution of the Intel's microATX form factor which was first unveiled in late 1999. The FlexATX addendum to the microATX specification addresses the requirements of only the motherboard and not the overall *system* solution. As such, it does not detail the interfaces, memory or graphics technologies required to develop a successful product design. These are left to the implementer and system designer. The choice of processor is, however, limited to socket-only designs. The principal difference between FlexATX and microATX is that the new form factor reduces the size of the motherboard - to 9in x 7.5in. Not only does this result in lower overall system costs, it also facilitates smaller system designs. The FlexATX form factor is backwards compatible with both the ATX and micro-ATX specifications - use of the same motherboard mounting holes as both of its predecessors avoids the need to retool existing chassis.



Riser architectures for motherboards :

In the late 1990s, the PC industry developed a need for a riser architecture that would contribute towards reduced overall system costs and at the same time increase the flexibility of the system manufacturing process. The Audio/Modem Riser AMR) specification, introduced in the summer of 1998, was the beginning of a new riser architecture approach. AMR had the capability to support both audio and modem functions. However, it did have some shortcomings, which were identified after the release of the specification. These shortcomings included the lack of Plug and Play (PnP) support, as well as the consumption of a PCI connector location.Consequently, new riser architecture specifications were defined which combine more functions onto a single card. These new riser architectures combine audio, modem, broadband technologies, and LAN interfaces onto a single card. They continue to give motherboard OEMs the flexibility to create a generic motherboard for a variety of customers. The riser card allows OEMs and system integrators to provide a customised solution for each customer's needs. Two of the most recent riser architecture specifications include CNR and ACR.

CNR - Communications and Networking Riser



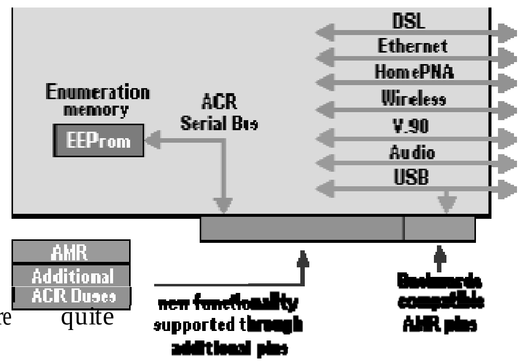
Intel's CNR (Communication and Networking Riser) specification defines a hardware scalable OEM motherboard riser and interface that supports the audio, modem, and LAN interfaces of core logic chipsets. The main objective of this specification is t to reduce the baseline implementation cost of features that are widely used in the Connected PC, while also addressing specific functional limitations of today's audio, modem, and LAN subsystems.
PC users' demand for feature-rich PCs, combined with the industry's current trend towards lower cost, mandates higher levels of integration at all levels of the PC platform. Motherboard integration of communication technologies has been problematic to date, for a variety of reasons, including FCC and international telecom certification processes, motherboard space, and other manufacturer specific requirements.
Motherboard integration of the audio, modem, and LAN subsystems is also problematic, due to the potential for increased noise, which in-turn degrades the performance of each system. The CNR specifically addresses these problems by physically separating these noise-sensitive systems from the noisy environment of the motherboard.
With a standard riser solution, as defined in this specification, the system manufacturer is free to implement the audio, modem, and/or LAN subsystems at a lower bill of materials (BOM) cost than would be possible by deploying the same functions in industry-standard expansion slots or in a proprietary method. With the added flexibility that hardware scalability brings, a system manufacturer has several motherboard acceleration options available, all stemming from the baseline CNR interface.
The CNR Specification supports the five interfaces:

- AC97 Interface - Supports audio and modem functions on the CNR card
- LAN Connect Interface (LCI) - Provides 10/100 LAN or Home Phone line Networking capabilities for Intel chipset based solutions
- Media Independent Interface (MII) - Provides 10/100 LAN or Home Phone line Networking capabilities for CNR platforms using the MII Interface
- Universal Serial Bus (USB) - Supports new or emerging technologies such as xDSL or wireless

- System Management Bus (SMBus) - Provides Plug and Play (PnP) functionality on the CNR card.Each CNR card can utilize a maximum of four interfaces by choosing the specific LAN interface to support.

ACR - Advanced Communications Riser

The rival ACR (Advanced Communications Riser) specification is supported by an alliance of leading computing and communication companies, whose founders include 3COM, AMD, VIA Technologies and Lucent Technologies. Like CNR, it defines a form factor and interfaces for multiple and varied communications and audio sub system designs in desktop OEM personal computers. Building on first generation PC motherboard riser architecture, ACR expands the riser card definition beyond the limitation of audio and modem codecs, while maintaining backward compatibility with legacy riser designs through an industry standard connector scheme. The ACR interface combines several existing communications buses, and introduces new and advanced communications buses answering industry demand for low-cost, high-performance communications peripherals.



ACR supports modem, audio, LAN, and xDSL. Pins are reserved for future wireless bus support. Beyond the limitations of first generation riser specifications, the ACR specification enables riser-based broadband communications, networking peripheral and audio subsystem designs. ACR accomplishes this in an open-standards context.

Although the two specifications both offer similar functionality, the way in which they are implemented are quite dissimilar. In addition to the PCI connector/shared slot issue, the principal differences are as follows:

- ACR is backwards compatible with AMR, CNR isn't
- ACR provides support xDSL technologies via its Integrated Packet Bus (IPB) technology; CNR provides such support via the well-established USB interface
- ACR provides for concurrent support for LCI (LAN Connect Interface) and MII (Media Independent Interface) LAN interfaces; CNR supports either, but not both at the same time
- The ACR Specification has already reserved pins for a future wireless interface; the CNR specification has the pins available but will only define them when the wireless market has become more mature.

Ultimately, motherboard manufacturers are going to have to decide whether the ACR specification's additional features are worth the extra cost.

Components Of Motherboards:

When you look at the mother board inside your computer, you notice that there are a number of different items connected to this board. The memory sockets are installed on this board; the CPU socket is located on the motherboard, and the BIOS chip is also located on the motherboard. In this section, we will identify the different systemboard components.

Processor

One of the easiest items to recognize on the motherboard is the processor. The processor is usually the largest chip on the system board and can be identified generally because it often has a heat sink or fan located on top of it.

Classic Pentium motherboards typically have a socket 7 slot that the processor is inserted into. This socket is implemented as a ZIF (zero insertion force) socket, which means that the processor chip can be removed or added to the socket with very little effort. ZIF sockets typically have a lever that you pull to pop the processor out of the socket.

Pentium II system boards had to implement a different socket for the Pentium II chip because the Pentium II chip was designed with a single edge connector and was inserted into the board standing up. The processor socket for Pentium II chips is called slot 1.

SIMM/DIMM sockets

When you look at a system board, one of the first items that should stand out is the processor or its socket; the next thing that you will usually take notice of are the memory slots that are used to install RAM.There are typically two types of sockets to install memory: SIMM (Single InLine Memory Module) sockets and DIMM (Dual Inline Memory Module) sockets. Original Pentium systems typically have either four 72-pin SIMM sockets, or two 168-pin DIMM sockets to install memory.

When installing SIMMs in Pentium motherboards, you have to install them in pairs, but when installing DIMMs, you can install them individually. The reason for the difference in the installation process is that when installing memory, you must fill a memory bank, which is the size of the processor's data path. That is, if you install 72-pin (32-bit) SIMMs onto a Pentium (64-bit) motherboard, then you have to install two modules to fill the 64-bit data path of the processor. DIMMs are 64-bit memory modules, which is why you only have to install one at a time.

Cache memory

Cache memory increases performance by storing frequently used program code or data. Because cache memory is faster than RAM, the system can store information accessed from RAM in cache memory when the data is accessed the first time. The processor can then retrieve the information from the faster cache memory for subsequent calls. All the processors today have integrated cache memory, which is known as level-1 cache. The types of cache are as follows:

L1 (level-1) cache: Cache that is integrated within the processor.

L2 (level-2) cache: Cache that is located outside the processor, like on the motherboard.

Older motherboards implemented cache memory as rows of DIP chips placed directly on the motherboard. This area was sometimes even labeled "cache." Labels on a motherboard seem to be something that you cannot always rely on though—if they are there, consider it an added bonus!

Newer systems have implemented the cache as a memory module, so you may see an empty slot on the motherboard that looks like a place where you would install a SIMM, but it will really hold a cache module. A lot of times this will be labeled as *cache* on the system board.

Expansion slot

Most motherboards have one or more expansion slots, which serve the purpose of adding functionality to the computer. Even if, for example, your computer doesn't have sound capability right now, you can install a sound card into the expansion slot to add that capability.

Expansion slots come in different varieties on systems today, and it is extremely important to understand the benefits of each type. If you look at the system board, you can see a number of expansion slots. There are probably some white narrow slots on the board, which are the PCI slots. You may also see some larger black slots; these are ISA slots.

Communication ports

Newer systemboards have communication ports integrated directly into the board. The communication ports are also known as the COM ports. Typically, there are two COM ports on each system, COM1 and COM2.

COM ports are also known as serial ports. The reason that they are called serial ports is because they send data in a series—a single bit at a time. If eight bits of data are being delivered to a device connected to the COM ports, then the system is sending the eight bits of data, one at a time.

You usually connect an external modem, or a serial mouse, to these ports. Each of these devices is used for communication; a modem is used to allow your computer to talk to another computer across phone lines, while a serial mouse is a communication device that allows you to communicate with the system. Serial ports on the back of the systemboard are one of two types:

DB9-male is a male serial port with 9 pins.

DB25-male is a male serial port with 25 pins.

Parallel port

Another type of connector that you will have on the back of the motherboard is the parallel port. The parallel port is also known as the printer port, or LPT1. The parallel port gets its name by being able to send information eight bits at a time. Whereas serial ports only send one bit at a time in single file, parallel ports send can send eight bits in one operation—side-by-side rather than single file. The parallel port is a female port located on the back of the system board with 25 pins, which is known as DB25-female.

You connect the parallel port to a printer by using a parallel cable that has a different type of connector at each end. On one end of the cable is a DB25 connector that attaches to the parallel port on the back of the computer (that makes sense—a female DB25 port has a cable with a DB25 male connector on it). On the other end of the cable (the end that connects to the printer) you will have a 36-pin Centronics connector.

Keyboard/Mouse connector

Most motherboards today have mouse and keyboard connectors that are most likely PS2 style connectors.Older motherboards may have an older DIN keyboard connector, which you can see on baby AT motherboards. These systems may or may not have a mouse port on the system board. If not, the mouse connector was located on the case that the system board was inserted into; the mouse connector would connect by wires to the systemboard.

Power connector

Located on the systemboard, you should see a type of connector that you can use to connect the power supply to the motherboard. All of these devices connected to the motherboard need to get power from somewhere, so the power supply is connected to the motherboard, which supplies power to the board and its components. There are power cables coming from the power supply to connect to the motherboard with very unique connectors on the end, these may be labeled as P1 and P2, or on some systems, P8 and P9.You have to be extremely careful to make sure that these connectors are inserted properly, or you could damage the motherboard. Often, the connectors are keyed (meaning that they can only go in one way) so that you cannot put both of the connectors in the wrong way.

Video adapter

Many motherboards today come with a built-in video adapter, sometimes called a video card or video controller.

Hard disk controller

A *controller* is a device that is responsible for controlling data flow, so a *hard drive controller* is responsible for both of the following:

1. Receiving information from the processor and converting or interpreting the information into signals that the hard disk can understand
2. Sending information back to the processor and converting the information into signals that the processor can understand.

Older drives implemented the controller as an expansion card installed into the system that connected to the hard disk via a cable connection. Today, however, hard disk controllers are integrated into the hard disks. You can also find either one or two hard disk controllers on newer motherboards (for more information, see the section titled "EIDE/ATA-2"). The controller on the motherboard has 40 pins and connects to the drive using a 40-wire ribbon cable.

IDE/ATA

A number of hard drive standards have been developed over the last number of years—the first major standard being the *IDE standard*. The IDE (Integrated Drive Electronics) standard calls for an integrated controller on the drive to manage information entering and leaving the hard disk.

IDE has been around since 1989. IDE drives attach to the motherboard by means of a 40-wire ribbon cable. The IDE standard also allows two drives to connect in a daisy-chain fashion, creating a master/slave relationship between devices. The master drive is responsible for sending and receiving information in the chain. The IDE standard is also known as the ATA (Advanced Technology Attachment) standard, which is sometimes known as the ATA-1 standard.

EIDE/ATA-2

The EIDE (Enhanced IDE) standard followed shortly after the IDE standard. The EIDE standard is a specification that allows four drives to be connected to a dual channel controller. This is usually implemented as a motherboard having two controllers, one being the primary controller and the other being the secondary controller. You would then connect two drives off of each controller, making a master/ slave chain off each controller; EIDE also supports larger hard disks; the typical size of an IDE drive was about 504 MB. The EIDE standard is also known as ATA-2.

ATAPI

Typically, IDE devices are implemented as hard drives, but there has been a new ATA specification that has allowed other types of devices to exist on an ATA (or IDE) chain. This specification is known as the ATA Packet Interface, which allows devices like CD-ROMs and tape drives to exist on an ATA chain. Other types of ATAPI devices are CD writers, DVD devices, and zip drives.

ULTRA DMA

Ultra DMA drives have two major benefits over ATA drives:

Speed: Ultra DMA devices function at double the speed of regular IDE devices. IDE devices execute commands at 16.6MB per second, whereas ultra DMA devices execute commands at 33.3MB per second.

Reliability: Ultra DMA devices implement error correction, which provides for increased data reliability compared with IDE, which does not implement error correction.

To take advantage of ultra DMA technology, you need an ultra DMA drive and an ultra DMA compatible BIOS. In addition, you need an ultra DMA compatible driver loaded in the operating system that uses the device.

It is important to note that ultra DMA technology is backward compatible with IDE and EIDE. For example, if you have a motherboard with ultra DMA support, you can still plug an IDE or EIDE device into the controllers on the motherboard. You can also take a ultra DMA drive and install it on an EIDE board.

Floppy disk controller

Located very close to the hard disk controllers, you should see a smaller *floppy drive controller* that connects the floppy drive to the motherboard. This controller supports a 33-wire ribbon cable, which connects the floppy drive to the motherboard. When connecting the floppy drive to the system, you will notice that the ribbon cable for the floppy drive has one end where the wires are twisted. This is the end of the ribbon cable that must be connected to the floppy drive. The opposite end is connected to the controller on the motherboard.

SCSI controller

Some high-end machines, particularly those designed for use as servers, may have a controller on the motherboard with 50 pins on it. This is the footprint of a SCSI (Small Computer System Interface) controller on the motherboard. Because SCSI devices outperform IDE devices, SCSI controllers are extremely popular for use in servers (which have greater hard-disk access and storage needs than regular desktop computers).

The following list compares the various flavors of SCSI. Know them for the exam:

SCSI: SCSI is an example of a technology that has been out for many years and has progressed within those years. The original version of SCSI, also known as SCSI-1 was an 8-bit technology with a transfer rate of 5 Mbps. One of the major benefits of SCSI is that you are not limited to two devices in a chain like you are with IDE SCSI-1 allows you to have eight devices in the chain, with the controller counting as one.

Fast SCSI-2: Fast SCSI-2 increases the performance of SCSI by doubling the transfer rate. Fast SCSI-2 devices transfer information at 10 Mbps, as opposed to 5 MBPS (SCSI-1). Fast SCSI-2 is still an 8-bit technology and supports eight devices in the chain.

Wide SCSI-2: Wide SCSI-2 takes the data path of SCSI (8-bit) and doubles it to 16 bits; because the width of Wide SCSI-2 has been doubled the transfer rate is also 10 Mbps. The number of devices in a Wide SCSI-2 chain is 16.

Fast Wide SCSI-2: Fast Wide SCSI-2 is the combination of Fast SCSI-2 and Wide SCSI-2. The data path of Fast Wide SCSI-2 is 16 bits, the transfer rate is 20 Mbps, and the number of devices that is supported in the chain is 16.

Ultra SCSI: Ultra SCSI takes the transfer rate of 10 Mbps and doubles it again to 20 Mbps! With Ultra SCSI, the bus width is only eight bits, and the number of devices that exist in the chain is eight.

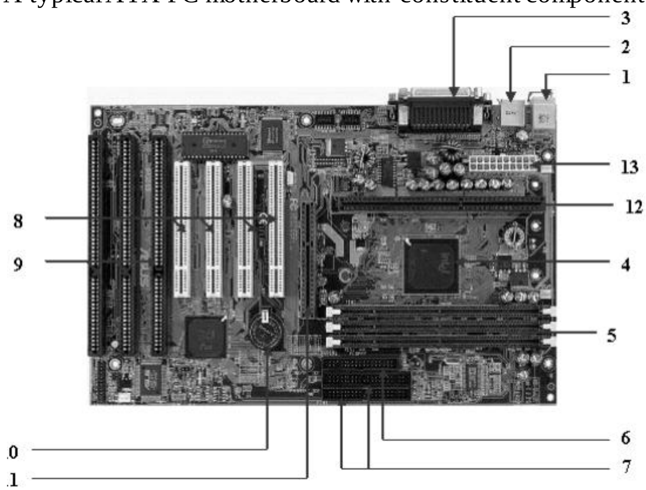
Ultra Wide SCSI: Ultra Wide SCSI is Ultra SCSI with the bus width increased to 16 bits and the number of devices in the chain is increased to 16! The transfer rate of Ultra Wide SCSI has been increased to 40 Mbps.
LVD (Ultra2): Low Voltage Differential, also known as Ultra2 SCSI, has a bus width of 16 bits and supports up to 16 devices. LVD gets its reputation from having a transfer rate of 80 Mbps.

BIOS chip
Locating the BIOS chip on the system board is easy; it is usually rectangular in shape and generally features the manufacturer's name as a label on the chip. Some of the popular manufacturers are AMI, AWARD, and IBM. The *Basic Input Output System* (*BIOS*) is the low-level program code that allows all the system devices to communicate with one another. This low-level program code is stored in the BIOS chip on the motherboard.
The BIOS chip is a ROM (read only memory) chip, which means that you can read information from the chip, but you cannot write to the chip under normal circumstances. Today's implementation of BIOS chips is EEPROM (Electrically Erasable Programmable ROM), which means that you can get special software from the manufacturer of the BIOS to write to the chip.
Why would you want to erase the BIOS? Suppose, for example, that your BIOS is programmed to support a hard disk up to 2GB in size, but that you want to install a new, larger hard disk instead. What can you do about it? You can contact the BIOS manufacturer and get an update for your BIOS chip, which is usually a software program today (in the past, you generally had to install a new chip). Running the software program writes new instructions to the BIOS to make it aware that there are hard disks bigger than 2GB and provides instructions for dealing with them. But before new instructions can be written, the old instructions need to be erased. The BIOS chip also contains code that controls the boot process for your system. It contains code that will perform a power on self test (POST), which means that the computer goes through a number of tests, checking itself out and making sure that it is okay. Once it has made it past the POST, the BIOS then locates a bootable partition and calls on the master boot record, which will load an operating system.

Battery
The computer keeps track of its inventory in what is known as *Complementary Metal Oxide Semiconductor* (*CMOS*). CMOS is a listing of system components, such as the size of the hard disk that is installed in the computer, the amount of RAM, and the resources (IRQs and IO addresses) used by the serial and parallel ports. This inventory list is stored in what is known as CMOS RAM, which is a bit of a problem because RAM loses its content when the power is shut off. You don't want the computer to forget that it has a hard disk or forget how much RAM it has installed. To prevent this sort of problem, a small watch-like battery on the system board maintains enough energy so that CMOS RAM does not lose its charge. If CMOS RAM loses its charge, it results in the CMOS content being lost.

Computer Motherboard and its constituent components:

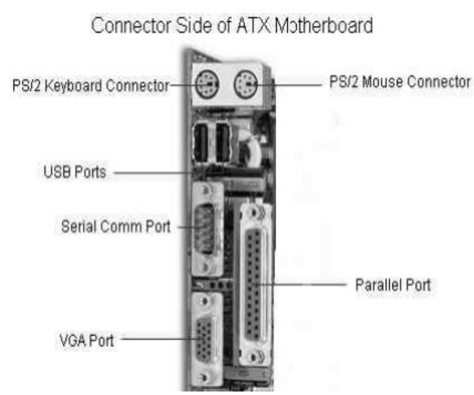
A typical ATX PC motherboard with constituent components is given below:



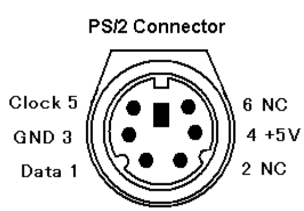
1. Mouse & keyboard: Keyboard Connectors are two types basically. All PCs have a Key board port connected directly to the motherboard. The oldest, but still quite common type, is a special DIN, and most PCs until recently retained this style connector. The AT-style keyboard connector is quickly disappearing, being replaced by the smaller mini DIN PS/2-style keyboard connector.

The important constituent components of an ATX Motherboard are given below:

Mouse & keyboard
USB
Parallel port
CPU Chip
RAM slots
Floppy controller
IDE controller
PCI slot
ISA slot
CMOS Battery
AGP slot
CPU slot
Power supply plug in



1. Mouse & keyboard: Keyboard Connectors are two types basically. All PCs have a Key board port connected directly to the motherboard. The oldest, but still quite common type, is a special DIN, and most PCs until recently retained this style connector. The AT-style keyboard connector is quickly disappearing, being replaced by the smaller mini DIN PS/2-style keyboard connector.



You can use an AT-style keyboard with a PS/2 -style socket (or the other way around) by using a converter. Although the AT connector is unique in PCs, the PS/2-style mini-DIN is also used in more modern PCs for the mouse. Fortunately, most PCs that use the mini-DIN for both the keyboard and mouse clearly mark each mini-DIN socket as to its correct use. Some keyboards have a USB connection, but these are fairly rare compared to the PS/2 connection keyboards.

2. USB (Universal serial bus):
USB is the General-purpose connection for PC. You can find USB versions of many different devices, such as mice, keyboards, scanners, cameras, and even printers. a USB connector's distinctive rectangular shape makes it easily recognizable.USB has a number of features that makes it particularly popular on PCs. First, USB devices are hot swappable. You can insert or remove them without restarting your system.

3. Parallel port: Most printers use a special connector called a parallel port. Parallel port carry data on more than one wire, as opposed to the serial port, which uses only one wire. Parallel ports use a 25-pin female DB connector. Parallel ports are directly supported by the motherboard through a direct connection or through a dangle.

4. CPU Chip : The *central processing unit,* also called the *microprocessor* performs all the calculations that take place inside a pc. CPUs come in Variety of shapes and sizes. Modern CPUs generate a lot of heat and thus require a cooling fan or heat sink. The cooling device (such as a cooling fan) is removable, although some CPU manufactures sell the CPU with a fan permanently attached.

5. RAM slots: Random-Access Memory (RAM) stores programs and data currently being used by the CPU. RAM is measured in units called bytes. RAM has been packaged in many different ways. The most current package is called a 168-pin DIMM (Dual Inline Memory module).

6. Floppy controller: The floppy drive connects to the computer via a 34-pin *ribbon cable,* which in turn connects to the motherboard. A *floppy controller* is one that is used to control the floppy drive.

7. IDE controller: Industry standards define two common types of hard drives: EIDE and SCSI. Majority of the PCs use EIDE drives. SCSI drives show up in high end PCs such as network servers or graphical workstations. The EIDE drive connects to the hard drive via a 2-inch-wide, 40-pin ribbon cable, which in turn connects to the motherboard. *IDE controller* is responsible for controlling the hard drive.

8. PCI slot: Intel introduced the *Peripheral component interconnect* bus protocol. The PCI bus is used to connect I/O devices (such as NIC or RAID controllers) to the main logic of the computer. PCI bus has replaced the ISA bus.

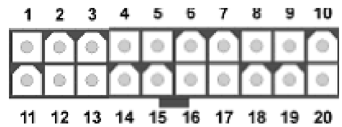
9. ISA slot: (Industry Standard Architecture) It is the standard architecture of the Expansion bus. Motherboard may contain some slots to connect ISA compatible cards.

10. CMOS Battery: To provide CMOS with the power when the computer is turned off all motherboards comes with a battery. These batteries mount on the motherboard in one of three ways: the obsolete external battery, the most common onboard battery, and built-in battery.

11. AGP slot: If you have a modern motherboard, you will almost certainly notice a single connector that looks like a PCI slot, but is slightly shorter and usually brown. You also probably have a video card inserted into this slot. This is an *Advanced Graphics Port (AGP)* slot.

12. CPU slot: To install the CPU, just slide it straight down into the slot. Special notches in the slot make it impossible to install them incorrectly. So remember if it does not go easily, it is probably not correct. Be sure to plug in the CPU fan's power.

13. Power supply plug in:
The Power supply, as its name implies, provides the necessary electrical power to make the pc operate. the power supply takes standard 110-V AC power and converts into +/-12-Volt, +/-5-Volt, and 3.3-Volt DC power. The power supply connector has 20-pins, and the connector can go in only one direction.



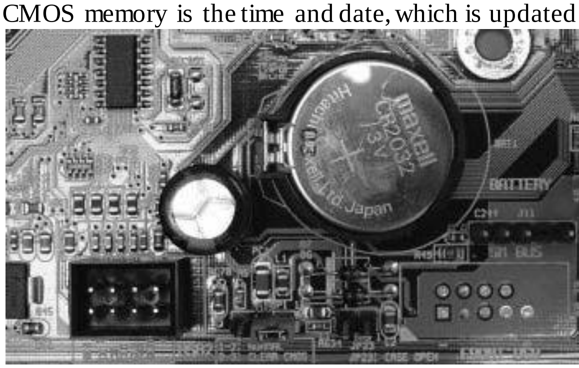
BIOS - What motherboard BIOS does for a PC:
All motherboards include a small block of Read Only Memory (ROM) which is separate from the main system memory used for loading and running software. The BIOS will most likely be stored in a 32-pin chip, which can typically be identified by a silver or gold sticker that shows the name of the BIOS company - such as AMIBIOS, AWARD or Phoenix - and a code that indicates the version of code it contains. If its rectangular in shape, it's what is known as a DIP (Dual In-line Package) chip. Older motherboards may have 28-pin DIP BIOS chips. If your BIOS chip is square with connections on all four sides, it is in a PLCC (Plastic Leaded Chip Carrier) package. A locating notch indicates the orientation of pin 1.

The ROM contains the PC's Basic Input/Output System (BIOS). This offers two advantages: the code and data in the ROM BIOS need not be reloaded each time the computer is started, and they cannot be corrupted by wayward applications that write into the wrong part of memory. If you have a DIP or PLCC chip that's actually soldered to your motherboard, you'll not be able to upgrade it by replacing the ROM. Modern-day BIOSes are flash upgradeable, meaning they may be updated via a floppy disk or, sometimes, through Windows, to ensure future compatibility with new chips, add-on cards and so on.
The BIOS comprises several separate routines, serving different functions. The first part runs as soon as the machine is powered on. It inspects the computer to determine what hardware is fitted and then conducts some simple tests to check that everything is functioning normally - a process called the power-on self test (POST). If any of the peripherals are plug and play devices, it's at this point that the BIOS assigns their resources within the system. There's also an option to enter the Setup program, allowing the user to tell the PC what hardware is fitted. Thanks to automatic self-configuring BIOSes this isn't used so much now, but is useful when encountering system errors, or for optimizing a system setup for advanced users.
If all the tests are passed, the ROM then tries to determine which drive to boot the machine from. Older PCs ship with the BIOS set to check for the presence of an operating system in the floppy disk drive first (A:), then on the primary hard disk drive. Later PCs have more options, including boot from a CD

or DVD drive, or booting from a USB device. BIOS options will allow configuring the sequence of boot devices, which can reduce normal boot time by a few seconds.
Some BIOS's also allow booting from a hard disk drive other than the primary IDE drive. In this case it would be possible to have different operating systems - or separate instances of the same OS - on different drives. Many BIOSes allow the start-up process to be interrupted to specify the first boot device without actually having to enter the BIOS setup utility itself. If no bootable drive is detected, a message is displayed indicating that the system requires a system disk. Once the machine has booted, the BIOS serves a different purpose by presenting DOS with a standardised API for the PC hardware. In the days before Windows, this was a vital function, but 32-bit "protect mode" software doesn't use the BIOS, so it's of less benefit in modern PCs.

CMOS - complementary metal oxide silicon - RAM chips on motherboards:

Motherboards also include a separate block of memory made from very low power consumption CMOS (complementary metal oxide silicon) RAM chips, which is kept alive by a battery even when the PC's power is off. This is used to store basic information about the PC's configuration: number and type of hard and floppy drives, how much memory, what kind and so on. All this used to be entered manually, but modern auto-configuring BIOSes do much of this work, in which case the more important settings are advanced settings such as DRAM timings. The other important data kept in CMOS memory is the time and date, which is updated by a Real Time Clock (RTC).



The CMOS memory is usually located with the real-time clock in the motherboard chipset or in a separate real-time clock chip. The PC reads the time from the RTC when it boots up, after which the CPU keeps time - which is why system clocks are sometimes out of sync. Rebooting the PC causes the RTC to be reread, increasing their accuracy.
In modern-day PCs the nonvolatile BIOS memory is generally an EEPROM or Flash memory chip. There is still a backup battery involved, but its role is not to maintain the data stored in the RAM, only to keep the RTC chip operational.

CPU interfaces - motherboard slots and sockets for AMD and Intel processors:

In essence, a CPU is a flat square sliver of silicon with circuits etched on its surface. This chip is linked to connector pins and the whole contraption encased some form of packaging - either ceramic or plastic - with pins running along the flat underside or along one edge. The CPU package is connected to a motherboard via some form of CPU interface, either a slot or a socket. For many years the socket style of CPU was dominant. Then both major PC chip manufacturers switched to a slot style of interface. After a relatively short period of time they both changed their minds and the socket was back in favour! The older 386, 486, classic Pentium and Pentium MMX processors came in a flat square package with an array of pins on the underside - called Pin Grid Array (PGA) - which plugged into a socket-style CPU interface on the motherboard. The earliest such interface for which many motherboards and working systems remain to this day - not least because it supported CPUs from so many different chip manufacturers - is Socket 7.

Name	Interface	Description
Socket 1	169-pin	Found on 486 motherboards, operated at 5 volts and supported 486 chips, plus the DX2, DX4 OverDrive.
Socket 2	238-pin	A minor upgrade from Socket 1 that supported all the same chips. Additionally supported a Pentium OverDrive.
Socket 3	237-pin	Operated at 5 volts, but had the added capability of operating at 3.3 volts, switchable with a jumper setting on the motherboard. Supported all of the Socket 2 chips with the addition of the 5x86. Considered the last of the 486 sockets.
Socket 4	273-pin	The first socket designed for use with Pentium class processors. Operated at 5 volts and consequently supported only the low-end Pentium-60/66 and the OverDrive chip. Beginning with the Pentium-75, Intel moved to the 3.3 volt operation.
Socket 5	320-pin	Operated at 3.3 volts and supported Pentium class chips from 75MHz to 133MHz. Not compatible with later chips because of their requirement for an additional pin.
Socket 6	235-pin	Designed for use with 486 CPUs, this was an enhanced version of Socket 3 supporting operation at 3.3 volts. Barely used since it appeared at a time when the 486 was about to be superseded by the Pentium.
Socket 7	321-pin	Introduced for the Pentium MMX, the socket had provision for supplying the split core/IO voltage required by this and later chips. The interface used for all Pentium clones with a 66MHz bus.
Socket 8	387-pin	Used exclusively by the Intel Pentium Pro, the socket proved extremely expensive to manufacture and was quickly dropped in favour of a cartridge-based design.
Slot 1	242-way connector	The circuit board inside the package had up to 512KB of L1 cache on it - consisting of two 256KB chips - which ran at half the CPU speed. Used by Intel Pentium II, Pentium III and Celeron CPUs.
Socket 370	370-pin	Began to replace Slot 1 on the Celeron range from early 1999. Also used by Pentium III Coppermine and Tualatin CPUs in variants known as FC-PGA and FC-PGA2 respectively.
Socket 423	423-pin	Introduced to accommodate the additional pins required for the Pentium 4's completely new FSB. Includes an Integral Heat Spreader, which both protects the die and provides a surface to which large heat sinks can be attached.
Socket 603	603-pin	The connector for Pentium 4 Xeon CPUs. The additional pins are for providing more power to future CPUs with large on-die (or even off-die) L3 caches, and possibly for accommodating inter-processor-communication signals for systems with multiple CPUs.
Socket 478	478-pin	Introduced in anticipation of the introduction of the 0.13-micron Pentium 4 Northwood CPU at the beginning of 2002. Its micro Pin Grid Array (µPGA) interface allows both the size of the CPU itself and the space occupied by the socket on the motherboard to be significantly reduced.

Socket 754	754-pin	AMD's 754-pin CPU interface form factor introduced with its 64-bit Athlon 64 processor in the autumn of 2003, finally replacing the longstanding and highly succesful Socket A. Targeted at budget desktop and mobile 64 bit computing.
Socket 940	940-pin	AMD's 940-pin CPU interface form factor originally used by Opteron and FX versions of the Athlon 64 CPU. Subsequently replaced for use by the latter by Socket 939, which allowed for a less-expensive motherboard option, one with only four layers rather than from six to nine.
Socket 939	939-pin	AMD's 939-pin CPU interface form factor introduced in the summer of 2004. The Socket 939 marked the convergence of the mainstream and FX versions of the Athlon 64 CPU, which had previously used different interfaces, the Socket 754 and Socket 940 respectively.
LGA775/ Socket T	775-pin	Land Grid Array 775: Intel's proprietary CPU interface form factor introduced in the summer of 2004. Similar to a pin grid array (PGA), the connection between LGA775 chip packaging and the processor chip is via an array of contacts rather than pins to sockets providing better power distribution to the processor. Used for some Pentium 4, Pentium D, Core 2 Duo and Core 2 Quad CPUs.
Socket AM2	940-pin	Released just before the Intel LGA771, the AM2 came as AMD's replacement for the Socket 939 and and Socket 754. Offering support for an array of processors and DDR2 RAM,
LGA771/ Socket J	771-pin	Land Grid Array 771: Released in June 2006, the Socket J processor was released to support Intel's Server and Workstation based Xeon pro cessor range. The J stands for " Jayhawk," a processor to have been released simultaneously but cancelled. The LGA771 supports the Dual Core Xeon Dempsey and Woodcrest, Quad Core Clovertown, and Core 2 Extreme processors.
Socket 479	479-pin	Also referred to as the mPGA479M socket, Socket 479 is best known as the CPU socket for the Intel Pentium M mobile processor. The format was also used for desktop PCs, Asus making a drop-in board which allowed Socket 479 CPUs to be used in selected desktop motherboards. Intel subsequently announced a new Socket 479 with a revised pinout for its new generation of Core CPUs.
Socket F	1207-pin	Released August 2006, AMD created the Socket F as a socket 940 replacement for its server line processors, particularly the Opteron range, though it also the high range Athlon 64 FX series of processors. Supporting AMD's native quad core Opteron processors and DDR2 RAM, this socket gave AMD a considerable boost in server market share over Intel.
Socket AM2+	940-pin	Released November 2007, this step up from the socket AM2 improved HyperTransport support and energy efficiency, though only on AM2 + compatible chips with fully AM2+ motherboards. Seen as a halfway house to socket AM3, takeup on the socket was arguably disappointing.
LGA1336/ Socket B	1336-pin	Land Grid Array 1336: Introduced in November 2008, superseding the LGA775/Socket T, to support Intel's Core i7 Nehalem CPUs: Bloomfield, Gainestown and Westmere. DDR3 RAM is required for this socket.

Chapter - 13
Power supply unit (SMPS)

Objectives of learning

- Power Rating and Efficiency
- Appearance of Power Supply
- Various connectors from a computer PSU
- AT vs. ATX
- Working Of SMPS
- Failure modes
- Precautions & Applications
- Terms And Facts Related To Power Supply
- Uninterrupted power supply(UPS)

A power supply unit (PSU) supplies DC power to the other components in a computer. It converts general-purpose alternating current (AC) electric power from the mains (110V to 120V at 60Hz [115V nominal] in North America, parts of South America, Japan, and Taiwan; 220V to 240V at 50Hz [230V nominal] in most of the rest of the world) to low-voltage (for a desktop computer: 12V, 5V, 5VSB, 3V3, -5V, and -12V) direct current (DC) power for the internal components of the computer. Some power supplies have a switch to select either 230 V or 115 V. Other models are able to accept any voltage and frequency between those limits and some models only operate from one of the two mains supply standards. Most modern desktop computer power supplies conform to the ATX form factor. ATX power supplies are turned on and off by a signal from the motherboard. They also provide a signal to the motherboard to indicate when the DC power lines are correct so that the computer is able to boot-up. While an ATX power supply is connected to the mains supply it provides a 5V stand-by (5VSB) line so that the standby functions on the computer and certain peripherals are powered. The most recent ATX PSU standard is version 2.31 of mid-2008.

Power Rating and Efficiency:

Computer power supplies are rated based on their maximum output power. Typical power ranges are from 500 W to lower than 300 W for small form factor systems intended as ordinary home computers, the use of which is limited to web-surfing and burning and playing DVDs. Power supplies used by gamers and enthusiasts mostly range from 450 W to 1400 W. Typical gaming PCs feature power supplies in the range of 500-800 W, with higher-end PCs demanding 800-1400 W supplies. The highest-end units are up to 2 kW strong and are intended mainly for servers and, to a lesser degree, extreme performance computers with multiple processors, several hard disks and multiple graphics cards. The power rating of a PC power supply is not officially certified and is self-claimed by each manufacturer. A common way to reach the power figure for PC PSUs is by adding the power available on each rail, which will not give a true power figure. Therefore it is possible to overload a PSU on one rail without having to use the maximum rated power.
This may mean that if:

- PSU A has a peak rating of 550 watts at 25°C, with 25 amps (300 W) on the 12 volt line, and

- PSU B has a continuous rating of 450 watts at 40°C, with 33 amps (400 W) on the 12 volt line, and if those ratings are accurate, then PSU B would have to be considered a vastly superior unit, despite its lower overall power rating. PSU A may only be capable of delivering a fraction of its rated power under real world conditions.

This tendency has led in turn to greatly over specified power supply recommendations, and a shortage of high-quality power supplies with reasonable capacities. Simple, general purpose computers rarely require more than 300–350 watts maximum. Higher end computers such as servers and gaming machines with multiple high power GPUs are among the few exceptions, although in recent years the power demand of "video cards" in the ability to watch high definition (HD) media has led to even the average ATX computer to consume between 400 and 500 watts.

Appearance of Power Supply:

Most computer power supplies are a square metal box, and have a large bundle of wires emerging from one end. Opposite the wire bundle is the back face of the power supply, with an air vent and a IEC 60320 C14 connector to supply AC power. There may optionally be a power switch and/or a voltage selector switch. A label on one side of the box lists technical information about the power supply including safety certifications maximum output power. Common certification marks for safety are the UL mark, GS mark, TÜV, NEMKO, SEMKO, DEMKO, FIMKO, CCC, CSA, VDE, GOST R and BSMI. Common certificate marks for EMI/RFI are the CE mark, FCC and C-tick. The CE mark is required for power supplies sold in Europe and India. A RoHS or 80 PLUS can also sometimes be seen. Dimensions of an ATX power supply are 150 mm width, 86 mm height, and typically 140 mm depth, although the depth can vary from brand to brand.

Various connectors from a computer PSU.

Typically, power supplies have the following connectors (all are Molex (USA) Inc Mini-Fit Jr, unless otherwise indicated):

- **PC Main** power connector (usually called **P1**): This is the connector that goes to the motherboard to provide it with power. The connector has 20 or 24 pins. One of the pins belongs to the PS-ON wire (it is usually green). This connector is the largest of all the connectors. In older AT power supplies; this connector was split in two: **P8** and **P9**. A power supply with a 24-pin connector can be used on a motherboard with a 20-pin connector. In cases where the motherboard has a 24-pin connector, some power supplies come with two connectors (one with 20-pin and other with 4-pin) which can be used together to form the 24-pin connector.
- **ATX12V** 4-pin power connector (also called the **P4 power connector**). A second connector that goes to the motherboard (in addition to the main 24-pin connector) to supply dedicated power for the processor. For high-end motherboards and processors, more power is required; therefore EPS12V has an 8 pin connector.
- **4-pin Peripheral** power connectors: These are the other, smaller connectors that go to the various disk drives of the computer. Most of them have four wires: two black, one red, and one yellow. Unlike the standard mains electrical wire color-coding, each *black wire* is a ground, the *red wire*

is +5 V, and the *yellow wire* is +12 V. In some cases these are also used to provide additional power to PCI cards such as FireWire 800 cards.

- **4-pin Molex (Japan) Ltd** power connectors (usually called **Mini-connector** or "mini-Molex"): This is one of the smallest connectors that supplies the floppy drive with power. In some cases, it can be used as an auxiliary connector for AGP video cards. Its cable configuration is similar to the Peripheral connector.
- **Auxiliary** power connectors: There are several types of auxiliary connectors designed to provide additional power if it is needed.
- **Serial ATA** power connectors: a 15-pin connector for components which use SATA power plugs. This connector supplies power at three different voltages: +3.3, +5, and +12 volts.
- **6-pin** Most modern computer power supplies include 6-pin connectors which are generally used for PCI Express graphics cards, but a newly introduced 8-pin connector should be seen on the latest model power supplies. Each PCI Express 6-pin connector can output a maximum of 75 W.
- **6+2 pin** For the purpose of backwards compatibility, some connectors designed for use with high end PCI Express graphics cards feature this kind of pin configuration. It allows either a 6-pin card or an 8-pin card to be connected by using two separate connection modules wired into the same sheath: one with 6 pins and another with 2 pins.
- An IEC 60320 C14 connector with an appropriate C13 cord is used to attach the power supply to the local power grid.

AT vs. ATX:

A typical installation of an ATX forms factor computer power supply.

There are two basic differences between AT and ATX power supplies: The connectors that provide power to the motherboard, and the soft switch. On older AT power supplies, the Power-on switch wire from the front of the computer is connected directly to the power supply.

On newer ATX power supplies, the power switch on the front of the computer goes to the motherboard over a connector labeled something like; PS ON, Power SW, SW Power, etc. This allows other hardware and/or software to turn the system on and off.

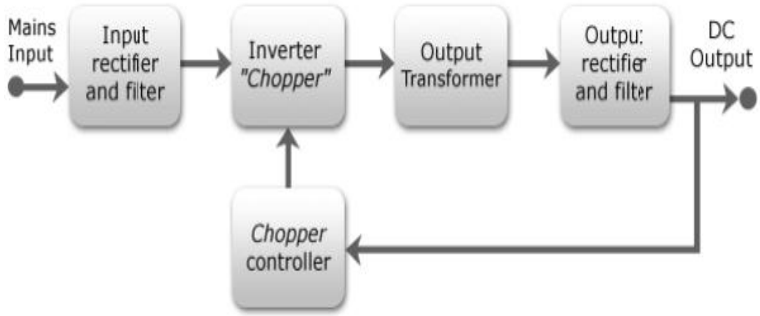
The motherboard controls the power supply through pin #14 of the 20 pin connector or #16 of the 24 pin connector on the motherboard. This pin carries 5V when the power supply is in standby. It can be grounded to turn the power supply on without having to turn on the rest of the components. This is useful for testing or to use the computer ATX power supply for other purposes.**AT stands for Advanced Technology when ATX means Advanced Technology eXtended.**

Classification of SMPS:

SMPSs can be classified into four types according to the input and output waveforms

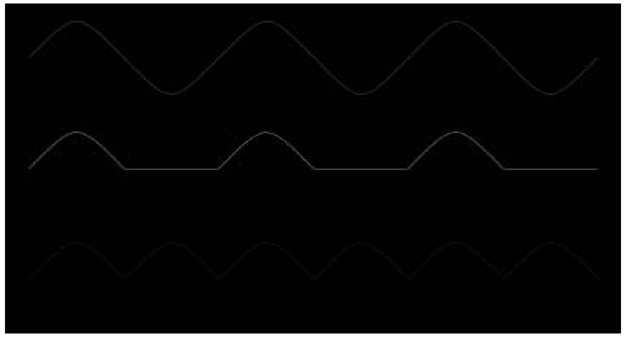
- AC in, DC out: rectifier, off-line converter input stage
- DC in, DC out: voltage converter, or current converter, or DC to DC converter
- AC in, AC out: frequency changer, cyclo converter, transformer, phase converter
- DC in, AC out: inverter

Working Of SMPS:



Input rectifier stage

If the SMPS has an AC input, then the first stage is to convert the input to DC. This is called ***rectification.*** The rectifier circuit can be configured as a voltage doublers by the addition of a switch operated either manually or automatically. This is a feature of larger supplies to permit operation from nominally 120 V or 240 V supplies. The rectifier produces an unregulated D voltage which is then sent to a large filter capacitor. The current drawn from the mains supply by this rectifier circuit occurs in short pulses around the AC voltage peaks. These pulses have significant high frequency energy which reduces the power factor. Special control techniques can be employed by the following SMPS to force the average input current to follow the sinusoidal shape of the AC input voltage thus the designer should try correcting the power factor. An SMPS with a DC input does not require this stage. An SMPS designed for AC input can often be run from a DC supply (for 230 V AC this would be 330 V DC), as the DC passes through the rectifier stage unchanged. It's however advisable to consult the manual before trying this, though most supplies are quite capable of such operation even though nothing is mentioned in the documentation. However, this type of use may be harmful to the rectifier stage as it will only use half of diodes in the rectifier for the full load. This may result in overheating of these components, and cause them to fail prematurely. If an input range switch is used, the rectifier stage is usually configured to operate as a voltage doubler when operating on the low voltage (~120 V AC) range and as a straight rectifier when operating on the high voltage (~240 V AC) range. If an input range switch is not used, then a full-wave rectifier is usually used and the downstream inverter stage is simply designed to be flexible enough to accept the wide range of DC voltages that will be produced by the rectifier stage. In higher-power SMPSs, some form of automatic range switching may be used.



Inverter stage

This section refers to the block marked ***chopper*** in the block diagram.

The inverter stage converts DC, whether directly from the input or from the rectifier stage described above, to AC by running it through a power oscillator, whose output transformer is very small with few windings at a frequency of tens or hundreds of kilohertz (kHz). The frequency is usually chosen to be above 20 kHz, to make it inaudible to humans. The output voltage is optically coupled to the input and thus very tightly controlled. The switching is implemented as a multistage (to achieve high gain) MOSFET amplifier. MOSFETs are a type of transistor with a low on-resistance and a high current-handling capacity.

Voltage converter and output rectifier

If the output is required to be isolated from the input, as is usually the case in mains power supplies, the inverted AC is used to drive the primary winding of a high-frequency transformer. This converts the voltage up or down to the required output level on its secondary winding. The output transformer in the block diagram serves this purpose. If a DC output is required, the AC output from the transformer is rectified. For output voltages above ten volts or so, ordinary silicon diodes are commonly used. For lower voltages, Schottky diodes are commonly used as the rectifier elements; they have the advantages of faster recovery times than silicon diodes (allowing low-loss operation at higher frequencies) and a lower voltage drop when conducting. For even lower output voltages, MOSFETs may be used as synchronous rectifiers; compared to Schottky diodes, these have even lower conducting state voltage drops. The rectified output is then smoothed by a filter consisting of inductors and capacitors. For higher switching frequencies, components with lower capacitance and inductance are needed. Simpler, non-isolated power supplies contain an inductor instead of a transformer. This type includes *boost converters*, *buck converters*, and the *buck-boost converters*. These belong to the simplest class of single input, single output converters which use one inductor and one active switch. The buck converter reduces the input voltage in direct proportion to the ratio of conductive time to the total switching period, called the duty cycle. For example an ideal buck converter with a 10 V input operating at a 50% duty cycle will produce an average output voltage of 5 V. A feedback control loop is employed to regulate the output voltage by varying the duty cycle to compensate for variations in input voltage. The output voltage of a boost converter is always greater than the input voltage and the buck-boost output voltage is inverted but can be greater than, equal to, or less than the magnitude of its input voltage. There are many variations and extensions to this class of converters but these three forms the basis of almost all isolated and non-isolated DC to DC converters. By adding a second inductor the Ćuk and SEPIC converters can be implemented, or, by adding additional active switches, various bridge converters can be realized. Other types of SMPSs use a capacitor-diode voltage multiplier instead of inductors and transformers. These are mostly used for generating high voltages at low currents (*Cockcroft-Walton generator*). The low voltage variant is called charge pump.

Regulation

A feedback circuit monitors the output voltage and compares it with a reference voltage, which shown in the block diagram serves this purpose. Depending on design/safety requirements, the controller may contain an isolation mechanism (such as opto-couplers) to isolate it from the DC output. Switching supplies in computers, TVs and VCRs have these opto-couplers to tightly control the output voltage.
Open-loop regulators do not have a feedback circuit. Instead, they rely on feeding a constant voltage to the input of the transformer or inductor, and assume that the output will be correct. Regulated designs compensate for the impedance of the transformer or coil. Mono polar designs also compensate for the magnetic hysteresis of the core. The feedback circuit needs power to run before it can generate power, so an additional non-switching power-supply for stand-by is added.

Transformer design:

SMPS transformers run at high frequency. Most of the cost savings (and space savings) in off-line power supplies come from the fact that a high frequency transformer is much smaller than the 50/60 Hz transformers formerly used. There are additional design tradeoffs.

Transformer size

The higher the switching frequency, the lesser the amount of energy that needs to be stored intermediately during the time of a single switching cycle. Because this energy is stored in form of magnetic energy in the transformer core material (like ferrite), less of such material is needed.
However, higher frequency also means more energy lost during transitions of the switching semiconductor. Furthermore, much more attention to the physical layout of the circuit board is required, and the amount of electromagnetic interference will be more pronounced.

Core loss

There are several differences in the design of transformers for 50 Hz vs 500 kHz. Firstly a low frequency transformer usually transfers energy through its core (soft iron), while the (usually ferrite) core of a high frequency transformer limits leakage.

Copper loss

At low frequencies (such as the line frequency of 50 or 60 Hz), designers can usually ignore the skin effect. At line frequencies, the skin effect becomes important when the conductors have a diameter larger than about 0.3 inches (7.6 mm).Switching power supplies must pay more attention to the skin effect because it is a source of power loss. At 500 kHz, the skin depth is about 0.003 inches (0.076 mm) – a dimension smaller than the typical wires used in a power supply. The skin effect is exacerbated by the harmonics present in the switching waveforms. The appropriate skin depth is not just the depth at the fundamental, but also the skin depths at the harmonics. Since the wave forms in a SMPS are generally high speed (PWM square waves), the wiring must be capable of supporting high harmonics of the base frequency due to effect. In addition to the skin effect, there is also a proximity effect, which is another source of power loss.

Failure modes:

Power supplies which use capacitors suffering from the capacitor plague may experience premature failure when the capacitance drops to 4% of the original value. This usually causes the switching semiconductor to fail in a conductive way. That may expose connected loads to the full input volt and current, and precipitate wild oscillations in output.

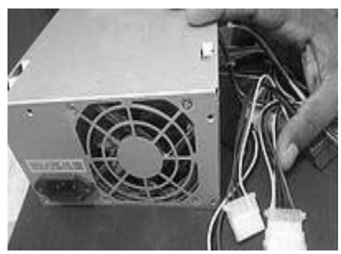
Failure of the switching transistor is common. Due to the large switching voltages this transistor must handle (around 325 V for a 230 V_{AC} mains supply), these transistors often short out, in turn immediately blowing the main internal power fuse.

Precautions:

The main filter capacitor will often store up to 325 V long after the power cord has been removed from the wall. Not all power supplies contain a small "bleeder" resistor to slowly discharge this capacitor. Any contact with this capacitor may result in a severe electrical shock. The primary and secondary side may be connected with an capacitor to reduce EMI and compensate for various capacitive couplings in the converter circuit, where the transformer is one. This may result in electric shock in some cases. The current flowing from line or neutral through a 2000 Ω resistor to any accessible part must according to IEC 60950 be less than 250 μA for IT equipment.

Applications of Power supply:

Switched mode mobile phone charger



A 450 Watt SMPS for use in personal computers with the power input, fan, and output cords visible

Switched-mode power supply units (PSUs) in domestic products such as personal computers often have universal inputs, meaning that they can accept power from most mains supplies throughout the world, with rated frequencies from 50 Hz to 60 Hz and voltages from 100 V to 240 V (although a manual voltage range switch may be required). In practice they will operate from a much wider frequency range and often from a DC supply as well. In 2006, at an Intel Developers Forum, Google engineers proposed the use of a single 12 V supply inside PCs, due to the high efficiency of switch mode supplies directly on the PCB. Most modern desktop and laptop computers also have a voltage regulator module—a DC–DC converter on the motherboard to step down the voltage from the power supply or the battery to the CPU core voltage, which is as low as 0.8 V for a low voltage CPU to 1.2–1.5 V for a desktop CPU as of 2007. Some motherboards have a setting in the BIOS that allows over lockers to set a new CPU core voltage; other motherboards support dynamic voltage scaling which constantly adjust the CPU core voltage. Most laptop computers also have a DC–AC converter to step up the voltage from the battery to drive a CCFL backlight in the flat-screen monitor, which typically requires around 1 kV_{RMS}. Due to their high volumes mobile phone chargers have always been particularly cost sensitive. The first chargers were linear power supplies but they quickly moved to the cost effective ringing choke converter (RCC) SMPS topology, when new levels of efficiency were required. Recently the demand for even lower no load power requirements in the application has meant that fly back topology is being used more widely; primary side sensing fly back controllers are also helping to cut the bill of materials (BOM) by removing secondary-side sensing components such as opt couplers.Where integration of capacitors for stabilization and batteries as a energy storage or hum and interference needs to be avoided in the power distribution, SMPS may be essential for efficient conversion of electric DC energy. For AC applications where frequency and voltage can't be produced by the primary source an SMPS may be essential as well. Applications may be found in the automobile industry where ordinary trucks uses nominal 24 V_{DC} but may need 12 V_{DC}. Ordinary cars use nominal 12 V_{DC} and may need to convert this to drive equipment. In industrial settings, DC supply is sometimes chosen to avoid hum and interference and ease the integration of capacitors and batteries used to buffer the voltage that makes SMPS essential. In the case of TV sets, for example, an excellent regulation of the power supply can be shown by using a variac. For example, in some TV-models made by Philips, the power supply starts when the voltage reaches around 90 V. From there, one can change the voltage with the variac, and go as low as 40 V and as high as 260 V (a peak voltage of $260\times\sqrt{2}$ alterations.

Laptops

Most portable computers have power supplies that provide 25 to 200 watts. In portable computers (such as laptops) there is usually an external power supply (sometimes referred to as a "power brick" due to its similarity, in size, shape and weight, to a real brick) which converts AC power to one DC voltage (most commonly 19 V), and further DC-DC conversion occurs within the laptop to supply the various DC voltages required by the other components of the portable computer.

Servers

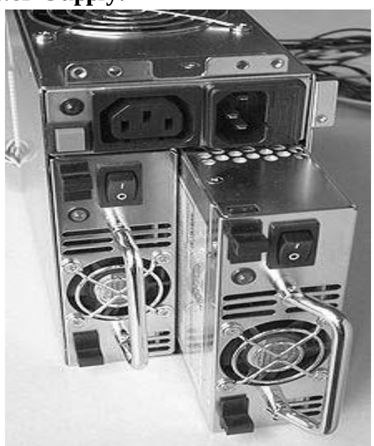
Some web servers use a single-voltage 12 volt power supply. All other voltages are generated by voltage regulator modules on the motherboard.

Energy efficiency:

Computer power supplies are generally about 70–75% efficient. That means in order for a 75% efficient power supply to produce 75 W of DC output it would require 100 W of AC input and dissipate the remaining 25 W in heat. Higher-quality power supplies can be over 80% efficient; higher energy efficient PSU's waste less energy in heat, and requires less airflow to cool and as a result will be quieter. Google's server power supplies are more than 90% efficient. HP's server power supplies have reached 94% efficiency. Standard PSUs sold for server workstations have around 90% efficiency, as of 2010.It important to match the capacity of a power supply to the power needs of the computer. The energy efficiency of power supplies drops significantly at low loads. Efficiency generally peaks at about 50-75% load. The curve varies from model to model (examples of how this curve looks can be seen on test reports of energy efficient models found on the 80 PLUS website). As a rule of thumb for standard power supplies it is usually appropriate to buy a supply such that the calculated typical consumption of one's computer is about 60% of the rated capacity of the supply provided that the

calculated maximum consumption of the computer does not exceed the rated capacity of the supply. Note that advice on overall power supply ratings often given by the manufacturer of single component, typically graphics cards, should be treated with great skepticism. These manufacturers want to minimize support issues due to under rating of the power supply specifications and advise customers to use a more powerful power supply to avoid these issues.
Various initiatives are underway to improve the efficiency of computer power supplies. Climate savers computing initiative promotes energy saving and reduction of greenho se gas emissions by encouraging development and use of more efficient power supplies. 80 PLUS certifies power supplies that meet certain efficiency criteria, and encourages their use via financial incentives. On top of that the businesses end up using less electricity to cool the PSU and the computer's themselves and thus save an initially large sum(i.e. incentive + saved electricity = higher profit).

Terms And Facts Related To Power Supply:



Redundant power supply

- Life span is usually measured in Mean Time Between Failures (MTBF). Higher MTBF ratings are preferable for longer device life and reliability. Quality construction consisting of industrial grade electrical components and/or a larger or higher speed fan can help to contribute to a higher MTBF rating by keeping critical components cool, thus preventing the unit from overheating. Overheating is a major cause of PSU failure. MTBF value of 100,000 hours (about 11 year's continuous operation) is not uncommon.
- Power supplies may have passive or active power factor correction (PFC). Passive PFC is a simple way of increasing the power factor by putting a coil in series with the primary filter capacitors. Active PFC is more complex and can achieve higher PF, up to 99%.
- In computer power supplies that have more than one +12V power rail, it is preferable for stability reasons to spread the power load over the 12V rails evenly to help avoid overloading one of the rails on the power supply.
  - Multiple 12V power supply rails are separately current limited as a safety feature; they are not generated separately. Despite widespread belief to the contrary, this separation has no effect on mutual interference between supply rails.
  - The ATX12V 2.x and EPS12V power supply standards defer to the IEC 60950 standard, which requires that no more than 240 volt-amps be present between any two accessible

points. Thus, each wire must be current-limited to no more than 20 A; typical supplies guarantee 18 A without triggering the current limit. Power supplies capable of delivering more than 18 A at 12 V connect wires in groups to two or more current sensors which will shut down the supply if excess current flows. Unlike a fuse or circuit breaker, these limits reset as soon as the overload is removed.
    - Because of the above standards, almost all high-power supplies claim to implement separate rails, however this claim is often false; many omit the necessary current-limit circuitry, both for cost reasons and because it is an irritation to customers. (The lack is sometimes advertised as a feature under names like "rail fusion" or "current sharing".)
- When the computer is powered down but the power supply is still on, it can be started remotely via Wake-on-LAN and Wake-on-Ring or locally via Keyboard Power ON (KBPO) if the motherboard supports it.
- Early PSUs used a conventional (heavy) step-down transformer, but most modern computer power supplies are a type of switched-mode power supply (SMPS) with a ferrite-cored High Frequency transformer.
- Computer power supplies may have short circuit protection; overpower (overload) protection, overvoltage protection, under voltage protection, over current protection, and over temperature protection.
- Some power supplies come with sleeved cables, which is aesthetically nicer, makes wiring easier and cleaner and have less detrimental effect on airflow.
- There is a popular misconception that a greater power capacity (watt output capacity) is always better. Since supplies are self-certified, a manufacturer's claims may be double or more what is actually provided. Although a too-large power supply will have an extra margin of safety as far as not over-loading, a larger unit is often less efficient at lower loads (under 20% of its total capability) and therefore will waste more electricity than a more appropriately sized unit. Additionally, computer power supplies generally do not function properly if they are too lightly loaded. (less than about 15% of the total load.) Under no-load conditions they may shut down or malfunction. For this reason the no-load protection was introduced in some power supplies.
- Another popular misconception is that the greater the total watt capacity is, the more suitable the power supply becomes for higher-end graphics cards. The most important factor for judging PSUs suitability for certain graphics cards is the PSUs total 12V output, as it is that voltage on which modern graphics cards operate. If the total 12V output stated on the PSU is higher than the suggested minimum of the card, then that PSU can fully supply the card. It is however recommended that a PSU should not just cover the graphics cards' demands, as there are other components in the PC that depend on the 12V output, including the CPU , disk drives and optical drives.
- Power supplies can feature magnetic amplifiers or double-forward converter circuit design.

Wiring Diagram: AT power connector (Used on older AT style main boards)

Color	Pin	Signal
	P8.1	Power Good
	P8.2	+5 V
	P8.3	+12 V
	P8.4	−12 V
	P8.5	Ground
	P8.6	Ground
	P9.1	Ground
	P9.2	Ground
	P9.3	−5 V
	P9.4	+5 V
	P9.5	+5 V
	P9.6	+5 V

24-pin ATX12V 2.x power supply connector

(20-pin omits the last four: 11, 12, 23 and 24)

Color	Signal	Pin	Pin	Signal	Color
Orange	+3.3 V	1	13	+3.3 V +3.3 V sense	Orange Brown
Orange	+3.3 V	2	14	−12 V	Blue
Black	Ground	3	15	Ground	Black
Red	+5 V	4	16	Power on	Green
Black	Ground	5	17	Ground	Black
Red	+5 V	6	18	Ground	Black
Black	Ground	7	19	Ground	Black
Grey	Power good	8	20	Reserved	N/C
Purple	+5 V standby	9	21	+5 V	Red
Yellow	+12 V	10	22	+5 V	Red
Yellow	+12 V	11	23	+5 V	Red

Uninterrupted power supply (UPS):

An uninterrupted power supply, also uninterrupted power source, UPS or battery/flywheel backup is an electrical apparatus that provides emergency power to a load when the input power source, typically the utility mains, fails. A UPS differs from an auxiliary or emergency power system or standby generator in that it will provide instantaneous or near-instantaneous protection from input power interruptions by means of one or more attached batteries and associated electronic circuitry for low power users, and or by means of diesel generators and flywheels for high power users. The on-battery runtime of most uninterruptible power sources is relatively short—5–15 minutes being typical for smaller units—but sufficient to allow time to bring an auxiliary power source on line, or to properly shut down the protected equipment. While not limited to protecting any particular type of equipment, a UPS is typically used to protect computers, data centers, telecommunication equipment or other electrical equipment where an unexpected power disruption could cause injuries, fatalities, serious business disruption or data loss. UPS units range in size from units designed to protect a single computer without a video monitor (around 200 VA rating) to large units powering entire data centers, buildings, or even cities.

Common power problems:

The primary role of any UPS is to provide short-term power when the input power source fails. However, most UPS units are also capable in varying degrees of correcting common utility power problems:

1. Power failure: defined as a total loss of input voltage.
2. Surge: defined as a momentary or sustained increase in the main voltage.
3. Sag: defined as a momentary or sustained reduction in input voltage.
4. Spikes, defined as a brief high voltage excursion.
5. Noise, defined as a high frequency transient or oscillation, usually injected into the line by nearby equipment.
6. Frequency instability: defined as temporary changes in the mains frequency.
7. Harmonic distortion: defined as a departure from the ideal sinusoidal waveform expected on the line.

UPS units are divided into categories based on which of the above problems they address and some manufacturers categorize their products in accordance with the number of power related problems they address.

Terms in UPS

- **Spikes**

Spikes are very high voltages which are caused due to the switching ON or switching OFF of a large electrical load.

- **Surges**

Surges are over voltages that last for more than one sine wave cycle.

- **Sags**

Sags are under voltages that last for more than one sine wave cycle.

- **Brown-Outs**

Brown-outs are the low voltage conditions that can be present even for several hours. This is often created when the power demands exceed to capacity of the power supply.

- **Black-Outs**

Black-outs are nothing but no-power conditions, caused due to several factors like, short circuits, fuse blown no voltage in the AC main etc.

- **Harmonic Distortion**

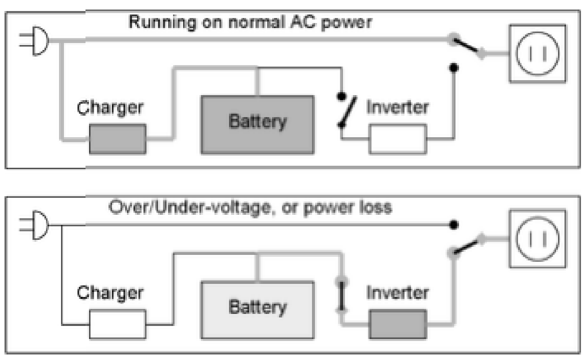
It is the deviation of the wave shape from a pure sine wave.

- **Frequency instability and Noise** are some of the other problems which way cause problem to the system.

Technologies:

The general categories of modern UPS systems are *on-line*, *line-interactive* or *standby*. An on-line UPS uses a "double conversion" method of accepting AC input, rectifying to DC for passing through the rechargeable battery (or battery strings), then inverting back to 120 V/230 V AC for powering the protected equipment. A line-interactive UPS maintains the inverter in line and redirects the battery's DC current path from the normal charging mode to supplying current when power is lost. In a **standby** ("off-line") system the load is powered directly by the input power and the backup power circuitry is only invoked when the utility power fails. Most UPS below 1 kVA are of the line-interactive or standby varieties which are usually less expensive. For large power units, dynamic uninterruptible power supplies are sometimes used. A synchronous motor/alternator is connected on the mains via a choke. Energy is stored in a flywheel. When the mains power fails, an Eddy-current regulation maintains the power on the load. DUPS are sometimes combined or integrated with a diesel generator forming a diesel rotary uninterruptible power supply, or DRUPS.
A fuel cell UPS has been developed in recent years using hydrogen and a fuel cell as a power source, potentially providing long run times in a small space.

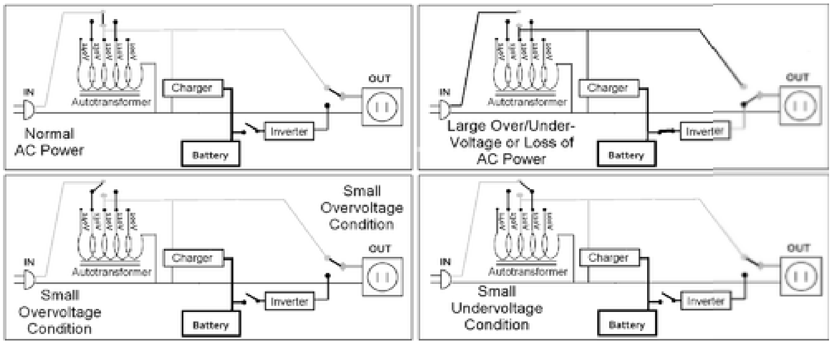
Offline / standby



Typical protection time: 0–20 minutes. Capacity expansion: Usually not available

The offline / standby UPS (SPS) offers only the most basic features, providing surge protection and battery backup. The protected equipment is normally connected directly to incoming utility power. When the incoming voltage falls below a predetermined level the SPS turns on its internal DC-AC inverter circuitry, which is powered from an internal storage battery. The SPS then mechanically switches the connected equipment on to its DC-AC inverter output. The switchover time can be as long as 25 milliseconds depending on the amount of time it takes the standby UPS to detect the lost utility voltage. The UPS will be designed to power certain equipment, such as a personal computer, without any objectionable dip or brownout to that device.

Line-interactive



Typical protection time: 5–30 minutes. Capacity expansion: Several hours

The line-interactive UPS is similar in operation to a standby UPS, but with the addition of a multi-tap variable-voltage autotransformer. This is a special type of electrical transformer that can add or subtract powered coils of wire, thereby increasing or decreasing the magnetic field and the output voltage of the transformer. This type of UPS is able to tolerate continuous under voltage brownouts and overvoltage surges without consuming the limited reserve battery power. It instead compensates by automatically selecting different power taps on the autotransformer. Depending on the design, changing the autotransformer tap can cause a very brief output power disruption, which may cause UPSs equipped with a power-loss alarm to "chirp" for a moment. This has become popular even in the cheapest UPSs because it takes advantage of components already included. The main 50/60 Hz transformer used to convert between line voltage and battery voltage needs to provide two slightly different turns ratios: one to convert the battery output voltage (typically a multiple of 12 V) to line voltage, and a second one to convert the line voltage to a slightly higher battery charging voltage (such as a multiple of 14 V). Further, it is easier to do the switching on the line-voltage side of the transformer because of the lower currents on that side. To gain the buck/boost feature, all that is required is two separate switches so that the AC input can be connected to one of the two primary taps, while the load is connected to the other, thus using the main transformer's primary windings as an autotransformer. The battery can still be charged while "bucking" an overvoltage, but while "boosting" an under voltage, the transformer output is too low to charge the batteries. Autotransformers can be engineered to cover a wide range of varying input voltages, but this requires more taps and increases complexity, and expense of the UPS. It is common for the autotransformer to cover a range only from about 90 V to 140 V for 120 V power, and then switch to battery if the voltage goes much higher or lower than that range.

In low-voltage conditions the UPS will use more current than normal so it may need a higher current circuit than a normal device. For example to power a 1000-watt device at 120 volts, the UPS will draw 8.32 amperes. If a brownout occurs and the voltage drops to 100 volts, the UPS will draw 10 amperes to compensate. This also works in reverse, so that in an overvoltage condition, the UPS will need less current.

Double-conversion / online:

Typical protection time: 5–30 minutes. Capacity expansion: Several hours, the online UPS is ideal for environments where electrical isolation is necessary or for equipment that is very sensitive to power fluctuations. Although once previously reserved for very large installations of 10 kW or more, advances in technology have now permitted it to be available as a common consumer device, supplying 500 watts or less. The initial cost of the online UPS may be slightly higher, but its total cost of ownership is generally lower due to longer battery life. The online UPS may be necessary when the power environment is "noisy", when utility power sags, outages and other anomalies are frequent, when protection of sensitive IT equipment loads is required, or when operation from an extended-run backup generator is necessary. The basic technology of the online UPS is the same as in a standby or line-interactive UPS. However it typically costs much more, due to it having a much greater current AC-to-DC battery-charger/rectifier, and with the rectifier and inverter designed to run continuously with improved cooling systems. It is called a *double-conversion* UPS due to the rectifier directly driving the inverter, even when powered from normal AC current. In an online UPS, the batteries are always connected to the inverter, so that no power transfer switches are necessary. When power loss occurs, the rectifier simply drops out of the circuit and the batteries keep the power steady and unchanged. When power is restored, the rectifier resumes carrying most of the load and begins charging the batteries, though the charging current may be limited to prevent the high-power rectifier from overheating the batteries and boiling off the electrolyte.

The main advantage to the on-line UPS is its ability to provide an electrical firewall between the incoming utility power and sensitive electronic equipment. While the standby and line-interactive UPS merely filter the input utility power, the double-conversion UPS provides a layer of insulation from power quality problems. It allows control of output voltage and frequency regardless of input voltage and frequency.

- ***Hybrid topology / double conversion on demand***

These hybrid designs do not have an official designation, although one name used by HP and Eaton is double conversion on demand. This style of UPS is targeted towards high efficiency applications while still maintaining the features and protection level offered by double conversion.

A hybrid (double conversion on demand) UPS operates as an off-line/standby UPS when power conditions are within a certain preset window. This allows the UPS to achieve very high efficiency ratings. When the power conditions fluctuate outside of the predefined windows, the UPS switches to online/double conversion operation. In double conversion mode the UPS can adjust for voltage variations without having to use battery power, can filter out line noise and control frequency. Examples of this hybrid/double conversion on demand UPS design are the HP R8000, HP R12000, HP RP12000/3 and the Eaton Blade UPS.

- ***Ferro-resonant:***

Typical protection time: 5 – 15 minutes. Capacity expansion: Several Hours

Ferro-resonant units operate in the same way as a standby UPS unit; however, they are online with the exception that a ferro-resonant transformer is used to filter the output. This transformer is designed to

hold energy long enough to cover the time between switching from line power to battery power and effectively eliminates the transfer time. Many ferro-resonant UPSs are 82–88% efficient (AC/DC-AC) and offer excellent isolation.The transformer has three windings, one for ordinary mains power, the second for rectified battery power, and the third for output AC power to the load.
This once was the dominant type of UPS and is limited to around the 150 kVA range. These units are still mainly used in some industrial settings (oil and gas, petrochemical, chemical, utility, and heavy industry markets) due to the robust nature of the UPS. Many ferro-resonant UPSs utilizing controlled ferro technology may not interact with power-factor-correcting equipment.

- ***DC power***

Typical protection time: Several hours. Capacity expansion: Yes

A UPS designed for powering DC equipment is very similar to an online UPS, except that it does not need an output inverter, and often the powered device does not need a power supply. Rather than converting AC to DC to charge batteries, then DC to AC to power the external device, and then back to DC inside the powered device, some equipment accepts DC power directly and allows one or more conversion steps to be eliminated. This equipment is more commonly known as a rectifier. Many systems used in telecommunications use 48 V DC power, because it is not considered a *high-voltage* by most electrical codes and is exempt from many safety regulations, such as being installed in conduit and junction boxes. DC has typically been the dominant power source for telecommunications, and AC has typically been the dominant source for computers and servers. There has been much experimentation with 48 V DC power for computer servers, in the hope of reducing the likelihood of failure and the cost of equipment. However, to supply the same amount of power, the current must be same.

Applications of UPS:

- **N+1**

In large business environments where reliability is of great importance, a single huge UPS can also be a single point of failure that can disrupt many other systems. To provide greater reliability, multiple smaller UPS modules and batteries can be integrated together to provide redundant power protection equivalent to one very large UPS. "N+1" means that if the load can be supplied by N modules, the installation will contain N+ 1 module. In this way, failure of one module will not impact system operation.

- ***M*ultiple redundancy**

Many computer servers offer the option of redundant power supplies, so that in the event of one power supply failing, one or more other power supplies are able to power the load. This is a critical point – each power supply must be able to power the entire server by itself. Redundancy is further enhanced by plugging each power supply into a different circuit (i.e. to a different circuit breaker).Redundant protection can be extended further yet by connecting each power supply to its own UPS. This provides double protection from both a power supply failure and a UPS failure, so that continued operation is assured. This configuration is also referred to as 2N redundancy. If the budget does not allow for two identical UPS units then it is common practice to plug one power supply into mains power and the other into the UPS.

- **Outdoor use**

When a UPS system is placed outdoors, it should have some specific features that guarantee that it can tolerate weather with a 'minimal to none' effect on performance. Factors such as temperature, humidity, rain, and snow among others should be considered by the manufacturer when designing an outdoor UPS system. Operating temperature ranges for outdoor UPS systems could be around −40 °C to +55 °C.Outdoor UPS systems can be pole, ground (pedestal), or host mounted. Outdoor environment could mean extreme cold, in which case the outdoor UPS system should include a battery heater mat, or extreme heat, in which case the outdoor UPS system should include a fan system or an air conditioning system.

- **Internal systems**

UPS systems can be designed to be placed inside a computer chassis. There are two types of internal UPS. The first type is a miniaturized regular UPS that is made small enough to fit into a 5.25-inch CD-ROM slot bay of a regular computer chassis. The other type are re-engineered switching power supplies that utilize dual power sources of AC and/or DC as power inputs and have an AC/DC built-in switching management control units.

- **Common Specifications of UPS**

✓ **General**

–UPS Type
– Load Rating

✓ **Input Specification**

– Input Voltage
– Nominal Frequency
– Input Connection

✓ **Output Specification**

– Output Voltage
– Output Waveform Type
– Transfer Time

✓ **Battery Specification**

– Battery Type
– Battery Capacity
– Typical Battery Life
– Typical Run Time at Full Load
– Time at Half Load
– Typical Recharge Time
– Battery Expansion

- **Other**

– Indicators and Alarms
– Control and Monitoring Hardware and Software
– Certifications

Chapter - 14
Assembling of the Computer

Objective of learning

- Why assembling to be done
- Components required for assembling
- Steps of assembling
- Precautions to be take for assembling
- Assembling troubleshooting tips

Building a computer can be a very rewarding experience. Since you're reading this, you're probably thinking about building your next computer instead of buying one pre-built. This is a very viable option these days and can bring many benefits; you can learn a lot about computer hardware by building one, you get a totally personalized computer, you can choose better components and you may be able to save some money and have fun. Additionally, if you are the sort of person who wants to understand how things work, if you take broken stuff apart just to see how it all fits together, if you have a drawer somewhere full of "parts" you think may come in handy someday, then you just may be in the right place

The first step to building a computer is acquiring the parts. This guide will start with a quick explanation of essential parts and elaborate on them further on.

A computer is made up of a case (or chassis) which houses several important internal components, and provides places to connect the external components, including non-peripherals.

Inside the case go the following internal parts:

- **Power Supply/PSU** – *power supply unit*, converts outlet power, which is alternating current (AC), to direct current (DC) which is required by internal components, as well as providing appropriate voltages and currents for these internal components.

- **Motherboard/Main board** – As the name indicates, this is the electronic centerpiece of the computer, everything else connects to the motherboard.

- **Processor/CPU** – *central processing unit*, the "brain" of the computer, most actual computation takes place here.

- **RAM** – *random access memory*, the "short-term memory" of a computer, used by the CPU to store program instructions and data upon which it is currently operating. Data in RAM is lost when the computer is powered off, thus necessitating a *hard drive*.

- **Hard Drive/Hard Disk** – the "long-term memory" of the computer, used for persistent storage – i.e. the things stored on it remain even when the computer is powered down. The operating system, and all your programs and data are stored here.

- **Optical Drive** – device for reading/writing optical disks. May read CDs, DVDs, or other optical media, depending on the type. It is essential for installing many operating systems and programs. It may be able to write some of these discs, as well. Some people like to have two such drives for copying disks.

- **Video Card/Graphics Card/GPU** – does processing relating to video output. Some motherboards have an "onboard" GPU built in so you don't need (but may add) a separate video card. Otherwise, you will need a video card. These plug into a slot on the motherboard and provide a place to connect a monitor to your computer.

On top of the internal components listed above, you will also need these external components:

- **Keyboard** – for typing on. Many motherboards won't even boot without a keyboard attached.

- **Mouse** – for pointing and clicking. Unless you chose a text-based operating system, you will likely want one of these.

- **Monitor** – This is where the pretty pictures go. They come in many forms, the most common being CRT and LCD.

These are the parts that a standard PC will use. We are not considering such esoterica as headless, touch screen, or voice-controlled systems. You might want to make a check list (perhaps using a spreadsheet) of parts to use as you go about your process of research and selection. That way you won't find yourself sitting down with a pile of brand new hardware only to find that you forgot an essential component. Before you jump onto the web and start spending lots of money on expensive computer parts, there are three important questions you should answer which will guide your purchases:

1. What will be the main function of the computer?
2. What useful parts do you have on hand, from an old computer or otherwise?
3. How much can you afford to spend on the system?

Once you've gathered all of your components, tools, and manuals to gether. The pages that follow describe the major steps in assembling a "typical" home built PC. It's a bit dated, but the basic principles are still the same.
But every computer building project is a little different, too. Take a few moments to look at your particular computer and plan for yourself what is the best sequence to use. For example, the design of your particular motherboard and case may make it easier to install the components in a different order than the order that appears here. That's fine. Also take a moment to review the safety and anti-static precautions before going any further. Few things feel quite so bad as ruining a part of your homebuilt PC because of failure to protect it against static discharge.

Precaution
It should go without saying that ALL COMPUTER ASSEMBLY MUST BE PERFORMED WITH THE COMPUTER UNPLUGGED FROM THE AC POWER.

Assembling of PC: Getting Ready
Before beginning to assemble your new computer, gather everything you need (your computer tool kit, components and manuals) together in one place.
Place something over your table to avoid damaging the surface. An anti-static mat is best because it will not only protect your table from

scratches, but also protect your computer's components from static damage.

Safety & Anti-Static Precautions

A static shock that is much too small for a human to to feel can still be enough to fry sensitive computer components. So if you don't have an anti-static wrist strap, stop right now and go buy one.
The anti-static kit pictured on the right is a professional model that comes with an anti-static mat (the red thing in the picture). The strap attaches to the anti-static mat as well as to the computer's chassis. Less expensive ones (and even disposable ones) are also available.

The wrist strap attaches to the computer's chassis by means of a high-tech device commonly known as an alligator clip. Connect the alligator clip to an unpainted, metal part of the computer chassis, and check it frequently to make sure it hasn't fallen off.
The wrist strap may be placed on either wrist, as long as it fits snugly. Most people place it on their non-dominant wrist so it's less in the way while they are working.
Anti-static kits are sometimes called "ESD" kits. ESD stands for "Electro Static Discharge." It means exactly the same thing.

Planning Computer's Assembly Sequence

Take a few minutes to look at your computer case, motherboard, and other parts. Try to think ahead through the assembly process to determine what is the best order in which to build the machine. What you're trying to avoid is installing a component that gets in the way of installing another component later on. A few minutes of planning at this point can help prevent annoyance later. In most cases, however, the first part you will install in your homebuilt computer is the motherboard; so if you're ready,

Installing the Motherboard in your Homebuilt Computer

Installing the motherboard in your homebuilt computer usually is pretty easy (though sometimes knuckle-busting). Basically, you just line up the board with the mounting holes and rear-panel openings, and then screw it in.

Read the Manual!

Before actually installing the motherboard, be sure to thoroughly read the motherboard manual (for you young people, that's that paper thing that came in the box) to familiarize yourself with the board's layout and connections, to make absolutely sure that it is compatible with the processor and RAM that you will be using, to make sure that the jumper settings, if any, are correct, and to check for any other warnings or instructions.
In most cases, you won't actually have to do anything to the motherboard. Most modern motherboards have a "jumper-free" option that can be selected (usually by setting a jumper, amusingly enough) that will allow you to control the

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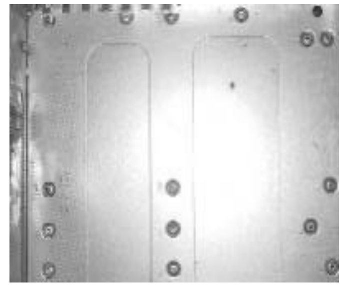
motherboard settings from the keyboard during CMOS setup. When setting a jumper is required to enable the jumper-free settings, that jumper is *usually* pre-set that way from the factory.

Determine Mounting Holes you will be using



About the only difficult part of installing a motherboard is matching up the mounting holes in the mobo with the ones on the case.

In theory, the mounting hole locations are standardized within a given form factor; but in practice, it's a rare thing to find a case and motherboard whose mounting holes exactly correspond. More often, you will have to look at the mounting holes in the motherboard to determine which mounting holes on the case you will be using. Its good practice to use all of the motherboard's mounting holes, but you probably won't use all of the case's mounting holes. Chances are that the case will have "extra" holes to accommodate different boards.

Installing the Standoffs

Once you have determined which mounting holes you will be using, you will need to insert *standoffs* in the corresponding holes in the computer case. Chances are that some of them will already be installed, and you will have to install the rest.

There are several types of standoffs, with the ones on the right being the most common. The purpose of standoffs is to separate the back of the motherboard from the metal case. You install the standoffs in the mounting holes in the case that correspond to the holes in your motherboard.

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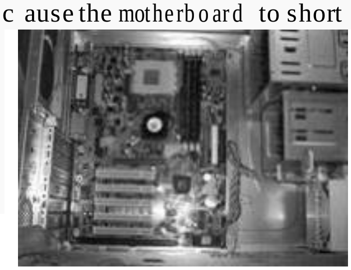
If you don't install the standoffs, then you will most likely damage your motherboard when you try to install it.

The standoffs are screwed or inserted into the chassis, and the mobo in turn is attached to the standoffs through the mounting holes in the motherboard. This creates a small space that prevents the back of the motherboard from shorting out against the metal case.

Again, don't be surprised if your motherboard has "extra" holes for which there are no corresponding holes in the case. This is normal. Very few cases and motherboards will match exactly. As long as you use all the mounting holes that *do* match, you'll be fine. (And there's no charge for the extra holes.)

Standoffs must NEVER be inserted into any of the "extra" holes, however. Standoffs installed in holes on the case that don't have corresponding holes in the motherboard can cause the motherboard to short out.

Install the Motherboard



Once you have the correct standoffs inserted, lay the motherboard into the case, line up the mounting holes and the rear-panel connectors, and screw it down.

Usually, the easiest way to install a motherboard is to lay the motherboard over the standoffs slightly forward of the rear panel connectors, then slide it back into the rear panel connectors until the mounting holes line up. Make sure that you're not snagging any wires, and then screw the board down.
Don't over tighten-the screws! You will crack the motherboard if you do, and then it will be useless! The screws should be snug, not excessively tight. Use a standard screwdriver, not an electric one. This is delicate stuff we're doing here.

Attach the Power Connectors

Finally, connect the ATX power connector from the power supply to the motherboard. Do this now. If you forget about it and later fire up your computer while the ATX connector is not connected to anything, then you will fry your computer's power supply.
On Pentium 4 and most other high-powered computers, you will also have to connect the P4 connector to the motherboard. You may also have to connect power to some high-end video cards and certain other components later on in the assembly process. If you're not sure where the connections are, read your motherboard's manual.

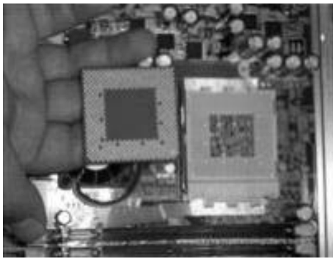
Installing the Processor

The microprocessor is often both the most delicate and the most expensive part of a homebuilt computer. As such, it deserves and requires special care. Handle processors gingerly, and never touch the pins or conductors with your fingers.

Anti Static Precautions

Processors are extremely sensitive to static charges and physical shock. A static charge that's too small for a human being to even feel can completely destroy a processor. In addition, processors can be damaged by rough handling or being dropped.
So never handle a processor roughly, never touch the pins, and never handle it unless you are using proper anti-static precautions.
Handle the processor carefully, holding it only by the edges. Set it down only on an anti-static mat or on the foam pad that it was shipped in. Be kind to your processor, and your processor will be kind to you.

Inserting the Processor Correctly



Processor sockets are keyed to prevent improper installation. But because they're so delicate and the pins so fine, it's really, really easy to permanently damage them if you're not careful.
Notice in the picture on the right that both the processor and the socket have two corners without pins. This is to prevent the processor from being installed the wrong way. All processors have some system to prevent improper insertion, but they're not all the same. Sometimes you have to look at the pins, and sometimes you have to line up an arrow. Whatever the case, look carefully *before* you insert the processor to make sure that you're inserting it correctly. If your processor came with a manual, read it.
Modern processor sockets have a ZIF (Zero Insertion Force) design. If the processor is aligned properly with the socket, gravity alone should cause it to drop right into the socket. You should

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never need to use force greater than a gentle nudge with a single finger (and the pinky finger, at that) to insert a modern processor. Never, never, never.

Some processors have no pins. Instead, they have little bumps that make contact with the CPU socket. They look like pimples and dimples. This design makes it nearly impossible to break the chip while installing it, but it does sometimes cause problems if dust, hair, or other debris finds its way to the socket. Canned air solves the problem.

Most processors are secured by a bail mounted alongside the socket. Once you've lined up the pins and allowed the processor to drop into the socket, check to make sure that the processor is fully inserted and not sitting crookedly.Once you are absolutely certain that the processor is seated properly, gently close the bail to secure the processor.

If you encounter too much resistance, stop and check again to make sure that the processor is lined up correctly. If you close the bail while the processor is not seated properly, you probably will ruin both the motherboard and the processor.

Finished? Congratulations! Now take a breather and a swig of your favorite beverage and prepare for the next step: Installing the CPU Cooler.

Installing the CPU Cooler

Today's fast processors generate a tremendous amount of heat. Without a CPU cooler, a processor would burn out in mere seconds.

Inadequate cooling also can result in data errors, performance problems, and reduced processor life. CPU manufacturers typically provide lists of "approved" coolers for their chips. These coolers may or may not be any better than other coolers, but using a non-approved cooler *might* void the CPU's warranty.

To extend your homebuilt computer's life and maximize its performance while not running the risk of voiding the CPU warranty, I recommend that you use the best cooler you can find that has been manufacturer-approved for your particular processor. The processor cooler is not a place to skimp.

Parts of a CPU Cooler

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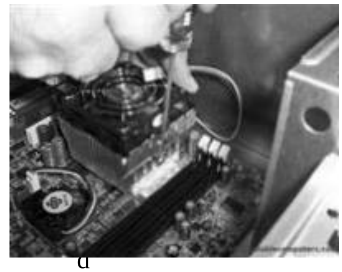
Most CPU coolers are composed of three parts: A fan, a heat sink, and a mounting device that attaches the cooler assembly to the motherboard directly over the processor. A fourth element of the cooling system is something called "heat sink compound" or "thermal jelly," which is applied between the heat sink and the die of the processor to improve heat transfer from the processor to the heat sink.

Many heat sinks come with a patch of heat sink compound pre-applied to the heat sink itself. The actual compound is covered with a little plastic tab during shipping. If you are using a heat sink with pre-applied heat sink compound, then you need to peel the protective tab off the heat sink prior to installing the cooler. Forgetting this simple step can cause serious damage to your processor. If your heat sink doesn't have pre-applied compound, you will need to apply a thin coating of heat sink compound directly to the processor die. This also applies if, for some reason, you have removed and are replacing the heat sink.

The old compound must be completely are carefully removed and new compound applied before replacing the cooler. Don't use steel wool or abrasives of any sort! Just wipe the jelly off the processor and the heat sink with a clean, lint-free cloth or paper towel.

I suggest you use a high-quality thermal jelly. Arctic Silver is my personal favorite. The difference in price is trivial, and high-quality thermal jelly will help keep your processor cool and comfy.

Mounting the CPU Cooler



The CPU cooler assembly is positioned over the processor and is usually secured to the motherboard by metal clips that hold the heat sink down tightly against the processor.

Notice that on bail-type sockets, both the socket and the heat sink are offset from center a little to accommodate the bail. Make sure you install the cooler with its offset on the same side as the offset on the socket.

Use a slotted screwdriver too gently, but firmly, hook the retaining clips under the tabs on the processor socket. Be very careful not to let the screwdriver slip. If it scratches the surface of the motherboard, the mobo could be ruined. Some cooling assemblies use plastic clips that simply slide straight down over the processor and snap into place. These types of assemblies usually don't require any tools to install.

Don't forget to plug in the fan! In most cases, it will plug into a three-pin connector on the mother board that is (appropriately enough) labeled "CPU Fan" in teensy-weensy letters. This is to allow the computer to control the fan speed based upon how hard the processor is working.

If you want, you can "hotwire" the fan using an adaptor that directly connects it to the power supply, which causes it to spin at full speed all the time. I don't recommend this for most users. It creates a lot of noise, uses more power, and causes the fan to wear out sooner. Some people also believe you can "overcool" the CPU by running the fan at full speed all the time. I personally don't think that's possible unless you're using the computer outdoors in Antarctica, but some people disagree. In most cases, you also can disable the fan speed control in CMOS setup, which has the same effect as hotwiring the fan, and which I also don't recommend.

Chipset Coolers

Most modern motherboards also have a chipset cooler, at least on the Northbridge chipset. These are almost always factory-installed and are adequate for all but the most intensive use. Just blow the fan out with canned air once in a while, and replace it if it stops spinning or starts making noises.

If you do find it necessary to replace or upgrade the factory-installed chipset cooler, the process is basically the same as installing a CPU cooler. The main difference is that chipset coolers usually are fastened to the motherboard using spring fasteners or plastic retainers rather than a metal clip. You may need to have access to the back of the motherboard to remove the fasteners, and you may have to install new fasteners if the old ones can't be removed without breaking them

Liquid CPU Cooling Systems

Water cooling is not a new idea. Liquid cooling systems have been around since the earliest days of mainframe computing, when every IT department had a plumber on call. Nowadays, liquid CPU cooling systems are popular mainly among PC builders who use their computers for gaming or other processor-intensive applications.

Not being much of a gamer myself (although I do love Microsoft Flight Simulator), my cooling needs tend not to be very intense. And frankly, I really haven't come across a system that worked so hard that a good fan-type cooler wasn't enough. Also, I'm a little skittish about mixing water and electronics; so most of the time I use good, old-fashioned air cooling.

But if you plan to over clock (also something I frown upon) or otherwise push your CPU to the edge, then liquid cooling can buy you a few critical degrees of extra cooling. That can make a difference while you are, for example, in the heat of battle, saving the world from invaders from outer space.

Okay, now that we've installed the cooler, let's move on to the next step: Installing RAM.

Installing the RAM (Memory) Modules

Anti-Static Precautions

Like processors, RAM modules are extremely sensitive to static charges and should be handled very carefully. Never touch the metal conductors, and only handle RAM modules by their edges. Nothing feels quite as bad as destroying a perfectly good stick of RAM.

You can learn more about anti-static precautions here.

Before actually installing the RAM modules in your computer, check again to make sure that the RAM you have is of the correct type and speed for your motherboard. Most computers nowadays use DDR-II or DDR-III memory modules, but double-check to make sure.

Proper Insertion of the RAM Modules

RAM modules are keyed with little notches that fit over corresponding tabs in the RAM slots. We've circled them in the picture on the right (click the picture for a close-up).

Before inserting the RAM module, make sure that the notches and tabs are correctly lined up. If there are more notches than there are tabs (or vice-versa), then you have the wrong RAM for your motherboard. Same thing goes for if the notches and tabs don't match up. You have the wrong RAM, and all the force in the world won't make it the right RAM.

Once you're sure you have the right RAM, to actually insert it, simply push it firmly, straight down into the slot, and push the retainer clips inward. That's it.

Which Slots to Use

If you are using SDRAM or single-channel DDR-SDRAM, then it usually doesn't matter which modules go into which slots. But a few motherboards require that you start with the first slot and fill them in order, so you may as well do it that way.

If you are using DDR memory in dual-channel configuration, however, then you must fill the first slot of each of the two RAM banks with an identical stick of RAM; and you must do the same with the second slots of each bank, if you are using them. The RAM sticks in each bank *must* be identical to each other. In addition, although it is not required, I recommend that the two banks also be identical.

In other words, a mother board that supports dual-channel DDR will usually have two (or more) RAM banks, which usually are identified by different color slots. Each bank has two slots, and both slots in each bank must have identical RAM. So if you put a 1 GB stick of PC2-5300 667MHz DDR2 in the first slot, then you must also put a 1 GB stick of PC2-5300 667MHz DDR2 in the second slot in order to use the dual-channel configuration.

If you choose to use the additional banks, then the same rule applies. Each stick in the bank must be identical, but the banks need not be identical to each other. In practice, however, I usually just fill all the slots with identical RAM sticks. Makes life easier, and I find I get far fewer conflicts this way.

When using SDRAM or DDR-SDRAM, any unused RAM slots are simply left empty. But if you are using RAMBUS RIMM modules, then you will have to install "continuity modules" in any unused RIMM slots. Remember: RAMBUS modules *must* be installed in identical pairs.

Manufacturers and Speeds

In theory, it shouldn't matter if the RAM modules installed in a computer are made by different manufacturers, as long as the type and speed are the same. There are standards for this sort of things, so memory from different manufacturers *should* be compatible. But sometimes subtle differences between manufacturers can cause problems; so I recommend that you purchase RAM made by the same manufacturer, if possible.

Also in theory, when different speed RAM modules are used, all of the RAM should clock to the speed of the slowest module. But in reality, I've found that mixing RAM speeds sometimes causes system instability. I've had plenty of cases where RAM sticks that tested just fine alone wouldn't play well together. So I *strongly* recommend that the entire RAM installed in your computer be of the same speed. In fact, in practice, I just use all identical sticks in any given computer. Whenever possible, I'll even remove perfectly good RAM when doing an upgrade, just so all the sticks I install are identical. (And again, you *must* use RAM pairs of identical size and speed when using RAMBUS or dual-channel DDR.)Now that you've installed your computer's RAM, let's move on to the next step: Installing Expansion Cards.

Installing Expansion Cards

Depending on the motherboard you have purchased, you may need to install one or more expansion cards. Many new motherboards have audio, video, and network "cards" built right into them. But if not (or if you don't want to use the integrated cards), then you will need to install expansion cards. If your board has integrated cards that you don't plan to use, you should disable them in BIOS, both to avoid possible conflicts and to avoid wasting resources on a component that's not being used.

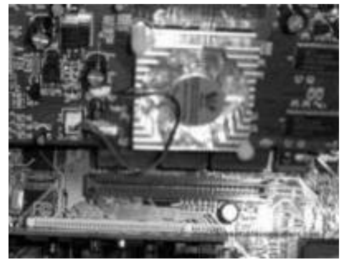
Precautions

Like any other component in your homebuilt computer, you should make sure that the cards you are about to install are compatible with your motherboard and with the operating system you plan on installing.

Compatibility becomes especially important when selecting AGP video cards, because the voltages for the different AGP standards are different. So be especially careful that your motherboard is capable of supporting the video card you have selected before you attempt to install it, and check to see if there are any motherboard jumpers you have to set for the card you are installing.

In addition, always be sure to observe anti-static precautions when handling expansion cards. Nothing is quite as depressing as totally destroying an ex pensive card b ecause you forgot to ta ke anti-static precautions.

Proper Insertion of Expansion Cards



Like RAM, expansion cards and slots a re keyed. They have little notches with corresponding tabs in the slot that are designed to prevent you from installing the wrong card.

So if the card doesn't seem to fit, check those notches and tabs. Don't break out a hammer and try to pound it in. You probably are trying to insert the wron g kind o f card (or insert the card in the wron g kind of slot).

Notice in the picture on the right that the AGP video slot is set back from the rest o f the slo ts and is of a diff erent size. In addition, the various ridges, tabs, and so fort h on the card and t he slot are intended to he lp prevent incorrect insertion or incompatible cards. You should read the documentation for your motherboard and cards to make sure they are compatible.

The card shown in this picture is a network card that fits into the PCI slot. Notice that it is keyed to the slot. (Also note that the card is onl y slanted to make it easier for you to see the slot. Expansion cards, like RAM, are pushed straight down into their slots, like in the next picture down.)

It *usually* doesn't matter which PCI cards are installed in which slots. But sometimes it does, depending on how a particular motherboard and OS manage shared resources. So before installing PCI cards, check the motherboard and expansion card manuals for any recom mendations for slot assignments; and if one of more of your cards don't work (or if the y cause system instability), try changing the slots before you trash the cards. Sometimes that's all it takes.

Once you have determined which cards will be installed in which slots, actually installing them is simple. Place the computer on its side so the slots on the motherbo ard face up, align the card in the slot perpendicular to the motherboard (that is, straig ht up, bec ause the computer is on its side), and p ush down until you feel the card "pop" into place.

You may have to use some oo mph here. If the card doesn't seat itself using fingertip pressure, place your palm over the card and push down firmly and evenly until you feel the card pop into place. But first check the slots, notches, and tabs to make sure you're not trying to install the card in the wrong slot.

Finally, secure the card into place by screwing the card's metal bracket into the screw hole over the expansion slot opening on the back of the case. Some cases don't use screws, and instead have some sort of metal or plastic clip that holds the card (or all of them, sometimes) in the motherboard. Usually this is obvious, but checks the manual that came with the case if you're confused.It's a good idea to save the slot covers

to cover the holes in case you ever decide to remove the card. Using electrical tape looks tacky and unprofessional.
Some cards may have additional connections that have to be made, such as the cable that connects a CD-ROM drive to the sound card, or a power connector for some high-powered video cards or audio break-out cards. Now let's proceed to the next step, Installing the Hard Drives.

Installing Your Computer's Hard Drive

There are several different types of hard drives you can use in your homebuilt computer. At the time of this revision, EIDE drives are being used less and less, and SATA (Serial ATA) drives are becoming the new standard. And of course, SCSI drives are still available, though few home users choose SCSI because of their high cost.
This page illustrates the installation of both EIDE and SATA drives. SATA hadn't really caught on when this computer was built. Also, installing an EIDE hard drive is slightly more involved than installing a SATA drive, and some people still use them. Although the physical installation is the same (there are only so many ways to tighten four screws, after all), SATA drives use different cables and connectors, and SATA drives don't require master/slave relationships, and therefore have no jumpers to set.

IDE Hard Drive Configuration

If you are using EIDE drives, then you will have to set the jumpers to match the drive's configuration before you physically install the drives in the computer. If you haven't yet done this, then please click here for detailed instructions before proceeding any further. (And if you're using SATA drives, ignore all this talk of jumpers.)

Physically Installing a Hard Drive

The case that we're using has a detachable "cage" for the hard drives. The cage is first removed from the case, the drives are mounted into the cage, and the cage is reattached to the case. This design helps reduced scraped knuckles from working in tight spaces and avoids the need to remove the side of the case behind the mother board to access the mounting screws.
I always prefer this sort of case design, all else being equal. It makes it a lot easier to remove and replace the drives if the need arises or if you want to upgrade in the future. But if you plan on installing *a lot* of drives in your new computer, then you're probably better off with a server-style case that has built-in bays for them.

The hard drive is mounted in the cage using four mounting screws. Make sure that you use the correct holes so that the cage will fit back in the case properly, and don't force the screws! Most hard drives are made of soft alloys that strip easily. If the screw doesn't want to turn, try turning it backwards until it seats itself.
If you are mounting a front-accessible drive (such as a floppy drive or ZIP drive) in the same cage, then make sure you mount the front-accessible drive in the position behind the opening in the front of the case. Again, don't overtighten the screws! Hand-tight is plenty.

Once you have screwed the drive into the cage, re-attach the drive cage into the computer case. (Click here for a handy trick to insert those hard-to-reach screws.)
A lot of people ask me, "Is it really necessary to use all four screws to mount the hard drive?" The amswer, alas, usually is yes. Using four screws reduces the chances of annoying buzzing caused by vibrations. So even though it can be a pain to reach the screw holes sometimes, you really should try to use all four mounting screws. It's just more professional. Some cases use friction mounts or rubber bushings to reduce vibration. Using them will help reduce your computer's noise and may help protect the hard drive from vibrations.

Connecting EIDE (PATA) Hard Drive Cables

Now we're ready to connect the data cables and power cables. EIDE drives use flat, ribbon cables, or the newer-style rounded cables. SATA drives use thinner, flexible cables that are easier to route through the case and that improve airflow.

For this demonstration, we're using old-fashioned ribbon cables. EIDE hard drives use an 80-conductor cable that usually has color-coded connectors. The black connector gets connected to the master drive, the gray to the slave drive (if any), and the blue to the motherboard. If the connectors are not color-coded, then the one off-center in the middle gets connected to the slave drive, the one on the end closest to the one in the middle gets connected to the master drive, and the one on the end farthest from the middle connector gets connected to the motherboard or IDE controller card.
Let's pause for a moment to clarify the difference between *primary* and *secondary*, versus *master* and *slave*. Some people are uncomfortable with the "master" and "slave" terminology, and use "primary" and "secondary" instead, thinking the two terms mean the same thing. But although they may be well-meaning, they're wrong. Primary and secondary refer to the two controllers on the motherboard, each of which can handle two drives: a master and a slave. So if all four drives are installed, there will be two masters and two slaves, one of each on both the primary and secondary controllers.
If it really bothers you, then just set all the drive jumpers to "CS" (for "Cable Select") and be done with it. That's what I usually do anyway. Just be sure to attach the correct connectors to each drive. Check here for more information about hard drive jumper settings.

You'll notice a colored stripe along one edge of the ribbon cable. This stripe must line up with pin Number 1 on both the IDE controller and the drive.
If pin Number 1 is not clearly marked on the device itself, then look in the manual or instructions. (On hard drives, pin 1 usually -- but not always -- is the one closest to the power connector.)
Most EIDE drive cables also have little raised grooves that fit into a little notch on the connector to insure that they are attached properly, but sometimes these are absent. If you attach the drive cable improperly, the drive will not work, and it may be permanently damaged.

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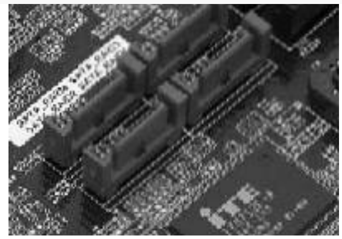
Attach the cables firmly, but gently, by pushing them straight onto the connectors on the drives and the motherboard. Make sure that the pins line up before you push. If you break a pin, you will permanently ruin the drive or motherboard.

Connecting SATA Drives



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If you are using a SATA (Serial ATA) drive, you don't have to worry about jumper settings or clumsy ribbon cables. The connectors on the motherboard will look like those in the picture on the right.

The first drive on the primary SATA controller should be connected to the system hard drive. Other than that, it really doesn't make much of a difference which connectors you use for the other drives.

Once again, the cable should be inserted straight down into the connector. Don't force it! If it doesn't seem to want to go in, make sure that the cable is properly oriented on the connector. SATA connectors are keyed to prevent improper insertion, so if it doesn't fit easily, you're probably trying to attach it backwards. If you force it, you'll break it, and your expensive new motherboard will be ruined.

Connecting the Power Cables

Finally, attach the power connectors to the drives. Make sure that the power connectors are attached using the correct polarity. The sockets and connectors are shaped so that they should only fit the correct way unless you force them. So don't force them. If it doesn't fit without forcing, then you probably are trying to connect it backwards!

If you fire up the computer while a drive power connector is attached backwards, you will immediately and permanently destroy the drive, and possibly the power supply and/or the motherboard. So make sure you double check to make sure that all the connectors are attached properly. Next, let's look at Installing Auxiliary Drives.

Installing Auxiliary Drives in your Computer

There are several different types of auxiliary drives available for your homebuilt computer, such as CD-RW and DVD-RW drives, ZIP drives, tape drives, and drive-like devices such as card readers. The installation procedures for all of these devices are quite similar.

For this demonstration, we will be installing a CD-RW drive on an EIDE interface. Other types of interfaces also are available (SATA and SCSI). The process is exactly the same for installing a device like a card reader, except that there may be an additional connection to the USB header on the motherboard, or to an add-on card.

Like any other EIDE device, the first step in installing a CD-RW drive is to decide where it will be positioned in your particular drive configuration (that is, as a master or a slave), and to set the jumpers accordingly. If you don't remember how to do this, please review the pages on hard drive configuration, which begin here. (And if you're using all SATA drives, ignore all this talk of masters, slaves, and jumpers.)

Once you have decided on the drive configuration and have put the jumpers where they belong, you can begin to physically install the drives. When deciding where to place the drives, keep both convenience of use and cable routing in mind.

In most cases, you'll have to remove both a plastic cover and a metal plate from the drive bay where you will be installing the drive. Most often, you do this by removing the plastic cover, and then prying the metal plate from the rest of the case using a screwdriver. Always wear eye protection when doing this, and please be careful not to cut yourself and get blood all over your new computer.

The next step is to insert the drive in the case. This is *usually* easiest to do from the front. Gently slide the drive back until its faceplate is flush with the front of the case.

Be careful not to catch the drives faceplate against the bezel of the case, or you may mar or damage the drive or the case. Also, don't push too hard. If the drive won't go in all the way, check to see what's blocking it before pushing like Samson.

Also be careful that the drive, once inserted, doesn't come too close to fans or push up against motherboard components. Some drives are slightly longer than average, and if you push them in fully without looking first, you may damage something on the motherboard.

Finally, secure the drive into place with the mounting screws, and connect the data and power cables.

The power and data cable connections are made in the same way as when installing a hard drive, but there's less consistency regarding power connectors on optical drives. Some still use Molex connectors, some use SATA connectors, and a few even use old-fashioned floppy-type power connectors. Some optical drives also have a legacy audio connector that connects to the sound card. It's obsolete technology and chances are that you don't need it. But it does no harm to connect it if your sound card or motherboard has a connector for it.

Installing the Cabinet Fan

While we're at it, let's also install the cabinet fan. On our case, the cabinet fan is mounted in a fan shroud, which is in turn snapped into the computer case. Other cases simply have holes for the fan to be directly mounted to the case using special screws that come with the fan.

Some people always mount the cabinet fans to blow the air outward, to avoid sucking dust into the computer. Others say you should install the front panel fan to draw the air inward, and the rear panel fan to blow the air outward. We say it depends. If the computer is going to be used in a dusty place, point the fan to blow the air out to avoid dust. If not, then point it in to increase airflow.

Either way, a cabinet fan or two will go a long way towards keeping your computer cool and comfy. Next, let's install the Panel Connectors

Installing the Front Panel Connectors

We're almost finished! One somewhat tedious but vital step in assembling your homebuilt computer is to connect all those little wires for the front-panel switches and LED's from the case to the motherboard.

If you purchased a "barebones" computer with the motherboard already mounted, then this was probably done for you already. Otherwise, you'll have to do it yourself. Hopefully, you have good eyes and can read the tiny lettering on both the connectors and the motherboard.

Each switch and LED on the front panel has a connector attached to it that must be connected to the appropriate pins on the motherboard.

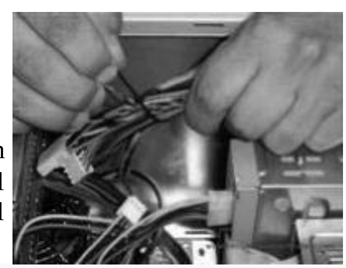
Some of the connectors (especially the LED's) are polarized, meaning that they have to be connected in the correct polarity. Polarized connectors have a little arrow or a plus sign by the positive wire, but no keyway to prevent you from attaching them backwards. Long story short: If one of your LED's doesn't work (or if it stays lit all the time), chances are that you attached it backwards. If so, simply correct it.

Unfortunately, there's no universal rule about the positions of these pins. To determine the correct pins to attach the connectors to, you will have to consult the motherboard manual or look for the teensy lettering on the motherboard adjacent to the pins.

The basic front panel headers found on most motherboards is those for the PC speaker (the one built into most cases that beeps when the computer passes POST), the power switch, the reset switch, the hard drive activity LED, the power LED, and sometimes a few others. Of these, the leads for the LEDs *must* be connected in the proper polarity in order to work properly. The rest *should* be connected in the proper polarity just for the sake of doing things professionally, but they will work even if they're attached backwards.

Time to Double-Check

Before firing up your new computer, take a few moments to double check the following items:



- Check all the fans to make sure they are properly connected. Starting up your computer with the CPU fan disconnected will likely kill your processor!
- Make sure that all wires and cables are safely tied away from the fans. Neatness counts. Use plastic cable ties, not metal twist-ties. If you can't get plastic cable ties, then use electrical tape.
- Check that all of the power and data cables are securely connected and are attached in the correct polarity.
- Make sure that there are no tools, screws, or jumpers floating around in the case.
- Check that all expansion cards and RAM modules are securely seated.

Get Ready for the Moment of Truth
Everything checks out okay? Great! Now comes the moment of truth: Get ready to start up your homebuilt computer for the first time!

Starting Up Computer
Before starting your computer for the first time, take a moment to check, yet again, that everything is properly connected and seated inside the box. Make sure the wires aren't blocking the fans. Makes sure there are no screws rattling around, and that you didn't leave any tools inside the machine.
I know, you did that already on the last page.
Do it again anyway. Humor me.
Now look on the back of the computer on the power supply. Chances are that you will see a little slider switch. Make sure that this switch is set to the correct voltage for your part of the world.
In the United States, the correct power setting will be 110 - 120 volts. In your part of the world, well, I have no idea. Ask someone local if you are unsure. Plug the power cord into the power supply, and the other end into a surge-protected AC power source or a battery backup. Hook up the keyboard, monitor, and mouse to their appropriate connectors, and press the power button.

The CMOS Setup Screen
If you have done everything correctly, after a few seconds you will hear a delightful beep as the computer passes its very first POST (Power-On-Self-Test), and you may be greeted by a screen that looks something like the one on the right. (You may have to press DELETE, F2, or some other key to get to this screen, depending on your motherboard. Read the manual.)
If you see something that looks like the picture shown here, then pat yourself on the back. And exhale. Your homebuilt computer is alive!

What you are seeing is something called the CMOS setup screen (or the BIOS setup screen). This is all your computer is capable of doing until you install an operating system on it, and the settings you select will affect the way your OS performs. Most computers come with CMOS settings designed for Windows, so you may not need to do anything at all.
That's good for me, because there are too many BIOS versions out there for me to really guide you along at this point. You'll simply have to read the motherboard manual and follow the instruction given there
But here are a few basic suggestions:

1. Start with the default settings. You can tweak them later if you like. Just check to make sure that the time and date are correct. You can use local time or Coordinated Universal Time (Greenwich Time). Most Windows machines use local time, and most UNIX and Linux machines use Greenwich Time; but either will work either way.
2. If you don't know what something means, leave it alone. Use the default settings unless you know what you are doing.
3. Make sure that all of your drives are showing up. If not, then shut down the machine, unplug it, and check all your drive connections and jumper settings again.

4. Before installing your operating system, make sure that the CD-ROM drive is set as a bootable device (unless you will be booting from a floppy for the installation, in which case make sure the floppy drive is set as a bootable device). You can usually find the settings for the boot sequence in a section of the CMOS screen called, appropriately enough, Boot Sequence.
5. Make sure the date and time are correct before installing the OS. Incorrect dates and times can cause all sorts of problems.

Once you've finished CMOS setup, saved the settings, and rebooted, you're ready to install the operating system.

What if it doesn't work?

Stay calm. And don't cry. Unless you're a little kid. Then you can cry if you want. The most common reason why a new computer doesn't work is that something isn't connected or seated properly. Here are a few very general tips about where to start looking:

- If absolutely nothing happens when you push the power button, then chances are that the power supply isn't connected, the voltage switch is in the wrong position, or there is a toggle switch on the back of the power supply that is in the off position. (Check to make sure the computer is plugged into the AC power, as well. You wouldn't believe how often people forget to plug the machine in.)
- If the LED's light up and the fans start turning, but nothing else happens, then most likely either the processor or the video card is not properly seated. Power down, reseat them, and try again.
- If the computer begins to fire up, but then emits a shrill alarm, power down the computer and re-seat the RAM modules and peripheral cards. If that doesn't work, then check the motherboard manual to see what the alarm means. (Different combinations of beeps mean different things, but the codes are different on different motherboards, just to keep us geeks on our toes.)
- Sometimes, two expansion cards sharing the same resources can prevent a computer from booting. If everything else checks out, remove all of the expansion cards except the video card, and try to boot up again. Then re-install the cards one-by-one, starting the machine after each card is installed to identify the problem card. Sometimes just moving the cards from one slot to another will make them work. Power down and unplug the computer every time you install or remove an expansion card.
- Most motherboard manuals include helpful diagnostic and troubleshooting information. Consult the manual before you get depressed. Most problems are simple ones that can be easily corrected.

We hope you've enjoyed building your own computer. It's been a lot of fun for us.

Chapter - 15
Computer Virus

Objectives of learning:

- What is Computer Virus:
- What Does A Virus Do:
- How Does A Virus Spread:
- Infection strategies:
- Virus Example
- Anti Virus Technologies:
- Recovery methods
- Types Of Viruses:
- Tips to protect your PC from viruses:

Introduction

A computer virus is a computer program that can copy itself and infect a computer. The term "virus" is also commonly but erroneously used to refer to other types of malware, including but not limited to adware and spyware programs that do not have the reproductive ability. *VIRUS stands for Vital Information of Resources Under Siege* true virus can spread from one computer to another (in some form of executable code) when its host is taken to the target computer; for instance because a user sent it over a network or the Internet, or carried it on a removable medium such as a floppy disk, CD, DVD, or drive. Viruses can increase their chances of spreading to other computers by infecting files on a network file system or a file system that is accessed by another computer. As stated above, the term "computer virus" is sometimes used as a catch-all phrase to include all types of malware, even those that do not have the reproductive ability. Malware includes computer viruses, computer worms, Trojan horses, most rootkits, spyware, dishonest adware and other malicious and unwanted software, including true viruses. Viruses are sometimes confused with worms and Trojan horses, which are technically different. A worm can exploit security vulnerabilities to spread itself automatically to other computers through networks, while a Trojan horse is a program that appears harmless but hides malicious functions. Worms and Trojan horses, like viruses, may harm a computer system's data or performance. Some viruses and other malware have symptoms noticeable to the computer user, but many are surreptitious or simply do nothing to call attention to them. Some viruses do nothing beyond reproducing themselves.

Virus programs:

The Creeper virus was first detected on ARPANET, the forerunner of the Internet, in the early 1970s. Creeper was an experimental self-replicating program written by Bob Thomas at BBN Technologies in 1971. Creeper used the ARPANET to infect DEC PDP-10 computers running the TENEX operating system. Creeper gained access via the ARPANET and copied itself to the remote system where the message, "I'm the creeper, catch me if you can!" was displayed. The *Reaper* program was created to delete Creeper.

A program called "Elk Cloner" was the first computer virus to appear "in the wild" — that is, outside the single computer or lab where it was created. Written in 1981 by Richard Skrenta, it attached itself to the Apple DOS 3.3 operating system and spread via floppy disk. This virus, created as a practical joke

when Skrenta was still in high school, was injected in a game on a floppy disk. On its 50th use the Elk Cloner virus would be activated, infecting the computer and displaying a short poem beginning "Elk Cloner: The program with a personality."
Before computer networks became widespread, most viruses spread on removable media, particularly floppy disks. In the early days of the personal computer, many users regularly exchanged information and programs on floppies. Some viruses spread by infecting programs stored on these disks, while others installed themselves into the disk boot sector, ensuring that they would be run when the user booted the computer from the disk, usually inadvertently. PCs of the era would attempt to boot first from a floppy if one had been left in the drive. Until floppy disks fell out of use, this was the most successful infection strategy and boot sector viruses were the most common in the wild for many years.
Traditional computer viruses emerged in the 1980s, driven by the spread of personal computers and the resultant increase in BBS, modem use, and software sharing. Bulletin board-driven software sharing contributed directly to the spread of Trojan horse programs, and viruses were written to infect popularly traded software. Shareware and bootleg software were equally common vectors for viruses on BBS's.
Macro viruses have become common since the mid-1990s. Most of these viruses are written in the scripting languages for Microsoft programs such as Word and Excel and spread throughout Microsoft Office by infecting documents and spreadsheets. Since Word and Excel were also available for Mac OS, most could also spread to Macintosh computers. Although most of these viruses did not have the ability to send infected email messages, those viruses which did take advantage of the Microsoft Outlook COM interface.
Some old versions of Microsoft Word allow macros to replicate themselves with additional blank lines. If two macro viruses simultaneously infect a document, the combination of the two, if also self-replicating, can appear as a "mating" of the two and would likely be detected as a virus unique from the "parents".
A virus may also send a web address link as an instant message to all the contacts on an infected machine. If the recipient, thinking the link is from a friend (a trusted source) follows the link to the website, the virus hosted at the site may be able to infect this new computer and continue propagating.
Viruses that spread using cross-site scripting were first reported in 2002, and were academically demonstrated in 2005.There have been multiple instances of the cross-site scripting viruses in the wild, exploiting websites such as MySpace and Yahoo.

What Does a Virus Do?

The task of a virus is not always destructive like deleting files that may be important or something like causing your hard drive to crash. Many viruses these days are more interested in harvesting information from your computer and or using it as a zombie for their intentions like spam or other illegal purposes. In times past it was often the intention of a virus to do damage just for the sake of destruction and maybe bragging rights among peers but almost all viruses today that are widespread have at their root some economic agenda.

How Does a Virus Spread?

One of the intents of all types of computer viruses that get installed on your computer will be to spread itself. This happens in a fashion that is not all that different from what happens with a virus in the human population. It is through exposure that the virus spreads when the computers defenses are down or nonexistent. Also like their biological counterpart the computer virus can be spread rapidly and are not very easy to get rid of.

Because the way a virus operates is to be stealthy, coupled with the rapid communications that happen between today's computers, it is easy to dramatically increase the speed at which a virus that is targeting a newly discovered vulnerability can move around the web and around the world. A virus that targets a network of computers can even more easily spread since so many computers are connected and most likely will have the same vulnerability and easy access to one another. Often viruses will spread via shared folders, email or over other media that is often exposed to other computers via removable media like cds and flash drives. Because there are so many types of computer viruses, a virus can infect another computer unintentionally anytime that program is run and the virus is activated. Something like opening a email attachment or downloading a file off the internet or giving or receiving a copy of a program or file from a co-workers thumb drive can expose you and others to a computer virus. Literally the gamut of these types of computer viruses can expose you whenever you have a downloaded file or a external drive attached to your pc. The most common way they spread is via email attachments or with the use or transfer of files via instant messaging.

Infection strategies:

In order to replicate itself, a virus must be permitted to execute code and write to memory. For this reason, many viruses attach themselves to executable files that may be part of legitimate programs. If a user attempts to launch an infected program, the virus' code may be executed simultaneously. Viruses can be divided into two types based on their behavior when they are executed. Nonresident viruses immediately search for other hosts that can be infected, infect those targets, and finally transfer control to the application program they infected. Resident viruses do not search for hosts when they are started. Instead, a resident virus loads itself into memory on execution and transfers control to the host program. The virus stays active in the background and infects new hosts when those files are accessed by other programs or the operating system itself.

Nonresident viruses

Nonresident viruses can be thought of as consisting of a *finder module* and a *replication module*. The finder module is responsible for finding new files to infect. For each new executable file the finder module encounters, it calls the replication module to infect that file.

Resident viruses

Resident viruses contain a replication module that is similar to the one that is employed by nonresident viruses. This module, however, is not called by a finder module. The virus loads the replication module into memory when it is executed instead and ensures that this module is executed each time the operating system is called to perform a certain operation. The replication module can be called, for example, each time the operating system executes a file. In this case the virus infects every suitable program that is executed on the computer.

Resident viruses are sometimes subdivided into a category of *fast infectors* and a category of *slow infectors*. Fast infectors are designed to infect as many files as possible. A fast infector, for instance, can infect every potential host file that is accessed. This poses a special problem when using anti-virus software, since a virus scanner will access every potential host file on a computer when it performs a system-wide scan. If the virus scanner fails to notice that such a virus is present in memory the virus can "piggy-back" on the virus scanner and in this way infect all files that are scanned? Fast infectors rely on their fast infection rate to spread. The disadvantage of this method is that infecting many files may make detection more likely, because the virus may slow down a computer or perform many suspicious actions that can be noticed by anti-virus software. Slow infectors, on the other hand, are designed to infect hosts infrequently. Some slow infectors, for instance, only infect files when they are copied. Slow infectors are designed to avoid detection by limiting their actions: they are less likely to slow down a computer noticeably and will, at most, infrequently trigger anti-virus software that detects suspicious behavior by programs. The slow infector approach, however, does not seem very successful.

Vectors and hosts

Viruses have targeted various types of transmission media or hosts. This list is not exhaustive:

- Binary executable files (such as COM files and EXE files in MS-DOS, Portable Executable files in Microsoft Windows, the Mach-O format in OSX, and ELF files in Linux)
- Volume Boot Records of floppy disks and hard disk partitions
- The master boot record (MBR) of a hard disk
- General-purpose script files (such as batch files in MS-DOS and Microsoft Windows, VBScript files, and shell script files on Unix-like platforms).
- Application-specific script files (such as Telix-scripts)
- System specific auto run script files (such as Autorun.inf file needed by Windows to automatically run software stored on USB Memory Storage Devices).
- Documents that can contain macros (such as Microsoft Word documents, Microsoft Excel spreadsheets, AmiPro documents, and Microsoft Access database files)
- Cross-site scripting vulnerabilities in web applications (see XSS Worm)
- Arbitrary computer files. An exploitable buffer overflow, format string, race condition or other exploitable bug in a program which reads the file could be used to trigger the execution of code hidden within it. Most bugs of this type can be made more difficult to exploit in computer architectures with protection features such as an execute disable bit and/or address space layout randomization.

PDFs, like HTML, may *link* to malicious code. PDFs can also be infected with malicious code.
In operating systems that use file extensions to determine program associations (such as Microsoft Windows), the extensions may be hidden from the user by default. This makes it possible to create a file that is of a different type than it appears to the user. For example, an executable may be created named "picture.png.exe", in which the user sees only "picture.png" and therefore assumes that this file is an image and most likely is safe, yet when opened runs the executable on the client machine.
An additional method is to generate the virus code from parts of existing operating system files by using the CRC16/CRC32 data. The initial code can be quite small (tens of bytes) and unpack a fairly large virus. This is analogous to a biological "prion" in the way it works but is vulnerable to signature based detection. This attack has not yet been seen "in the wild".

Methods to avoid detection

In order to avoid detection by users, some viruses employ different kinds of deception. Some old viruses, especially on the MS-DOS platform, make sure that the "last modified" date of a host file stays the same when the file is infected by the virus. This approach does not fool anti-virus software; however, especially those which maintain and date cyclic redundancy checks on file changes.
Some viruses can infect files without increasing their sizes or damaging the files. They accomplish this by overwriting unused areas of executable files. These are called *cavity viruses*. For example, the CIH

virus, or Chernobyl Virus, infects Portable Executable files. Because those files have many empty gaps, the virus, which was 1 KB in length, did not add to the size of the file.
Some viruses try to avoid detection by killing the tasks associated with antivirus software before it can detect them.
As computers and operating systems grow larger and more complex, old hiding techniques need to be updated or replaced. Defending a computer against viruses may demand that a file system migrate towards detailed and explicit permission for every kind of file access.

Avoiding bait files and other undesirable hosts

A virus needs to infect hosts in order to spread further. In some cases, it might be a bad idea to infect a host program. For example, many anti-virus programs perform an integrity check of their own code. Infecting such programs will therefore increase the likelihood that the virus is detected. For this reason, some viruses are programmed not to infect programs that are known to be part of anti-virus software. Another type of host that viruses sometimes avoid are *bait files*. Bait files (or *goat files*) are files that are specially created by anti-virus software, or by anti-virus professionals themselves, to be infected by a virus. These files can be created for various reasons, all of which are related to the detection of the virus:

- Anti-virus professionals can use bait files to take a sample of a virus (i.e. a copy of a program file that is infected by the virus). It is more practical to store and exchange a small, infected bait file, than to exchange a large application program that has been infected by the virus.
- Anti-virus professionals can use bait files to study the behavior of a virus and evaluate detection methods. This is especially useful when the virus is polymorphic. In this case, the virus can be made to infect a large number of bait files. The infected files can be used to test whether a virus scanner detects all versions of the virus.
- Some anti-virus software employs bait files that are accessed regularly. When these files are modified, the anti-virus software warns the user that a virus is probably active on the system.

Since bait files are used to detect the virus, or to make detection possible, a virus can benefit from not infecting them. Viruses typically do this by avoiding suspicious programs, such as small program files or programs that contain certain patterns of 'garbage instructions'.
A related strategy to make baiting difficult is *sparse infection*. Sometimes, sparse infectors do not infect a host file that would be a suitable candidate for infection in other circumstances. For example, a virus can decide on a random basis whether to infect a file or not, or a virus can only infect host files on particular days of the week.

Stealth

Some viruses try to trick antivirus software by intercepting its requests to the operating system. A virus can hide itself by intercepting the antivirus software's request to read the file and passing the request to the virus, instead of the OS. The virus can then return an uninfected version of the file to the antivirus software, so that it seems that the file is "clean". Modern antivirus software employs various techniques to counter stealth mechanisms of viruses. The only completely reliable method to avoid stealth is to boot from a medium that is known to be clean.

Self-modification

Most modern antivirus programs try to find virus-patterns inside ordinary programs by scanning them for so-called *virus signatures*. A signature is a characteristic byte-pattern that is part of a certain virus or family of viruses. If a virus scanner finds such a pattern in a file, it notifies the user that the file is infected. The user can then delete, or (in some cases) "clean" or "heal" the infected file. Some viruses employ techniques that make detection by means of signatures difficult but probably not impossible. These viruses modify their code on each infection. That is, each infected file contains a different variant of the virus.

Encryption with a variable key

A more advanced method is the use of simple encryption to encipher the virus. In this case, the virus consists of a small decrypting module and an encrypted copy of the virus code. If the virus is encrypted with a different key for each infected file, the only part of the virus that remains constant is the decrypting module, which would (for example) be appended to the end. In this case, a virus scanner cannot directly detect the virus using signatures, but it can still detect the decrypting module, which still makes indirect detection of the virus possible. Since these would be symmetric keys, stored on the infected host, it is in fact entirely possible to decrypt the final virus, but this is probably not required, since self-modifying code is such a rarity that it may be reason for virus scanners to at least flag the file as suspicious.

An old, but compact, encryption involves XORing each byte in a virus with a constant, so that the exclusive-or operation had only to be repeated for decryption. It is suspicious for a code to modify itself, so the code to do the encryption/decryption may be part of the signature in many virus definitions.

Polymorphic code

Polymorphic code was the first technique that posed a serious threat to virus scanners. Just like regular encrypted viruses, a polymorphic virus infects files with an encrypted copy of itself, which is decoded by a decryption module. In the case of polymorphic viruses, however, this decryption module is also modified on each infection. A well-written polymorphic virus therefore has no parts which remain identical between infections, making it very difficult to detect directly using signatures. Antivirus software can detect it by decrypting the viruses using an emulator, or by statistical pattern analysis of the encrypted virus body. To enable polymorphic code, the virus has to have a polymorphic engine (also called mutating engine or mutation engine) somewhere in its encrypted body. See Polymorphic code for technical detail on how such engines operate.

Some viruses employ polymorphic code in a way that constrains the mutation rate of the virus significantly. For example, a virus can be programmed to mutate only slightly over time, or it can be programmed to refrain from mutating when it infects a file on a computer that already contains copies of the virus. The advantage of using such slow polymorphic code is that it makes it more difficult for antivirus professionals to obtain representative samples of the virus, because bait files that are infected in one run will typically contain identical or similar samples of the virus. This will make it more likely that the detection by the virus scanner will be unreliable, and that some instances of the virus may be able to avoid detection.

Metamorphic code

To avoid being detected by emulation, some viruses rewrite themselves completely each time they are to infect new executables. Viruses that utilize this technique are said to be metamorphic. To enable metamorphism, a metamorphic engine is needed. A metamorphic virus is usually very large and complex. For example, W32/Simile consisted of over 14000 lines of Assembly language code, 90% of which is part of the metamorphic engine.

Virus Examples:

- I LOVE YOU Virus

– The virus only targets users running Microsoft Windows operating system, attacking the Outlook e-mail program and the Internet Explorer browser, both of which are made by Microsoft.
– Victim activates the virus by opening the e-mail, then clicking on the attachment inside.
– Best defense, is to simply leave any unusual or unknown attachments unopened.

- Code Red

– Worms use up computer time and network bandwidth when they are replicating, and the worm called Code Red made huge headlines in 2001.
– Code Red worm slowed down Internet traffic when it began to replicate itself and each copy of the worm scanned the Internet for
Windows NT or Windows 2000 servers that do not have the
Microsoft security patch installed.
– The memory resident worm, once active on a system, first attempts to spread itself by creating a sequence of random IP addresses to infect unprotected web servers.

- W95.CIH

– CIH virus, also known as Chernobyl, was first discovered in June 1998 in Taiwan.
– CIH is a destructive virus with a payload that destroys data and on
April 26, 1999, the payload triggered for the first time, causing many computer users to lose their data.
– CIH is a virus that infects the 32-bit Windows 95/98/NT executable files, but can function only under Windows 95/98 and ME.

- W32.Blaster.Worm

– W32.Blaster.Worm is a worm that exploits the DCOM RPC vulnerability (first described in Microsoft Security Bulletin MS03- 026) using TCP port 135.
– Worm also attempts to perform a Denial of Service (DoS) on the Microsoft Windows Update Web server (windowsupdate.com).
– Systems Affected are Windows 2000, Windows NT, Windows
Server 2003, Windows XP

- **Vulnerability and countermeasures:** The vulnerability of operating systems to viruses:

Just as genetic diversity in a population decreases the chance of a single disease wiping out a population, the diversity of software systems on a network similarly limits the destructive potential of viruses. This became a particular concern in the 1990s, when Microsoft gained market dominance in desktop operating systems and office suites. The users of Microsoft software (especially networking software such as Microsoft Outlook and Internet Explorer) are especially vulnerable to the spread of viruses. Microsoft software is targeted by virus writers due to their desktop dominance, and is often criticized for including many errors and holes for virus writers to exploit. Integrated and non-integrated Microsoft applications (such as Microsoft Office) and applications with scripting languages with access to the file system (for example Visual Basic Script (VBS), and applications with networking features) are also particularly vulnerable.

Although Windows is by far the most popular target operating system for virus writers, viruses also exist on other platforms. Any operating system that allows third-party programs to run can theoretically run viruses. Some operating systems are more secure than others. Unix-based operating systems (and NTFS-aware applications on Windows NT based platforms) only allow their users to run executables within their own protected memory space.

An Internet based experiment revealed that there were cases when people willingly pressed a particular button to download a virus. Security analyst Didier Stevens ran a half year advertising campaign on Google Ad Words which said "Is your PC virus-free? Get it infected here!". The result was 409 clicks. As of 2006, there are relatively few security exploits targeting Mac OS X (with a Unix-based file system and kernel).The number of viruses for the older Apple operating systems, known as Mac OS Classic, varies greatly from source to source, with Apple stating that there are only four known viruses, and independent sources stating there are as many as 63 viruses. Many Mac OS Classic viruses targeted the HyperCard authoring environment. The difference in virus vulnerability between Macs and Windows is a chief selling point, one that Apple uses in their Get a Mac advertising. In January 2009, Symantec announced the discovery of a Trojan that targets Macs. This discovery did not gain much coverage until April 2009.

- **The role of software development**

Because software is often designed with security features to prevent unauthorized use of system resources, many viruses must exploit software bugs in a system or application to spread. Software development strategies that produce large numbers of bugs will generally also produce potential exploits.

Anti-virus software and other preventive measures:

Many users install anti-virus software that can detect and eliminate known viruses after the computer downloads or runs the executable. There are two common methods that an anti-virus software application uses to detect viruses. The first, and by far the most common method of virus detection is using a list of virus signature definitions. This works by examining the content of the computer's memory (its RAM, and boot sectors) and the files stored on fixed or removable drives (hard drives, floppy drives), and comparing those files against a database of known virus "signatures". The disadvantage of this detection method is that users are only protected from viruses that pre-date their last virus definition update. The second method is to use a heuristic algorithm to find viruses based on common behaviors. This method has the ability to detect novel viruses that anti-virus security firms have yet to create a signature for.

Some anti-virus programs are able to scan opened files in addition to sent and received email messages "on the fly" in a similar manner. This practice is known as "on-access scanning". Anti-virus software does not change the underlying capability of host software to transmit viruses. Users must update their software regularly to patch security holes. Anti-virus software also needs to be regularly updated in order to recognize the latest threats.

One may also minimize the damage done by viruses by making regular backups of data (and the operating systems) on different media, that are either kept unconnected to the system (most of the time), read-only or not accessible for other reasons, such as using different file systems. This way, if data is lost through a virus, one can start again using the backup (which should preferably be recent).

If a backup session on optical media like CD and DVD is closed, it becomes read-only and can no longer be affected by a virus (so long as a virus or infected file was not copied onto the CD/DVD). Likewise, an operating system on a bootable CD can be used to start the computer if the installed operating systems become unusable. Backups on removable media must be carefully inspected before restoration. The Gammima virus, for example, propagates via removable flash drives.

- **Anti Virus Technologies:**

Anti Virus solutions have devised a variety of techniques to detect, cure and immunize against viruses. These technologies are constantly being modified and refined to be effective against the new viruses that are continuously being written which are as follows:

– Virus detection using Signatures
– Virus detection using TSR Guards
– Virus detection using Checksums

What to look for in an Anti-virus Software:

• Does the anti-virus package come with a DOS boot disk and does it ask you to create an emergency repair disk during installation?
• Does the anti-virus package offer option for scanning the boot record and a complete file scan immediately after pre-install scan?
• Does the application check for file integrity?
How often can the user download virus signature updates?
• Does the anti-virus software have the option of performing a heuristic analysis?
• Is the anti-virus package capable of analyzing and disinfecting compressed archives such as .ZIP and .ARJ files, as well as disinfecting files within the archive?

- **Recovery methods:**

Once a computer has been compromised by a virus, it is usually unsafe to continue using the same computer without completely reinstalling the operating system. However, there are a number of recovery options that exist after a computer has a virus. These actions depend on severity of the type of virus.

- **Virus removal**

One possibility on Windows Me, Windows XP, Windows Vista and Windows 7 is a tool known as System Restore, which restores the registry and critical system files to a previous checkpoint. Often a virus will cause a system to hang, and a subsequent hard reboot will render a system restore point from the same day corrupt. Restore points from previous days should work provided the virus is not designed to corrupt the restore files or also exists in previous restore points. Some viruses, however, disable System Restore and other important tools such as Task Manager and Command Prompt. An example of a virus that does this is CiaDoor. However, many such viruses can be removed by rebooting the computer, entering Windows safe mode, and then using system tools.
Administrators have the option to disable such tools from limited users for various reasons (for example, to reduce potential damage from and the spread of viruses). A virus can modify the registry to do the same even if the Administrator is controlling the computer; it blocks *all* users including the administrator from accessing the tools. The message "Task Manager has been disabled by your administrator" may be displayed, even to the administrator.

Users running a Microsoft operating system can access Microsoft's website to run a free scan, provided they have their 20-digit registration number. Many websites run by anti-virus software companies provide free online virus scanning, with limited cleaning facilities (the purpose of the sites is to sell anti-virus products). Some websites allow a single suspicious file to be checked by many antivirus programs in one operation.

- **Operating system reinstallation**

Reinstalling the operating system is another approach to virus removal. It involves either reformatting the computer's hard drive and installing the OS and all programs from original media, or restoring the entire partition with a clean backup image. User data can be restored by booting from a Live CD, or putting the hard drive into another computer and booting from its operating system with great care not to infect the second computer by executing any infected programs on the original drive; and once the system has been restored precautions must be taken to avoid reinfection from a restored executable file. These methods are simple to do, may be faster than disinfecting a computer, and are guaranteed to remove any malware. If the operating system and programs must be reinstalled from scratch, the time and effort to reinstall, reconfigure, and restore user preferences must be taken into account. Restoring from an image is much faster, totally safe, and restores the exact configuration to the state it was in when the image was made, with no further trouble.

Types of Viruses:

Not all computer viruses behave, replicate, or infect the same way. There are several different categories of viruses and malware. Below I list and discuss some of the most common types of computer viruses

- **Trojan Horse:**

  A Trojan horse program has the appearance of having a useful and desired function. While it may advertise its activity after launching, this information is not apparent to the user beforehand. Secretly the program performs other, undesired functions. A Trojan horse neither replicates nor copies itself, but causes damage or compromises the security of the computer. A Trojan horse must be sent by someone or carried by another program and may arrive in the form of a joke program or software of some sort. The malicious functionality of a Trojan horse may be anything undesirable for a computer user, including data destruction or compromising a system by providing a means for another computer to gain access, thus bypassing normal access controls.

- **Worms:**

  A worm is a program that makes and facilitates the distribution of copies of itself; for example, from one disk drive to another, or by copying itself using email or another transport mechanism. The worm may do damage and compromise the security of the computer. It may arrive via exploitation of system vulnerability or by clicking on an infected e-mail.

- **Boot sector Virus:**

  A virus which attaches itself to the first part of the hard disk that is read by the computer upon boot up. These are normally spread by floppy disks.

- **Macro Virus:**
  Macro viruses are viruses that use another application's macro programming language to distribute themselves. They infect documents such as MS Word or MS Excel and are typically spread to other similar documents.

- **Memory Resident Viruses:**
  Memory Resident Viruses reside in a computers volatile memory (RAM). They are initiated from a virus which runs on the computer and they stay in memory after its initiating program closes.

- **Root kit Virus:**
  A root kit virus is an undetectable virus which attempts to allow someone to gain control of a computer system. The term root kit comes from the Linux administrator root user. These viruses are usually installed by Trojans and are normally disguised as operating system files.

- **Polymorphic Viruses:**
  A polymorphic virus not only replicates itself by creating multiple files of it, but it also changes its digital signature every time it replicates. This makes it difficult for less sophisticated antivirus software to detect.

- **Logic Bombs/Time Bombs:**
  These are viruses which are programmed to initiate at a specific date or when a specific event occurs. Some examples are a virus which deletes your photos on Halloween, or a virus which deletes a database table if a certain employee gets fired.

Tips to protect your PC from viruses:

- The single most important way to protect against infection is to keep your software up-to date, including your Operating System. Check regularly for updates or set up automatic updates.

- Use quality Antivirus software from a well- known manufacturer. Check the manufacturer's recommendations for information such as set-up and configuration.

- Avoid questionable sites, such as sites that offer commercial software (software that you would have to pay for normally) to download for free.

- Avoid sites that offer software hacks and cracks. Hacks and cracks are usually a small patch or software file that circumvents copy protection or usage restrictions.

- Never open e-mail from unknown sources. If you have any doubts about an e-mail, it is better to err on the side of caution and delete it.

Tips to detect computer virus:

- Your first step to detect a com puter virus is when your computer starts to run slower th an usual.
- Your computer crashes and/or restarts on it's own.
- Your computer stops responding and/or freezes up.
- Your applications on your computer aren't working correctly.
- Your disk drives are inaccessible.
- Unusual error messages pops up on your screen.
- Abnormal dialog boxes or a menu pops up on your screen.
- Browser does not Load Fast
- Strange files in Registry

Install and Configure Symantec Anti-Virus Software:
Before You Begin
To use Symantec Antivirus for Windows, you need the following:

- a machine running Windows 98, ME, NT, 2000, or XP/7
- 128 MB of available hard drive space for Windows 98, ME, NT, 2000 and XP (Note: This figure includes space used for temporary Windows files, the actual application may require less space.)
- an active Internet connection (if you plan to use the product's auto-update function), including:
  - An installed Ethernet card and Category 5 Ethernet cable, if connecting with UTNet, Resnet, wired Public Network, or other Ethernet connection.
  - A modem that works with your operating system, if dialing in.

Before you install Symantec Antivirus software:

- Close all open programs on your machine, so you won't lose work when you restart the machine during this installation.
- (Windows NT/2000/XP/7) Log in as **Administrator**, or as a user with administrative privileges.

Task 1 - Install Symantec Antivirus for Windows
IMPORTANT! If you want to update your software or schedule auto-updates, this application requires Internet connectivity. If you begin installation when you are not connected, the program may attempt to make a connection to complete the installation process.
For this product to install correctly, you need to uninstall or disable any existing anti-virus applications and restart your machine. Then, you should temporarily disable any firewall applications that are running.

1. Double-click on the installer. Double-click the **Symantec Antivirus** folder, and follow the steps below.
2. Click **Install** to begin installation.
3. Click **next** when the installer screen appears.
4. Read the license agreement screen, and if you agree to it, select **I accept the terms of the license agreement** and click **next**.
5. Click **next** to install all components using the default installation path, or click **Custom** to specify components and installation path.

6. In the **Network Setup Type** window, select **Unmanaged**, and then click **next**.
    - o If your department operates a management console, you may be able to select **Managed**. This option takes advantage of a companion server product that automatically installs program patches, virus definition updates, and protection policies. This means that you do not need to configure your software for automatic updates. Check with your department's network administrator to find out if you have this capability.
    - o If you chose **Managed**, enter the management server's DNS name or IP address in the **Select Server** window.
7. In the **Install Options** window, select **Auto-Protect** if you want Symantec Antivirus to automatically monitor your system as you work.
8. If you have an active Internet connection, select **Run Live Update** to acquire the latest version of the software and update your virus definition files during installation.
9. Click **next**, and then click **Install.**
10. If you selected Run Live Update above, the installer will automatically launch the Live Update program. Click **Next** to have Live Update check with Symantec for the latest virus definitions. When the update is complete, click **Finished**. If you receive an "Old Virus Definition File" message, disregard it and click **Close**.
11. In the Symantec Antivirus - Install Shield Wizard window, click **Finish** to complete the installation process.
12. To open the program, double-click the Symantec Antivirus Corporate Edition icon in the Windows taskbar (Figure 1).

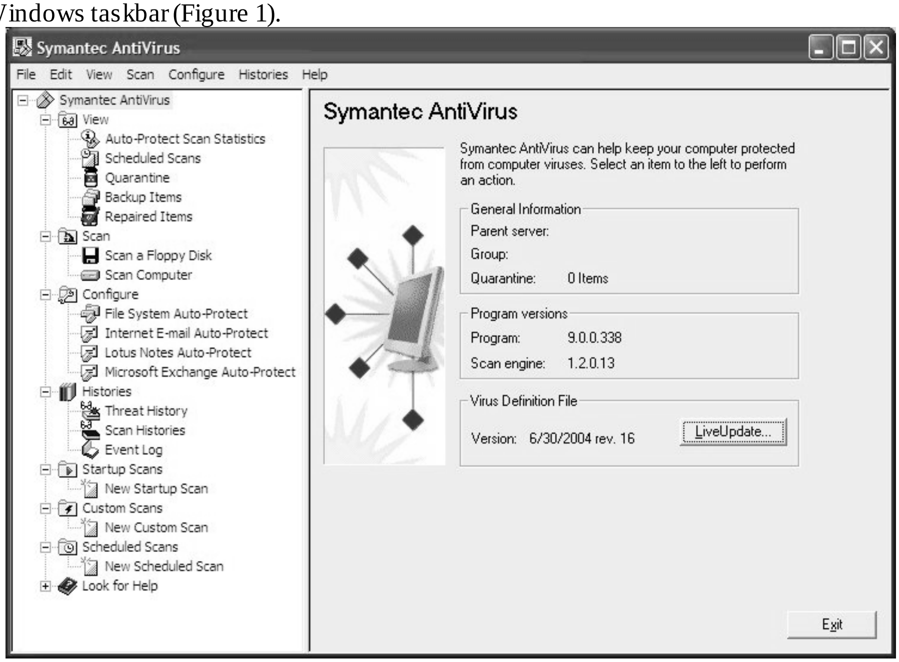


Figure 1. Symantec Antivirus Main Screen

Task 2 - Schedule daily updates of virus definition files.

You can schedule three types of scans. This document walks you through setting up a Scheduled Scan, but the process is very similar for Startup Scans (defined scans that occur when you start your system) and Custom Scans (defined scans that you can run manually, but that do not run automatically).

NOTE: If you selected **Managed** during installation, you can skip this step. The management server will handle virus updates.

To schedule a daily virus definition update:

1. Double-click on the Symantec Antivirus icon in the Windows taskbar (if the icon is not in the taskbar, you must first run the program).
2. Click **File**, and then click **Schedule Updates**.
3. Select the **Enable automatic scheduled updates** checkbox.
4. Click **Schedule** (Figure 2).
   - You can also manually run Live Update at any time. Click **Live Update** from the main program window, or click **File** and select **Live Update**.
5. In the **Virus Definition Update Schedule** window, select the **Daily** radio button and choose the time of day updates should occur, and then click **OK**.

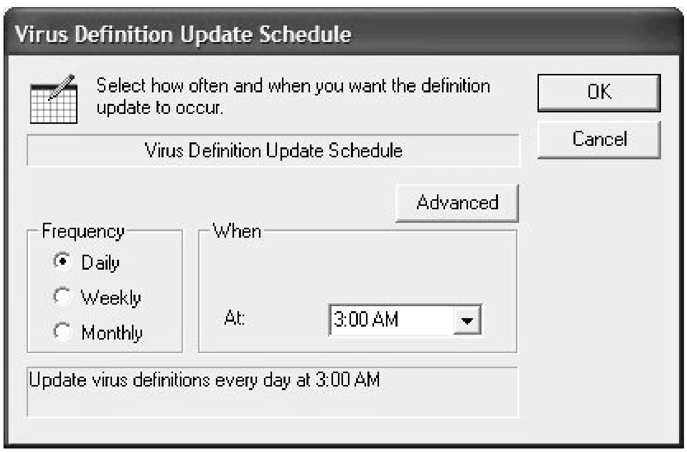


Figure 2. Symantec Antivirus Schedule Window

Task 3 - Schedule weekly system scans.

NOTE: If you selected **Managed** during installation, you can skip this step. The management server will schedule virus scans for you. Note that for automatic scanning in Windows NT, 2000, or XP, you must be logged into the network for a schedule scan to occur. You can press Control-Alt-Delete to remain logged in and prevent others from using your computer while you're away.

To schedule weekly system scans:

1. Double-click on the Symantec Antivirus icon in the Windows taskbar (if the icon is not in the taskbar, you must first run the program).
2. In the left column, double-click **Scheduled Scans**, and then click **New Scheduled Scan**.
3. Enter a **Name** for your scan, and then click **next**.
4. The **Enable scan** checkbox is checked by default. Select the **Weekly** radio button (Figure 3).
5. Click the drop-down time menu to specify the time the scan should occur, and then click **next**.

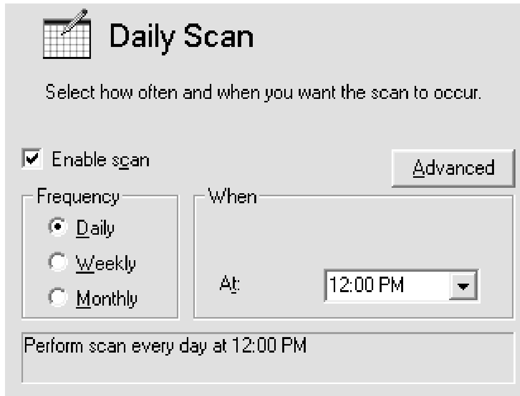


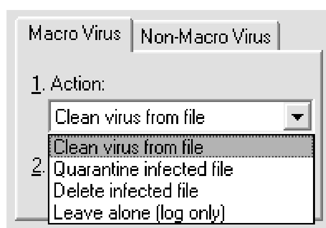
Figure 3. Automatic Scheduled Scan Options

7. Place a check next to each volume you want to scan.
8. Click **Save** to store your scheduled scan, or **Options** to modify scanning options and actions.
    - To edit the settings later, click on the name of your scan in the left column, then click **Edit** in the right side of the window.
    - To run a scheduled scan immediately, double click on its name in the left column.

Task 4 - Set advanced options.

Although it is not required, you can set a number of other options within Symantec Antivirus.

- **File System Real time Protection**
  These options specify what types of files should be scanned, and what should happen when the program detects an infected file. To set real-time virus options, click **Configure**, then select **File System Real time Protection**. You can specify different actions for macro viruses (such as worms that e-mail your entire address book or infect Microsoft Word documents) and non-macro viruses:



    - **Clean virus from file** removes the virus, but leaves the file intact.
    - **Quarantine infected file** moves the file into a protected area. To view quarantined files, click **View**, then **Quarantine**.
    - **Delete infected file** removes the virus and deletes the file.
    - **Leave alone** writes to the log file, but does not remove the virus or file.
- **Advanced Heuristics**
  Heuristics are internal program rules used to filter files and messages for viruses. You can specify stricter or looser rules. Click **Configure**, and then click **File System Real time Protection**. Click **Advanced**, and then click **Heuristics**. You can choose **Minimum**, **Default**, or **Maximum** detection levels if the **Bloodhound** checkbox is enabled.

- **Microsoft Exchange Real time Protection**
  you can configure the scan to automatically send a customized message to any person who sends you an infected e-mail. To set real-time Exchange options, click **Configure**, then select **Microsoft Exchange Real-time Protection**.
- **History Logs**
  Click **History** to view virus, scan, and event history logs. These files track the results of all scans, updates, detected viruses, and actions taken by the program.

Chapter - 16
Troubleshooting

Objectives of learning:

- What is Troubleshooting
- Basic Troubleshooting Techniques
- Basic Troubleshooting Steps
- Five phases of troubleshooting
- Diagnostics Software
- Basic Windows Troubleshooting Approach
- Safe Mode and Command Mode
- Common Problems and Solutions

What is Troubleshooting

Troubleshooting the computer problems is a very vital role of the system administrator hardware technicians and system specialists. Every hardware component in the computer system has its own configurations methods and troubleshooting techniques.

There are some basic techniques and you should be aware of them.

Basic Troubleshooting Techniques

• Problems reported are just symptoms, not the cause.
• Investigate and pinpoint the real cause.
• Plan of action to correct the problem.
• Look for the cause, not the symptom.
• Organize
• Eliminate as many alternatives as possible and focus on the things that might be the cause of the problem.

Basic Troubleshooting Steps

• Check for operator error-commands or software or hardware configurations that you may have done wrong.
• Check that everything is plugged into either a direct power source or the PC itself is plugged in correctly.
• Check the software, including program files and drivers are configured properly.
• Check for external signs of trouble, such as flickering LED power indicators or strange sounds or lack of display.
• Run appropriate diagnostic programs.
• When all else fail, disassemble the PC, disconnect all power, remove the case, ground yourself, and go inside to check cable and power connections and anything out of the ordinary.

Five phases of troubleshooting

• Phase I: Define the Problem
– Investigate the events that led up to the failure
– Ask question to client/user

• Phase II: Zero in on the Cause
– For a totally random, intermittent problem, always suspect the power supply.
• Phase III: Conduct the Repair
– Make a Plan
– Follow the Plan from Beginning to End
– Repair or Replace
• Phase IV: Confirm the Results
– Conform Problem no longer exists
• Phase V: Document the Results

Diagnostics Software
• This software, some of which is included with the system when purchased, assists users in identifying many problems that can occur with a computer's components.
• All versions of Windows from Windows 98 on include a set of diagnostic system tools (accessed via Start > Programs >
Accessories > System Tools) that can help you track down many types of system problems.
E.g. Scandisk, Disk Defragmenter, System Information Tool, Dr.Watson Logging tool,
System File Checker.

Basic Windows Troubleshooting Approach

• Gather Information

– Start with the user's complaint.
– Find out about the configuration – H/W & S/W
– Locate backups, emergency repair disk (ERD), or other external diagnostic or recovery tools.
– What was going on when the system failed?
– Hardware problem, that must be resolved before any work on the operating system proceeds.
– To identify a problem and pinpoint a resolution you can employ a technique known as differential diagnosis.
– One by one rule out the possible causes of failure by diagnosing suspected components.
– If there is, and fixing it makes the underlying problem disappear, then you have empirical proof that your diagnosis was correct. If not, you must proceed with the process of elimination.
• Differential diagnosis on operating system problems
• Break the cycle into three components.
• System startup (operating system starts to load and it ends when control is turned over to the user)
• The operating phase (the user and the operating system can use the environment.)
• System shutdown - a shutdown command is given—or occurs unexpectedly.

Safe Mode and Command Mode

• Both Windows 98 and Windows 2000 offer safe mode.
• Safe mode loads the OS with minimal set of drivers
• If the hard disk is still functional, you may attempt to start the system in command mode.
• Press F8 just after the POST to get in to menu where you can get different option to boot the system
• Safe mode offers access to a wider variety of tools to help isolate and repair problems.

Common Problems and Solutions

- **PROBLEM: The computer locks up and/or is acting weird:**

Solution1: If the computer is frozen and will not respond to any commands, it may be necessary to press Ctrl + Alt + Del (all three keys at the same time) to bring up the Task List. Select any program that says "Not responding" and click the End Task button. Repeat until all tasks are ended. If this does not work, turn the computer off, wait several seconds, turn the computer back on, and let the computer run the Scandisk.
Solution2: Reboot it. A majority of problems that occur while you are using your computer can be fixed by rebooting. Applications sometimes don't release memory like they should when they are finished. The end result is your computer locks up or acts really weird. When you reboot, memory registers are cleared and most everything is reset. This fixes a lot of problems.

- **PROBLEM: The computer seems to be running slow.**

Solution 1: Make sure that the system is running in Turbo Mode. Is the turbo led lit ? Turbo Mode allows the computer to process information at its full potential, 33 MHz for a 33 MHz machine, and so forth. If you are NOT in turbo mode, your system may only be running in 16MHz (which is very slow - snail's pace by today's standards). Are the proper video drivers installed?
Solution 2: Try to cleanup your computer. Kill all TEMP files, clear CACHE on your web browser, and get rid of the garbage (if you know it is for sure garbage and how to safely do it). Then DEFRAG your hard drive. You really don't ever want to allow your system to become more than 2% fragmented, as it can really slow your system down.
Solution 3: Another trick, make more memory available to the system by using memory managers intelligently and/or removing unnecessary TSR's, (Terminate and Stay Resident Programs) which remain in memory even though you don't really know the programs are running in the back ground. Pressing Ctrl/Alt/Delete in Win95 will display a list of most of the programs and non-driver files that is currently loading your systems memory. Are the drivers installed? Is the printer cable attached to both the printer port on the back of the computer AND to the printer? Is the cable a parallel connection? If no, you will need to setup the serial parameters. If yes, then restart the system in DOS mode and type AUTOEXEC.BAT >PRN and press the enter key. Most printers will then print... though lasers and some ink jets will NOT automatically eject the paper, so you will need to press the page feed button on the front of the printer.

- **PROBLEM: The system will not come up at all, the display is blank and the computer does not make any beep sounds from the speaker.**

Solution 1: Check the power connectors to the case, the monitor... and to the wall and on the Mother Board. Are any lights coming on at the monitor, case? If not, then you may have popped circuit breaker in your house or office. Try plugging in a different electrical device or multi-meter to check the power... it should be between 115 and 120, over
125 can easily FRY a computer and other electrical devices. If the lights are on, and the power seems to be fine then you need to determine if the fan in the power supply coming on? Is the monitor powered on? Is the monitor's video cable plugged into the video card ? Double check the brightness

and contrast settings. Plug the monitor into another computer if possible to verify the monitor isn't the Problem.

Solution 2: Are any of the drive lights on - floppy, hard disk, or CD ROM drives? Did they flash during power on? If yes, then it's probably not the hard drive or cabling... if they are staying on, there a definite problem. Check the BIOS settings. Maybe the battery is dead or too low. If the BIOS are correct, trace the cables and double check all of the connections and jumpers. Make sure that it did not miss any of the pins when it was installed. Also, make sure that the power connector is on properly; remember "red towards power" on most drives.

Solution 3: If the monitor is working fine, and all of the rest of the stuff checks out, chances are - short on the motherboard, bad power supply, or PC speaker connected wrong. If the PC speaker is wrong, you wouldn't hear the beep codes.

Solution 4: Verify that all of the expansion cards are fully seated in the slots. A partially inserted card can cause the system not to boot - power supply fan may be on, but the monitor is black (blank) without any messages.

Solution 5: Try unplugging and disconnecting everything **except** the motherboard, PC speaker, and video card... if it doesn't power up here, then check the RAM, video card, motherboard, and power supply.

Solution 6: Try a different power supply - this is a very common problem. Today's power supplies are designed to give up their lives to protect (save) the rest of your computer. Also, most of the new power supplies being sold today we tested do NOT pass the basic tests, and use many short cuts to reduce the cost.

Solution 7: Replace the system RAM, or move them to different slots.

Solution 8: If all else has failed, replace the Mother Board itself. This is a very rare problem, but does occur in once of one-hundred plus boards.

Solution 9: Try a different CPU - also extremely rare... in 20 years, I have only seen this twice on a system that was previously working.

- **PROBLEM: The keyboard doesn't work**

Solution1. Press Ctrl + Alt + Del (all three keys at the same time) to bring up the Task List. Select any program that says "Not responding" and click the End Task button. Repeat until all tasks are ended. Check periodically to see if the keyboard will work.

Solution2. Check to make sure the keyboard is still properly connected to the computer. If the keyboard has been disconnected, you may have to reboot your computer.

Solution3. If all else fails, then turn the power off. Wait a couple of minutes before turning the computer back on.

- **PROBLEM: The computer displays a disk error or non-system disk message?**

Solution1: You may have left a disk in the A drive. Remove it and press any key on the keyboard to reboot the computer.

Solution2: If you don’t have a disk in the A drive and the message is accompanied by a "clunking" sound, turn the computer off and send for a technician.

- **PROBLEM: The computer starts up in "safe mode"**

Solution: At times your computer could develop a problem which causes your machine to boot up in what is called "safe mode". The easiest way to try and solve this problem is to run a "scandisk".

1. Click on **Start, Programs, Accessories, System Tools,** and **Scandisk**.
2. Place a check on "Automatically fix errors".
3. When Scandisk finishes, reboot your computer to see if this fixed the problem.
4. If the computer still boots up in the Safe Mode, click on **Start, Programs, Accessories, System Tools,** and **Disk Defragmenter**. If you receive the message "You don't need to defragment this drive now", continue with the process anyway.
5. When Disk Defragmenter is finished, reboot your computer to see if this fixed the problem.
6. If the computer still starts up in safe mode, you need to contact a computer technician.

- **PROBLEM: The printer doesn't work**

If the printer will not print at all, you need to determine if the printer itself will not work or if it is not receiving a print message from the computer.

Solution1: Many models have a built-in self test option which allows you to print a test page by holding down the feed button for a few seconds. The power button will begin to flash and a test page will print. If the printer self test fails, your problem is with the printer itself rather than the printer cable or computer. Should this occur, you should contact a technician.

Solution2: If the printer self test prints, the next step is to have Windows print a test page. Click on **Start, Settings, Printers,** and right click on the icon of the printer with the problem. Select **properties** and press the **Print Test Page** button. If the test page fails to print, make sure the printer cable is firmly seated in both the computer and the printer. You should also check the ends of the printer cable to make sure that none of the prongs are bent. If the test print fails, or if the print consists of nonsense characters or a few characters printed over many pages, you need to uninstall then reinstall the drivers for your printer.

Note: Paper feed problems and jams can often be resolved by using paper which conforms with the specifications provided by the printer manufacturer. On ink jet printers, the rubber rolls which pick up each sheet can sometimes become coated with paper residue which decreases the friction. Cleaning off the residue can sometimes solve paper feed problems.

- **PROBLEM: The system sounds like it is booting but there is no video display.**

Solution 1: Verify that the monitor is connected to the computer and power, and is turned on.
Solution 2: Check that the brightness and contrast controls are NOT at the lowest settings.
Solution 3: Replace the Video Adapter.
Solution 4: Replace the monitor itself.

- **PROBLEM: The system emits a series of beeps but does not display a message on the screen.**

Solution: Video Card or RAM memory is the usual problem. Double check the beep codes in the motherboard manual. Remember, there are long and short beeps, like Morris code. Consult the Technical Manual for your Mother Board, to get a description of what these codes indicate. After you have located the code replace the indicated circuits, fix the cables, or otherwise try to solve the problem, and boot the system. Did the beep codes change, stop, or remain?
Each BIOS has a different set of "beep codes" you motherboard manual should have a detailed listing of the beeps you are hearing on YOUR system. RAM and video card are to of the most important items on the system, next to the CPU.
If all of the jumpers are working right, there are no shorts on the mother board, and the CPU, RAM and Video card are good and working properly, the system WILL start, and WILL give you either beep codes, number codes (displayed on the monitor), or Nearly human understandable error messages.

- **PROBLEM: The system displays a numeric error code (usually alphanumeric numbers).**

Solution: Check the motherboard manual. Double check the RAM and various cards. Are they seated, and installed correctly? Can you get into the BIOS? If yes, double check the BIOS settings. Don't change ANY SETTINGS unless you are absolutely sure a particular setting is wrong. If you are a novice, bring in a smart friend at this point or a consultant, and consider calling the company you purchased the components from. This is a rare message type on today's systems.

- **PROBLEM: The Screen displays both FDD and HDD Controller Failure messages.**

Solution 1: Check the Bios. If the controller is on a card (not the motherboard) then make sure the card is properly seated in the slot and the cables are correctly set to pin 1.
Solution 2: Make sure that the data and power cables are properly connected to both the drives and the controller.
Solution 3: If both control circuits are on the same interface card, this is common, replace the interface card.

- **PROBLEM: The screen displays a FDD Controller Failure message.**

Double check the cabling and power. Did the floppy drive light up shortly after power up? Yes, did it stay on? Yes - the cable is backwards or wrong. No, double check the BIOS settings. Is the Floppy drive type correct?

Solution 1: Make sure that the data and power cables are properly connected to both the drives and the controller.
Solution 2: Verify the drive controller is fully inserted into the Mother Board.
Solution 3: Replace the Floppy Disk Drive Controller.
Solution 4: Replace the Floppy Disk Drive.

- **PROBLEM The screen displays a HDD Controller Failure message.**

Double check the cabling. Is pin 1 in the correct location? Is the drive hooked up correctly? Is there more than one drive on the same cable? Are the jumpers (master/salve/cable select) set properly? Is there a CD-ROM on that cable?
If yes, make sure the CD's jumper is set correctly.

Solution 1: Make sure that the data and power cables are properly connected to both the drives and the controller.
Solution 2: If you have more than one drive in the computer make sure that the drive select jumpers are properly configured. These jumpers are detailed in the Technical Manuals provided with the Hard Disk Drives or written directly on top of the drives.
Solution 3: Verify the drive specifications are set correctly in CMOS.
Solution 4: Verify the drive controller is fully inserted into the Mother Board, if it isn't integrated.
Solution 5: Replace the Hard Disk Drive Controller.
Solution 6: Replace the Hard Disk Drive.

- **PROBLEM: The screen displays a Keyboard not installed or Keyboard Error message.**

Is the keyboard plugged in? Yes, did the num lock light flash after power on? No - bad key board or wrong setting (check the back of the key board, and make sure it isn't set to XT mode - set it to AT mode). When RAM is counting, can you get in to the BIOS? Try a different key board if possible.
Solution 1: Verify that the keyboard is connected to the computer.
Solution 2: Is the keyboard set correctly? Many keyboards still have an XT setting on the bottom or back, which will generate errors on the new systems.
Solution 3: Double check the BIOS - is the Keyboard turned on .If yes, and the keyboard works on a different system, then replace the Mother Board. The circuits that control the keyboard are located on the Mother Board itself.

- **PROBLEM: The Floppy Disk Drive will not access a disk when it is installed in the computer.**

Is the disk good? Is the drive new? Is the disk new? Does the light flash when you press the enter key, make the access sound... and then go off? Either the heads on the drive are bad or the disk is bad. Try the disk on a different computer.

Solution: Is the cabling and power correct? Does the floppy disk work in other computers? In some instances, the case of the computer can bind against the floppy disk drive, preventing the motor from spinning. If this occurs, carefully adjust the case until the problem is resolved, or replace the case.

- **PROBLEM: The computer will not Read from or Write to a Floppy Disk Drive.**

Solution 1: Does the BIOS match the type of floppy drive you have?
Solution 2: Does the floppy drive light come on and appear to work properly? If yes, you could have the wrong type of disk (trying to access a 1.44MB floppy in a 720 KB drive is impossible), or it could

be a defective diskette (which is very common). Replace the diskette with one you know works and try again.

Solution 3: Has the case or floppy drive been changed? Or removed and reinstalled? Maybe it is bound, twisted, or out-of-level just slightly? Are the screws on the same level (bottom on both sides, and the top holes on both sides – or in all of the holes on both sides). If this is true, then try resetting the drive. If it is not true, then move to the final probability, Solution 4.

Solution 4: Replace the Floppy Disk Drive. If that doesn't work, replace the Floppy Disk Drive Controller.

- **PROBLEM: The computer will not Read from or Write to a Hard Disk Drive.**

Solution 1: Is the BIOS set correctly? If yes, try the "Auto detect HDD" that exists in most BIOS's to see if the computer SEES the drive. If the drive is seen at the BIOS level, then you must be sure that the installed settings are the same as those you are currently set at. Most drives have two or three different settings. The general rule of thumb is drives below 540MB are usually the "normal" setting, and drives above 1.6 Gigabytes are most always LBA (Large Block Access). Disk drives between those size settings could be Normal, Large, or LBA try all three of them. If the BIOS can't see the drive at the BIOS level on the auto-detect, then you have bad power supply or a plug, cabling that isn't connected correctly, a controller problem, or bad drive. It is also possible that the read-write permissions have been password protected, or the drive has been locked with software.

Solution 2: Try a different Hard Disk Drive or Replace the Hard Disk Drive Controller.

- **PROBLEM: The mouse does not respond.**

Solution 1: Makes sure that the mouse is properly connected to the computer.

Solution 2: Make sure that the software drivers are load for the mouse (Windows95 will automatically detect the mouse if it connected correctly and working properly - and reasonably standardized - DOS mode usually requires drivers to be in either the Config.sys or Autoexec.bat files).

Solution 3: If you have a modem installed, verify the IRQ settings don't conflict.

Solution 4: Try replacing the I/O port that the mouse is connected to.

- **PROBLEM: The printer will not print.**

Solution 1: Verify that the printer is connected to the correct port, some scanner and SCSI port can appear to be printer ports, and that the printer is turned on and On Line. If the failure is in Windows, verify that it doesn't work in

DOS mode also (from the DOS prompt, type: TYPE AUTOEXEC.BAT>PRN and press enter. Laser Printers and some Ink Jets will require a "form feed" button to be pushed, but all should have a "data" or "working" light on that wasn't previously on.

Solution 2: Replace the printer cable, newer printers REQUIRE an IEEE1284 cable... which looks and feels like a regular cable, but is made with higher standards and better components.

Solution 3: Replace the printer drivers. They may have become corrupted, over written with incorrect drivers, or otherwise not functioning. You might try to replace the port - on integrated computers, all you can do is disable the integrated port(s) and plug-in an internal I/O card.

Solution 4: Replace the printer itself. It is rare that a printer itself has a problem of this nature, but it does occur.

Troubleshooting

You have either just finished assembling a computer or you have been using it for some time, and you encounter problems that make you focus on your motherboard's functionality; this is because your PC either doesn't boot successfully (locks in the middle of the boot process or posts error messages) – or doesn't power up or boot at all. Moreover, it could be that your system has simply become unstable, exhibiting frequent crashes. Other peripherals of your PC may come into play as well, but you want to rule out your motherboard as a culprit – here's what to do.

Before moving on, you need to have an accurate picture of your computer's configuration.

• In order to identify your motherboard.

• In order to gather additional information about your installed components and their respective drivers.

CAUTION

Please discharge yourself of any static electricity before attempting anything on your motherboard and while you are working. Electrostatic Discharge (ESD), which is a bit annoying but for sure harmless to humans, is certainly lethal to sensitive electronics. (For example, a few steps on a vinyl floor will produce 12,000V of static electricity - many times the destruction threshold of a typical electronic component.) You will be generating static electricity whenever for example:

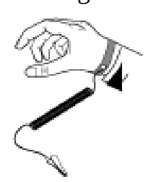
• You open a common plastic bag.

• You remove adhesive tape from a container.

• You slide a circuit board on a work bench.

• You walk across a floor.

As you can see, rather common actions can potentially have catastrophic consequences. Electrical fields can penetrate electronic devices. ESD is not selective and can damage components directly and indirectly. In order to be on the safe side, the best idea is to use antistatic wristbands (which are also called ESD wrist straps) - especially when handling the processor and the memory chips. You can see an antistatic wristband pictured below. The wrist strap is connected to ground through a coiled retractable cable and 1 megaohm resistor, which allows high-voltage charges to leak through but prevents a shock hazard when working with low- voltage parts. If you are willing to invest in an ESD wrist strap, then please do not buy a very cheap one; because typically these do not have conductive fabric and instead use the fabric to hold the metal plate against the skin, which can result in reduced ESD protection over time as the metal corrodes. When using an ESD wrist band, then do not forget to attach its alligator clip to a bare metal part of your computer, workbench or other grounded connection.



If you do not have any ESD wrist straps, then please touch a metallic object to let the static discharge, *before* you start handling your motherboard. However, *while* handling the motherboard, avoid touching any metal leads or connectors. If you will need to walk and then continue working on your motherboard, touch again briefly an unpainted metal part of your computer casing, *before* resuming work.

CAUTION

Here are some general best-practice guidelines when working with your motherboard and its components:

• When you intend to remove the motherboard from the computer's case, first turn everything off and unplug the power cord before continuing. When working on portable computers, also remove all batteries, PCMCIA cards and disconnect all peripherals.

• Before unplugging the power connector(s) of the motherboard, verify first that the power supply is switched off.

• Do not use magnetic tools (like screw drivers etc).

• Prior to installing any electronic component, keep it on top of an antistatic pad or inside an antistatic bag (formally called an electrostatic shielding container).

• Do not allow screws or other metallic parts to come in contact with the motherboard circuit or its components. Moreover, always weed out screws or metallic objects that may have been left inside the computer casing.

• Make sure you place all screws you remove, in a safe place out of the way. Moreover, if the screws you have removed appear to be of various sizes, then keep them in separate spots and take notes regarding where they were removed from.

• Do not remove any of the stickers on the motherboard, because this can void your warranty.

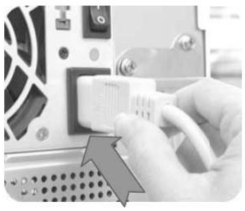
• Have all the relevant documentation handy, and study it *before* acting.

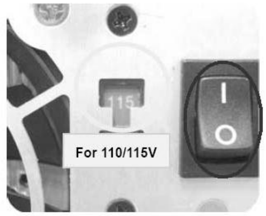
NOTE Please keep in mind that this is a generic troubleshooting guide for the average user. There is always a chance you might be facing issues that are not covered by the procedure laid out here (especially if you have a motherboard that is very complex/advanced, very old or with a record of extreme incidents). In any case, and particularly if you are evaluating the possibility of discarding your motherboard, please consult the TSF experts at the Motherboards, Bios & CPU sub forum. If you have questions or do not understand a term or method described here, please do not hesitate to ask.

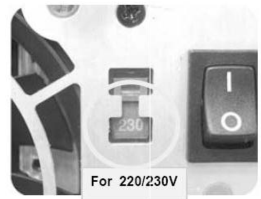
A. You press the Power button on your PC and no message is posted on the screen.

You may be seeing absolutely no indications that your system powers up or you may see only the CPU fan turning. Or you may have positive indications that your system powers up, nevertheless it does not post anything and you are hearing beeping sounds. Another case is your system does power up but shuts down within a couple of seconds. The following is a step-by-step procedure to troubleshoot this kind of incidents to the wider scope possible.

1. Confirm that the computer and the monitor are properly plugged in an outlet or a functioning UPS. (UPS stands for “Uninterrupted Power Supply” and is a device described and explained in step 5 of Confirm that the power switch at the back of your computer (if present) is on (**I**=ON, **O**=OFF). Confirm that the voltage selector (if present) is set correctly for your area.

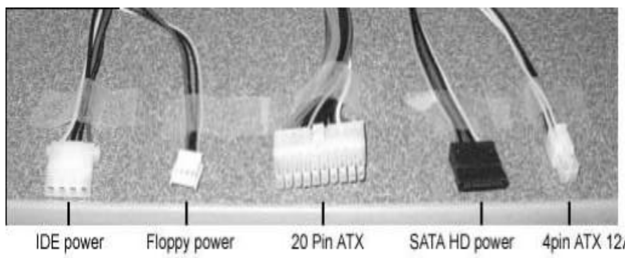




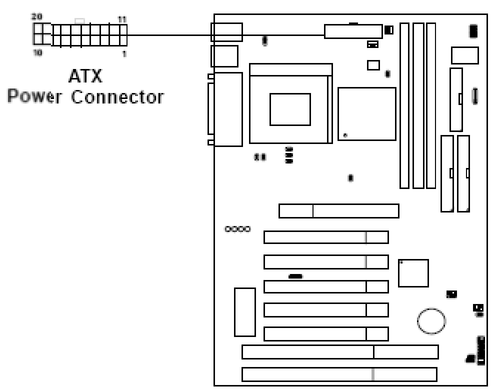


2. Confirm that the monitor is properly and securely connected to your video adapter. If you have positive indications that the motherboard comes alive, yet you see nothing on the screen and you cannot guarantee the good functionality of the monitor in use, and then try again your rig with another monitor of known good functionality.

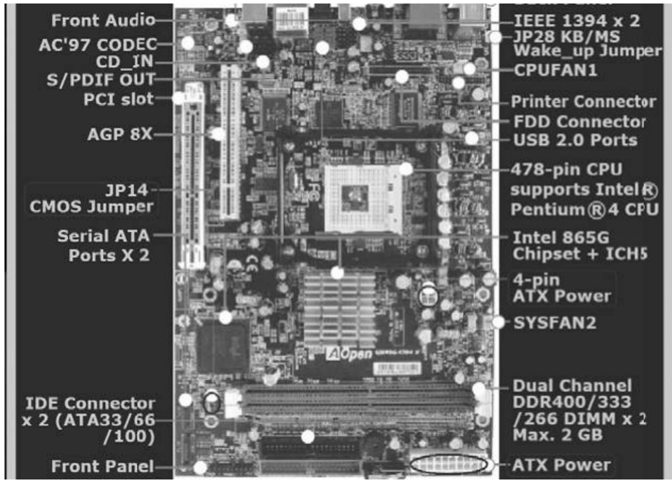
3. Confirm that the motherboard is correctly connected to the power supply.



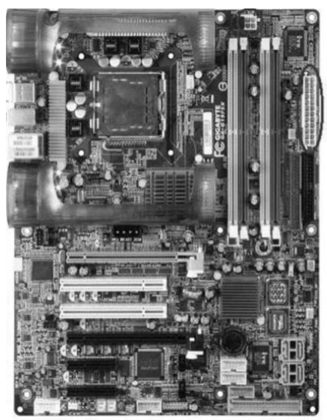
Older motherboards are powered through the ATX 20-pin connector only:



Pentium 4 motherboards require an ATX 2.03 spec power supply, with an ATX 12V 4-pin connector plugged to the 4-pin power header on the motherboard:



Even newer motherboards are equipped with an ATX 24-pin connector (instead of the 20-pin one) – see the image on the left. Some motherboards permit that either an ATX 24-pin or 20-pin connector is used (notice the cap) – see the image on the right:



4. Eliminate the possibility that the power button of the case is malfunctioning. To do so, you will first need to locate in your motherboard the Front Panel Header. This is an area, shown inside a black circle in the following image, where the wires that come from the front panel of your computer's casing, are connected to the respective pins of the motherboard. Every motherboard has a Front Panel Header (some manufacturers call it a Front Panel Jumper), yet the actual pin configuration differs from one motherboard to the other and you will need to consult its documentation in order to understand the exact layout for your case. Typically, the Front Panel Header will host the following connectors:

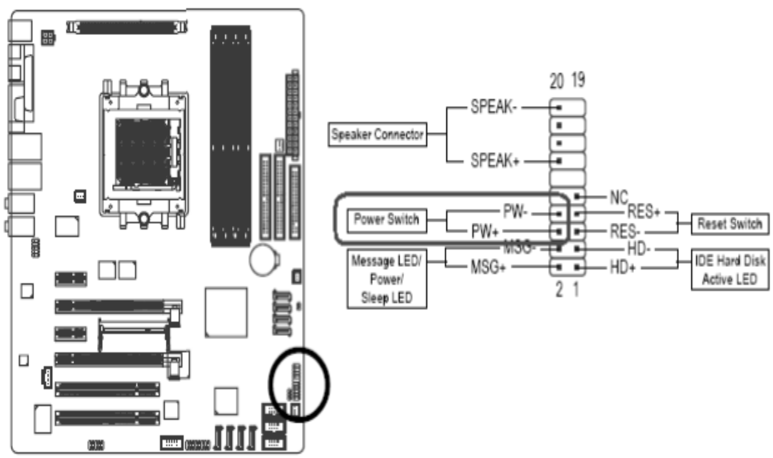
• Power Switch, a two-pin receptacle where the connector coming from the casing's power button is plugged. Motherboards and casings typically identify this connector as “POWER SW” or “PW”.

• Reset Switch, a two-pin receptacle where the connector coming from the casing's reset button is plugged. Motherboards and casings typically identify this connector as “RESET SW”, “RESET” or “RES”.

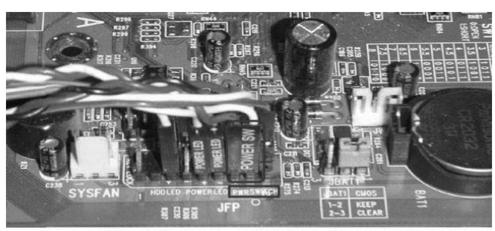
• Hard Disc LED, a two-pin receptacle where the connector coming from the casing's LED that signifies the Hard Disc is active, is plugged. Motherboards and casings typically identify this connector as “HDD LED”, “HDD” or “HD”.

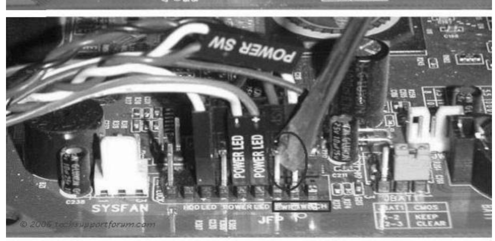
• Power/Message/Sleep LED, a two-pin receptacle where the connector coming from the casing's LED that signifies the computer is powered on, is plugged. Motherboards and casings typically identify this connector as “POWER LED” or “PWR_LED”.

• Speaker, a four-pin receptacle where the connector coming from the computer's speaker is plugged. Motherboards and casings typically identify this connector as “SPEAKER” or “SPEAK”.

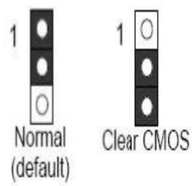


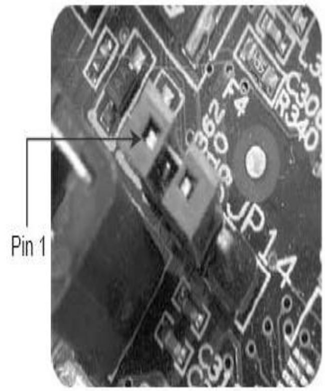
So, first use the motherboard's documentation and then inspect visually, in order to locate the pins that correspond to the Power Switch. Remove the power switch connector from the respective pins, and then short those two pins with a small screwdriver (as shown in the picture below). If your computer now posts successfully, your problem was caused by a faulty power button.





5. Verify that the CMOS jumper is set at the “Keep Data” position (pins 1-2):





6. Verify that your power supply has enough wattage to support your system. Use TSF's exceptional Power Supply Information and Selection advisory – where you will also find a great PSU calculator you can use to see if you are severely underpowered. A word of caution: aforementioned TSF advisory is the greatest tutorial on how to select the best PSU for your system; so, do not take it lightly or for granted that you are covered power-wise simply because your system finally boots up. Having a computer on the edge of being adequately supplied with power can and will lead you to endless problems and issues which may eventually hurt almost all your components (and, mainly, your computer's functionality and your own mental balance). Buying the best PSU for your computer actually buys you peace of mind.

7. Verify that your power supply is operative. Find another one of known functionality and equal or higher wattage, and try powering your computer with it. Also, keep in mind that a mere statement of the wattage is not enough. For a power supply to be operative, the voltage will *have* to be within acceptable limits, and the delivered amperes will *need* to be adequate for the specific rig. Please, take the comment from the previous step into *serious* consideration and, if you haven't already done so, *study carefully* the PSU selection advisory mentioned therein.

8. Verify that the CPU that you intend to use is indeed supported by your motherboard. Visit the website of your motherboard's manufacturer and find the CPU support list that corresponds to your motherboard. If you see in this list and the relevant support documentation that your motherboard supports your CPU only via a BIOS update, then download that newer BIOS version and the respective Flash utility, and follow the instructions that accompany the Flash utility in order to update your BIOS. Beware, though! If you are required to ultimately flash your BIOS then, *before moving any further*, please read *now* all the precautions you will need to take, which are explained in step 14 of this process.

9. Verify that the graphics card that you intend to use is working OK and is well seated. If your motherboard has onboard video, retest it with the graphics card removed. If it does not have onboard video, then retest this time using another compatible graphics card of known functionality. If you are using an AGP graphics card, these are typically keyed as shown in the image below, in order to prevent an inadvertent installation on a non-supporting motherboard. However, be advised that this is not adequate prevention for you! There is only one way to know for sure if your graphics card is

supported or not; and this is to know its exact type and then check it out in your motherboard's documentation. Why is this? Because there are two versions of the AGP physical interface, for 3.3 V and 1.5 V cards respectively. The 1.5 V version has a key further away from the external connector, while the 3.3 V version is the opposite. However, some poorly designed older 3.3V cards incorrectly have the 1.5V key, which may result in a burnt motherboard if installed in a AGP 4X/8X slot. So, be very, very careful!

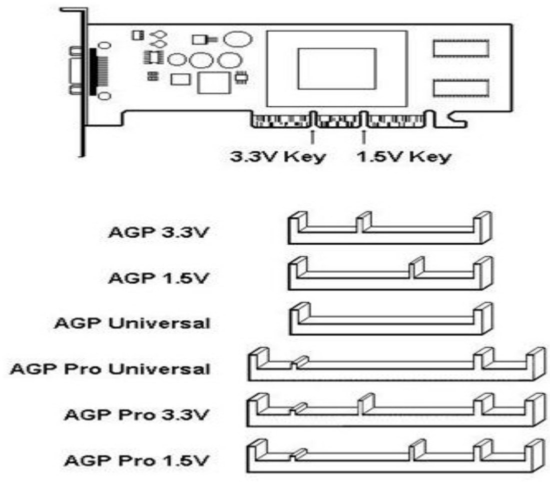


Image created by Windkin 13:25, 21 May 2006 (UTC)

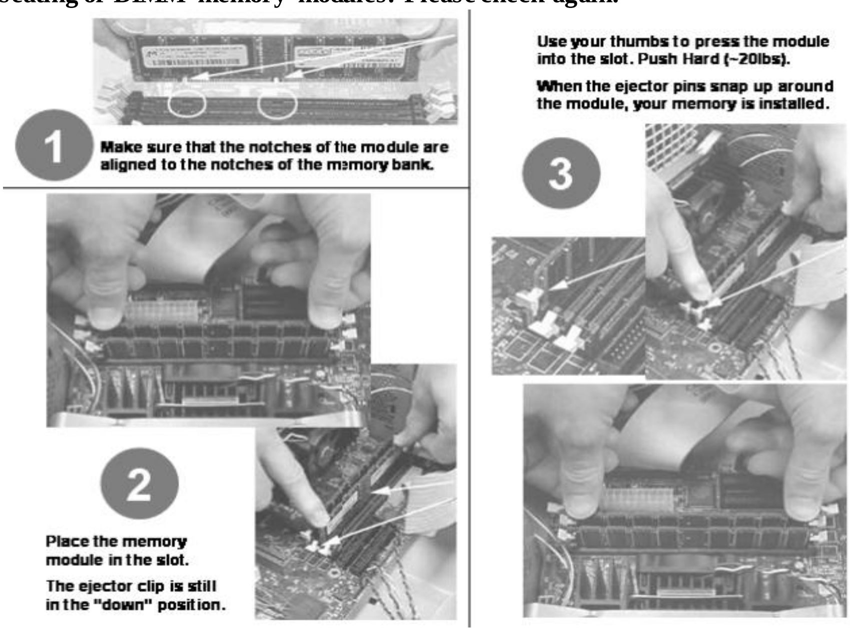
AGP cards are backward and forward compatible within limits. 1.5V-only keyed cards will not go into 3.3V slots and vice versa (but remember what we've just told regarding a sad yet catastrophic exception to this rule), though "Universal" slots exist which accept either type of card. AGP Pro cards (rarely used) will not fit into standard slots, but standard AGP cards will typically work in a Pro slot. Some newer cards like nVidia's GeForce 6-series or ATI's X800-series only have keys for 1.5V to prevent them from being installed in older motherboards without 1.5V support. The graphic cores can only handle 0.8V for AGP8x and 1.5V for AGP4x and will be damaged by 3.3V slots. Some of the last modern cards with 3.3 V support were the nVIDIA GeForce FX5000-series and the ATI Radeon 9500/9700/9800(R350) – but not 9600/9800(R360). Additionally, moving cards between computers of various CPU architectures may not work due to firmware issues.

10. Verify that your memory specifications are supported by your motherboard and that you have placed the memory modules correctly (well seated in the right slots). You will need to consult your motherboard's documentation because not all memory/slot configurations are functional; in the image below you can see a relevant excerpt from a specific motherboard's manual (this is just an illustrative example – your own motherboard may be different):

CAUTION All of the memory configurations below will cause system unable to boot.
(DS: Double Side, SS: Single Side)

	DDR1	DDR2	DDR3	DDR4
1 memory module	X	DS/SS	X	X
	X	X	X	DS/SS
2 memory modules	X	DS/SS	DS/SS	X
	DS/SS	X	X	DS/SS
	X	DS/SS	X	DS/SS
3 memory modules	DS/SS	DS/SS	DS/SS	X
	X	DS/SS	DS/SS	DS/SS
	DS/SS	X	DS/SS	DS/SS
	DS/SS	DS/SS	X	DS/SS

NB: Version 2.0 of this article will contain here a comprehensive guide on confirming the proper seating of DIMM memory modules. Please check again.

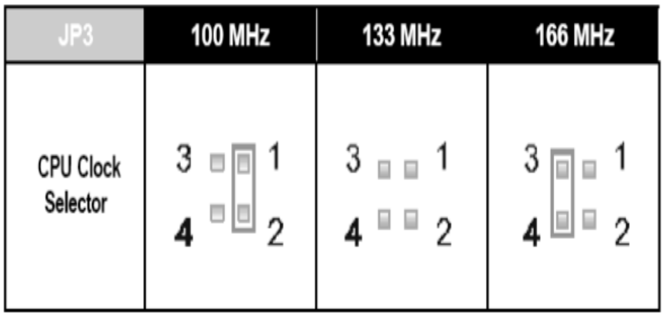


An important note if the memory you are using is SIMM: When installing SIMMs, it is important to remember that most systems (Pentium and newer), require two SIMM modules to make a single bank of memory. Because of this, you need to fill the two slots in a bank with identical modules. However, each bank can hold different size modules. For example, bank 1 (slots 1 and 2) may have two 32MB modules, while bank 2 (slots 3 and 4) may have two 16MB modules. The larger modules must be in the first bank (slots 1 and 2). For most 486-based systems, a memory bank can be single SIMM. Early 486-based systems may require four 30-pins SIMMs to make a single memory bank.

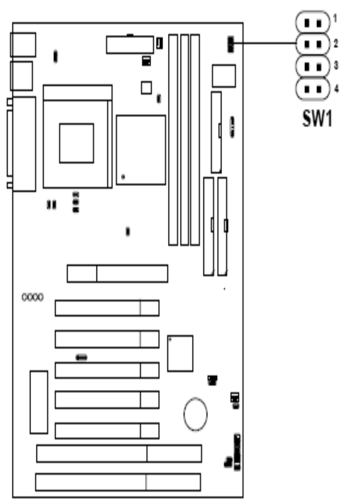
An important note if the memory you are using is 184-pin Rambus RIMMs: These require that all empty memory slots contain a "Continuity Module" (C-RIMM), so you will need to confirm these are also properly in place. In this case, all memory slots are filled (with either a RIMM or a C-RIMM).

11. On motherboards equipped with jumpers to set the FSB speed, verify that the FSB-setting jumpers are in the correct position for your CPU. Consult your motherboard's documentation to confirm what these settings should be. In the image below you can see a relevant excerpt from a specific motherboard's manual (this is just an illustrative example – your own motherboard may be different):

CPU Front Side Bus clock jumper setting



12. On motherboards equipped with jumpers to set the Core/Bus ratio, verify that they are in the correct position for your CPU. Consult your motherboard's documentation to confirm what these settings should be. In the image below you can see a relevant excerpt from a specific motherboard's manual (this is just an illustrative example – your own motherboard may be different):



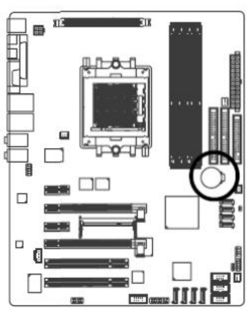
SW1				CPU
1	2	3	4	Core/Bus Ratio
ON	ON	OFF	ON	3
ON	OFF	OFF	ON	3.5
ON	ON	ON	OFF	4
ON	OFF	ON	OFF	4.5
ON	ON	OFF	OFF	5
ON	OFF	OFF	OFF	5.5
OFF	ON	ON	ON	6
OFF	OFF	ON	ON	6.5
OFF	ON	OFF	ON	7
OFF	OFF	OFF	ON	7.5
OFF	ON	ON	OFF	8

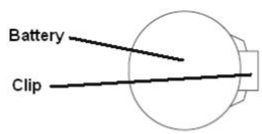
ON = Short OFF = Open

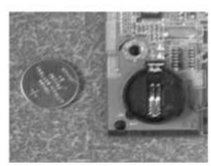
13. Eliminate the possibility that your BIOS is incorrectly set. The first thing to do is to clear the CMOS. You can achieve this by unplugging the power cord and then setting the CMOS jumper (see image in step 5 above) to the "Clear CMOS" position (pins 2-3) for about a minute. From this point

on, whenever your troubleshooting procedure requires you to retest your motherboard under a different configuration (e.g. other CPU, re-flashed BIOS, etc), you will have to repeat this step before moving on. Some motherboards (like MSI K8NGM-V) are equipped with a specific switch that clears the CMOS (you simply press the button in the middle of the connector top side to clear the data – you can see this switch surrounded with a blue circle in the following image):

An alternative way to clear the CMOS is by removing the CMOS battery with the system unplugged for about ten minutes. The CMOS battery is round and silver, and is retained by a small clip. Be careful when you place it again in its position, to seat it with the correct polarity up:







14. Eliminate the possibility that your BIOS is corrupt. Visit the site of your motherboard's manufacturer and locate the correct BIOS version for your system, as well as the respective Flash utility, and follow the instructions that accompany the Flash utility in order to re-flash your BIOS. Beware, though! Before moving on, please read very carefully and make sure you fully understand these important things:

• Make sure that the BIOS version you want to flash matches your motherboard model; that is, you haven't downloaded a wrong BIOS version.

• If your BIOS is flash-protected, please do not enable BIOS Flash Protection under Advanced CMOS Setup (AMI BIOS) or Advanced BIOS Features (AWARD BIOS) in the Setup menu.

• Be very careful when flashing your BIOS, because the power should never be interrupted during the

process – using an appropriate UPS is highly advisable.
• More and more often nowadays the motherboard manufacturers offer to the users the option of updating their BIOS online; that is, the users can visit the proper website and then update their BIOS in pretty much the same way they update any software they have installed in their computer. However, the BIOS is not just another program. The alleged benefits of this method unfortunately have not been widely verified. On the contrary, there has been an extensive feedback from users complaining that their online-flash attempt ultimately failed and, more often than not, resulted in serious mess-ups in the computer. Although this troubleshooting step relates to non-booting computers that anyhow would not be able to connect to the Internet for an online-flash, this is a prime opportunity to urge the reader to avoid using the online-flash option at any cost, and instead adopt the simple, yet fail-safe Flash operation: In other words, to search and locate the right BIOS version for their motherboard, to also search and locate the correct corresponding Flash utility, and then to manually update the BIOS within DOS (usually with a floppy) in accordance with the utility's instructions.

An alternative option for some modern motherboards is that you are given the capability of recovering your BIOS or booting with backup BIOS – check your motherboard's documentation to see if this is applicable in your case. Another option if you do not have Internet access and you do have kept a copy of your BIOS (plus the respective Flash utility if you have an Award BIOS) is to attempt recovering your BIOS in accordance with the following procedures:

a. For AMI BIOS: Rename the desired AMI BIOS file (which normally has an extension signifying its version – e.g. A6712VMS.190) to AMIBOOT.ROM. Insert this floppy disk in the floppy drive. Turn on the system and press and hold Ctrl+Home to force update. Your system will read the AMIBOOT.ROM file and recover the BIOS. When 4 beeps are heard you may remove the floppy disk and restart the computer.

b. For Award BIOS: Make a bootable floppy disk in another PC. Copy the Award Flash utility files & BIOS file to the bootable floppy diskette. Open Notepad and write a command line with the name of your Flash executable followed by a space and the name of the BIOS file. Then save this to the floppy drive and name it as **Autoexec.bat**. Restart your system with this floppy (it can take two minutes before the screen comes out).

15. If you succeeded in re-flashing your BIOS, yet you are still having issues, move on to step 16. If you cannot successfully program your BIOS after having tried all aforementioned options, it might be that you are facing a failed BIOS chip. However, it could still be another device culpable or the whole motherboard altogether; so it is advisable that you connect your motherboard to a minimum set of known good devices (CPU with its heat sink, one memory module, a graphics card or onboard video, and a floppy drive) on a non-conductive surface and retry flashing your BIOS. If you succeed, you have to troubleshoot your devices and peripherals by continuing the procedure. If you are still unsuccessful, weigh the option of getting a replacement BIOS chip against the option of getting a new motherboard.

16. Now that you have confirmed that your BIOS is OK, eliminate the possibility that your case shorts your motherboard. To do so, remove the motherboard from the case and leave on it only the CPU with its heat sink, the memory modules and the graphics card (or onboard video if present). Most probably you will need to unplug and/or disconnect almost everything before doing this, because you may be

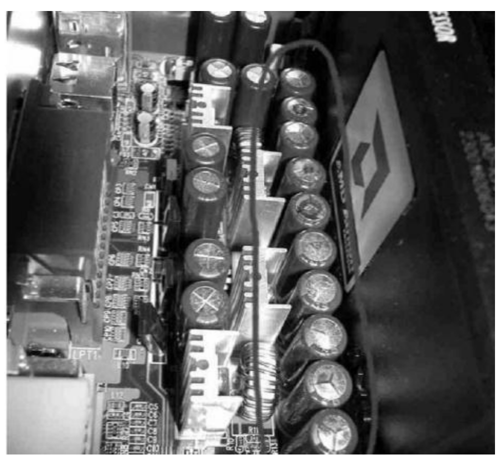
running into the danger of causing damage to the components, in case you attempt such a t ask with everything connected. Keep track of what you unplug or disconnect and from where, and take notes on your motherboard's manual, which you should always have handy next to you. Moreover, it is highly advisable that you unscrew the power supply from the casing and you place it next to the spot on the bench, where you are going to perform this step of the process. Take carefully the motherboard in your hands and place it on a non-conductive surface. Make sure that the heat sink fan is plugg ed to the motherboard and that the needed minimal components (RAM and VGA) are pr operly seated. Plug the power connectors to the mothe rboard (see step 3 above) and ret est to s ee if any message will be posted. If even at the bare-bones configuration still no message is posted, th en move to step 17. If indeed a message is posted when you power the motherboard, then check the case mounting standoffs to verify that they are lining up correctly with the mounting holes on the motherboard and move on to step 21.

17. Eliminate the possibility that a memory module is defective. Repeat step 16 above, this time with one memory module at a time. Be careful to put it in the right slot according to your motherboard's specification. If you do achieve a post with a s pecific memory module, keep it in place and start adding devices in accordance with step 21 below. If you still get no p ost or if your configuration includes a sing le memory module only, find another supported memory module o f known functionality and retest your motherboard. If it posts, it was the memory and you have to replace it.

18. Verify that the CPU Fan is connected to the respective conne ctor. Moreover, make sure the Fan is not defective or obstructed or contacts in anyway the CPU.

19. Eliminate the possibility that the CPU is def ective. Find a supported CPU of known functionality and retest your motherboard. If now it posts, and you have confirmed during step 8 above that the nonworking CPU is ind eed supported by your motherboard, then you are having a failed CPU. If it still does not post, then move to step 20.

20. Verify that the motherboard is in good shape. Carefully examine it visually to determine if there are any components (even very small ones) on the board that look burnt, meted or partially detached, if any clip (e.g the heat sink retainer) or essential c onnector is broken, if th ere are visible traces of the board being scratched or otherwise physically damaged. In addition, carefully examine all capacitors, to make sure they are not bulged or leaking. In the following images you can see some capacitors that exhibit the aforementioned physical signs of failure:



If your motherboard shows any of the above physical damage, then you should consult the TSF experts at the Motherboards, Bios & CPU sub forum, in order to be advised on what to do. There are component issues on a motherboard that can be successfully dealt with by a specialized technician, and some other, simpler ones, where an advanced user can rectify minor discrepancies. However, not all repairs will have a justifiable cost, especially for older or generic motherboards; so, do not hesitate to post a question in the Technical Support Forum. If your board has no damage whatsoever, and it still does not post even after the preceding 20 steps, then you are most probably facing a dead motherboard issue.

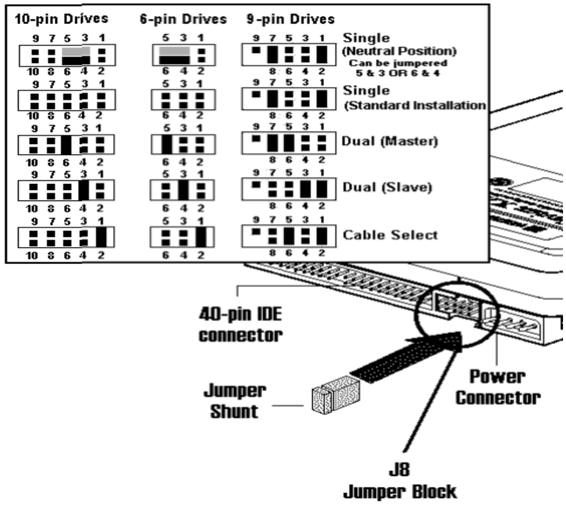
21. Eliminate the possibility that the issue is caused by a device. Place the motherboard in aforementioned bare-bones configuration (step 16 above) back in the case (do not connect any other peripherals yet) and retest it. If it does not post anything, then it is a short for sure and you have to check the mountings as said above. If it posts again like when it was on the bench, then it is a peripheral issue. So, now you have to find the culpable device. Start connecting one peripheral at a time, with this sequence:

a. Keyboard. If yours is a USB one, you may need to enable it through the System Setup utility. If you have a PS/2 unit and your motherboard supports it, try your set-up with this one first until the troubleshooting procedure is successfully concluded. If, however, your only option is a USB keyboard and you intend, after having concluded this troubleshooting procedure, to use this USB keyboard for a Windows XP installation, then be advised that you can face severe problems, as is explained in this article: Universal serial bus (USB) input devices may not work when unsigned drivers are being installed during Windows Setup

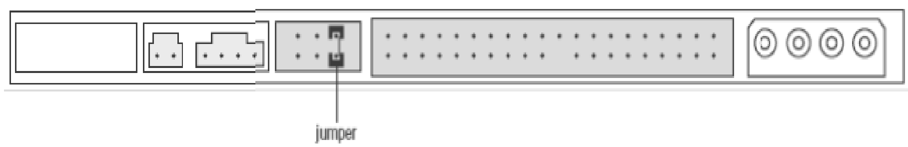
b. VGA card (if you have been testing so far with the onboard video). Do not forget to disable onboard video through the System Setup utility before moving on. Also, keep in mind the compatibility concerns mentioned in step 9 above.

c. Floppy disc drive. When you start adding drives, do not forget to connect them to the power supply and the appropriate data bus. If your floppy cable has a twist, connect your drive to the connector after that twist. If the floppy drive is not working when you attempt booting and its busy light comes on and stays on, then unplug its connector and insert its cable reversely. If the only floppy drive available is a USB one, you may need to enable it through the System Setup utility. However, beware! If you intend, after having concluded this troubleshooting procedure, to use this USB floppy drive for a Windows XP installation, then be advised that the drives which can be used in this case are very specific ones and can be found in this article: A connected USB floppy disk drive does not work when you press F6 to install mass storage drivers during the Windows XP installation process

d. Hard disc drive. Apart from the power connector, do not forget to set its jumpers (Single/Master/Slave) correctly to Single (the image below is for illustrative purposes only – consult your HDD's documentation). If you're HDD supports IDE connect it there, even if you intend ultimately to use it in a SATA/RAID configuration. Even for an IDE drive, you might still need to detect it through BIOS. If it is a SATA-only HDD, then you may need to enable the respective SATA controller through the System Setup utility before moving on.



e. CD-ROM drive. Again, apart from the power connector and the bus cable, do not forget to set its jumpers (Master/Slave) correctly, and that you might still need to detect it through BIOS.



f. Remaining devices. You can continue adding all other devices (mouse, remaining fans, additional drives, PCI cards, etc) one at a time, until you finally spot the malfunctioning one. However, generally speaking it is a good practice to achieve a fully functioning state with your operating system installed first, and then continue with the expansion cards and the additional hard discs. Please keep a very careful eye on installation instructions and restrictions for each one of them. Always consult your motherboards and their own documentation before moving to the next step. Do not forget to set the jumpers in the drives according to the current setup each time and to power them correctly. Also, every time you add another component verify that your BIOS settings reflect correctly your current configuration before booting your system. If you move your hard disc to a SATA/RAID controller, confirm that you have configured the relevant BIOS settings correctly.

g. Special considerations. If you have a removable device such as a Magneto-Optical (MO) disk or a USB Card Reader connected to the computer and you intend, after having concluded this troubleshooting procedure, to install Windows XP in this computer, then be advised that in order to avoid trouble you have to follow a specific procedure laid out in this article: Drive letter that is assigned to the primary hard disk partition is not correct when you perform a CD-ROM-based clean installation of Windows XP. If you have an Iomega Zip drive on the same integrated device electronics (IDE) cable as the hard disk drive, then you can run into this problem: "STOP: C0000221 unknown hard error" or "STOP: C0000221 STATUS_IMAGE_CHECKSUM_MISMATCH" error message occurs. Also, avoid having the Iomega Zip drive connected during a Windows XP installation.

B. You are hearing beeps when you power on your motherboard.

Regardless of error messages that might be posted on your screen, you might also be hearing beeps coming from your motherboard. The beeps correspond to specific error codes which, if you successfully decipher, can help you limit the scope of your troubleshooting endeavour to a narrower spectrum of potentially culpable components. Beware, though! The error beep code that your motherboard is emitting, could be linked to a cause deeper than the one actually identified by the beeps themselves – so, resist the temptation of shortcut-fixes and perform thorough troubleshooting if necessary. For example, it could be that you are getting a component error, but the real culprit is an insufficient power supply; in such a case, replacing the component will not relieve you from the actual problem.

1. High/Low tone (siren sound)

This means that your CPU is overheating. Immediately check and verify that the CPU heat sink is properly installed and correctly connected to the power supply.

2. AMI Beep Codes

With AMI BIOS, your computer will give you one short beep when the system boots successfully. Apart from beep code 8, all other error codes are fatal.

Beeps - Error message

1 short: System RAM refreshes failure

2 short: Memory parity circuit error

3 short: Base 64KB memory failure

4 short: System timer failure

5 short: CPU failure

6 short: 8042 - Gate A20 (keyboard) failure

7 short: Processor exception interrupts error

8 short: Display memory read/write failure

9 short: BIOS ROM checksum error

10 short: CMOS shutdown register read/write error

11 short: Cache memory error

1 long - 3 short: Conventional/Extended memory test failure

1 long - 8 short: Display/Retrace test failure

3. Award Beep Codes
With Award BIOS, your computer will give you one short beep when the system boots successfully. Beware of the fact that the Award BIOS typically is customized by the motherboard manufacturer, so it may very well be that the generic beep codes cited below either do not exist in your own motherboard, or you are hearing an error code that cannot be found here. It is always highly advisable to consult your specific documentation.

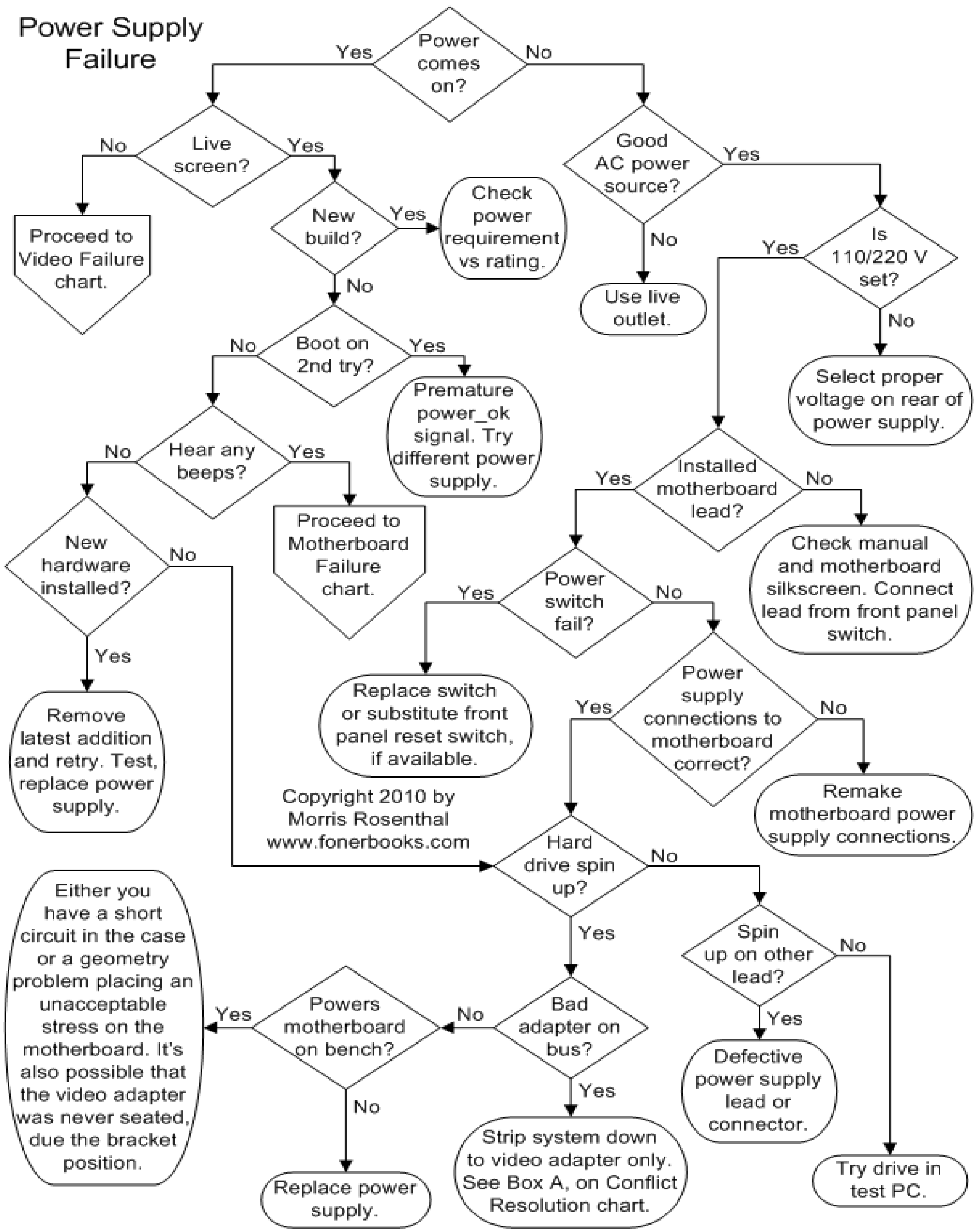
Beeps - Error message
2 short: CMOS setting error
1 long, 1 short: DRAM or Motherboard error
1 long, 2 short: Monitor or display card error
1 long, 3 short: Keyboard error
1 long, 9 short: BIOS ROM error
Continuous long beeps: DRAM error
Continuous short beeps: Power error

4. IBM Beep Codes
In the original/standard IBM set of error codes, your computer will give you one short beep when the system starts the self-test, followed by a Normal Post that indicates it boots successfully.

Beeps - Error message
2 short: Initialization error
1 long, 1 short: System board error
1 long, 2 short: Video adapter error (MDA, CGA)
1 long, 3 short: EGA/VGA Graphics adapter error
3 long: 3270 keyboard adapter error

Repeating short: Power supply or system board problem
Continuous: Power supply, system board, or keyboard problem
None: Power supply or system board problem

5. Compaq Beep Codes
Your computer will give you one short beep when the system boots successfully.
Beeps - Error message
2 short: General error
1 long, 1 short: BIOS ROM checksum error
1 long, 2 short: Video adapter error


Power Supply Failure
Power comes on?
Yes
No
Live screen?
No
Yes
Proceed to Video Failure chart.
New build?
Yes
Check power requirement vs rating.
No
Boot on 2nd try?
No
Yes
Premature power_ok signal. Try different power supply.
Hear any beeps?
No
Yes
Proceed to Motherboard Failure chart.
New hardware installed?
No
Yes
Remove latest addition and retry. Test, replace power supply.
Good AC power source?
Yes
No
Use live outlet.
Is 110/220 V set?
Yes
No
Select proper voltage on rear of power supply.
Installed motherboard lead?
Yes
No
Check manual and motherboard silkscreen. Connect lead from front panel switch.
Power switch fail?
Yes
No
Replace switch or substitute front panel reset switch, if available.
Power supply connections to motherboard correct?
Yes
No
Remake motherboard power supply connections.
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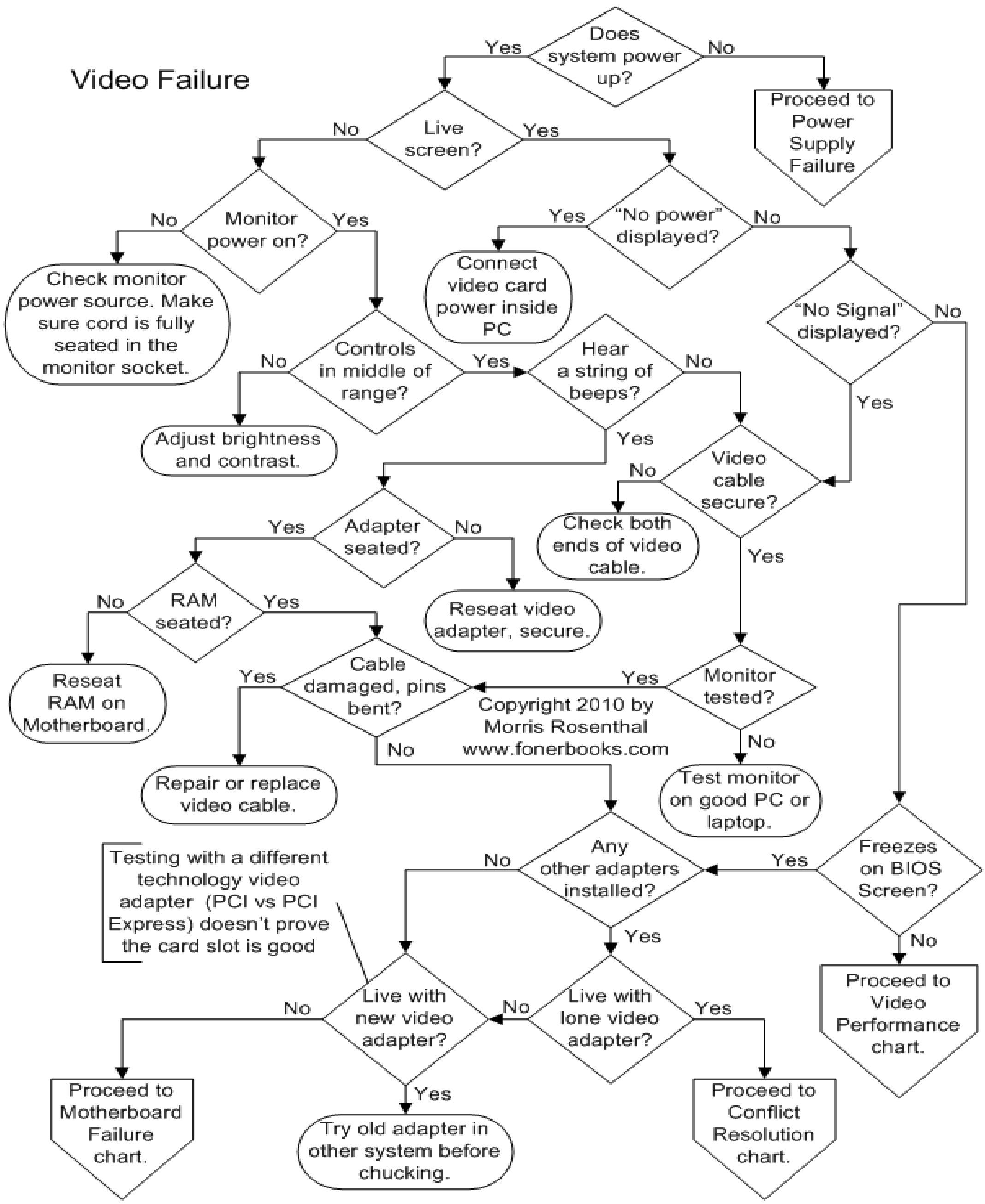
Hard drive spin up?
No
Yes
Spin up on other lead?
No
Yes
Defective power supply lead or connector.
Try drive in test PC.
Bad adapter on bus?
No
Yes
Strip system down to video adapter only. See Box A, on Conflict Resolution chart.
Powers motherboard on bench?
Yes
No
Either you have a short circuit in the case or a geometry problem placing an unacceptable stress on the motherboard. It's also possible that the video adapter was never seated, due the bracket position.
Replace power supply.


Video Failure
Does system power up?
Yes
No
Proceed to Power Supply Failure
Live screen?
No
Yes
Monitor power on?
Check monitor power source. Make sure cord is fully seated in the monitor socket.
Controls in middle of range?
Adjust brightness and contrast.
"No power" displayed?
Connect video card power inside PC
"No Signal" displayed?
Hear a string of beeps?
Video cable secure?
Check both ends of video cable.
Adapter seated?
Reseat video adapter, secure.
RAM seated?
Reseat RAM on Motherboard.
Cable damaged, pins bent?
Repair or replace video cable.
Monitor tested?
Test monitor on good PC or laptop.
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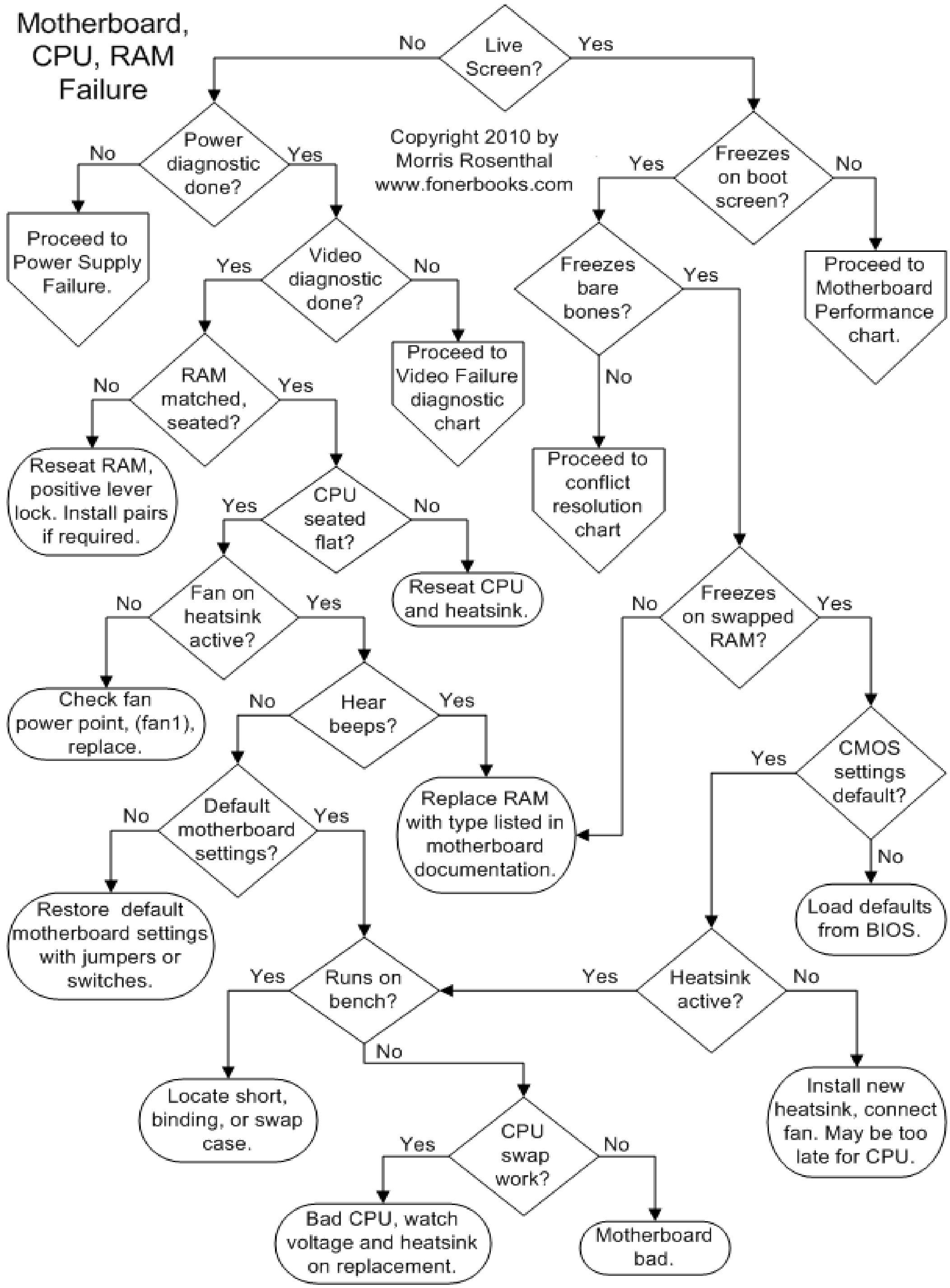
Any other adapters installed?
Freezes on BIOS Screen?
Proceed to Video Performance chart.
Testing with a different technology video adapter (PCI vs PCI Express) doesn't prove the card slot is good
Live with new video adapter?
Live with lone video adapter?
Proceed to Motherboard Failure chart.
Try old adapter in other system before chucking.
Proceed to Conflict Resolution chart.


Motherboard, CPU, RAM Failure
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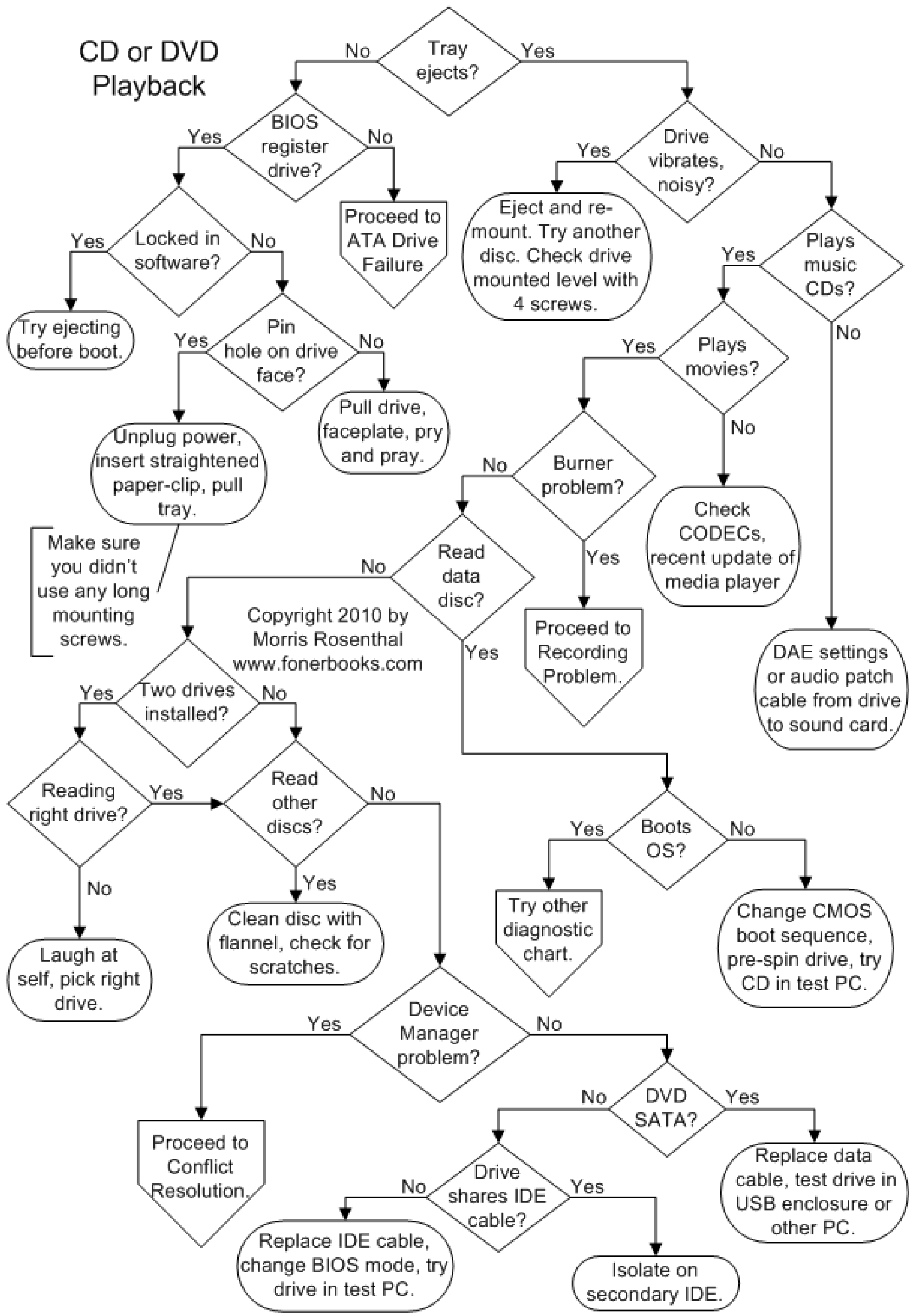
Live Screen?
No
Yes
Power diagnostic done?
Proceed to Power Supply Failure.
Video diagnostic done?
Proceed to Video Failure diagnostic chart
RAM matched, seated?
Reseat RAM, positive lever lock. Install pairs if required.
CPU seated flat?
Reseat CPU and heatsink.
Fan on heatsink active?
Check fan power point, (fan1), replace.
Hear beeps?
Replace RAM with type listed in motherboard documentation.
Default motherboard settings?
Restore default motherboard settings with jumpers or switches.
Runs on bench?
Locate short, binding, or swap case.
CPU swap work?
Bad CPU, watch voltage and heatsink on replacement.
Motherboard bad.
Freezes on boot screen?
Proceed to Motherboard Performance chart.
Freezes bare bones?
Proceed to conflict resolution chart
Freezes on swapped RAM?
CMOS settings default?
Load defaults from BIOS.
Heatsink active?
Install new heatsink, connect fan. May be too late for CPU.


CD or DVD Playback
Tray ejects?
No
Yes
BIOS register drive?
Yes
No
Proceed to ATA Drive Failure
Locked in software?
Yes
No
Try ejecting before boot.
Pin hole on drive face?
Yes
No
Unplug power, insert straightened paper-clip, pull tray.
Pull drive, faceplate, pry and pray.
Make sure you didn't use any long mounting screws.
Drive vibrates, noisy?
Yes
No
Eject and re-mount. Try another disc. Check drive mounted level with 4 screws.
Plays music CDs?
Yes
No
Plays movies?
Yes
No
Check CODECs, recent update of media player
DAE settings or audio patch cable from drive to sound card.
Burner problem?
No
Yes
Proceed to Recording Problem.
Read data disc?
No
Yes
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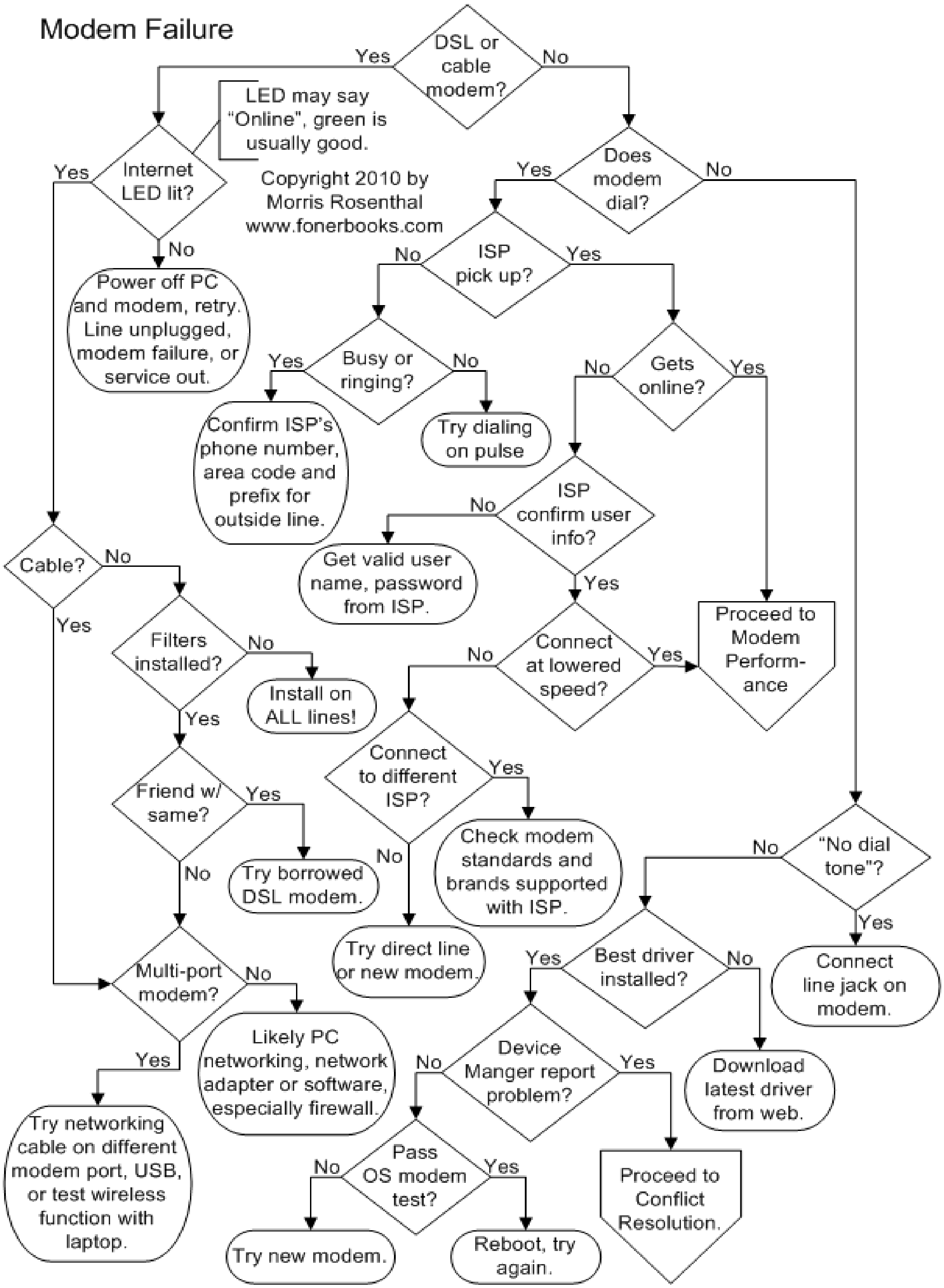
Two drives installed?
Yes
No
Reading right drive?
Yes
No
Laugh at self, pick right drive.
Read other discs?
Yes
No
Clean disc with flannel, check for scratches.
Boots OS?
Yes
No
Try other diagnostic chart.
Change CMOS boot sequence, pre-spin drive, try CD in test PC.
Device Manager problem?
Yes
No
Proceed to Conflict Resolution.
DVD SATA?
No
Yes
Replace data cable, test drive in USB enclosure or other PC.
Drive shares IDE cable?
No
Yes
Replace IDE cable, change BIOS mode, try drive in test PC.
Isolate on secondary IDE.


Modem Failure
DSL or cable modem?
Yes
No
LED may say "Online", green is usually good.
Internet LED lit?
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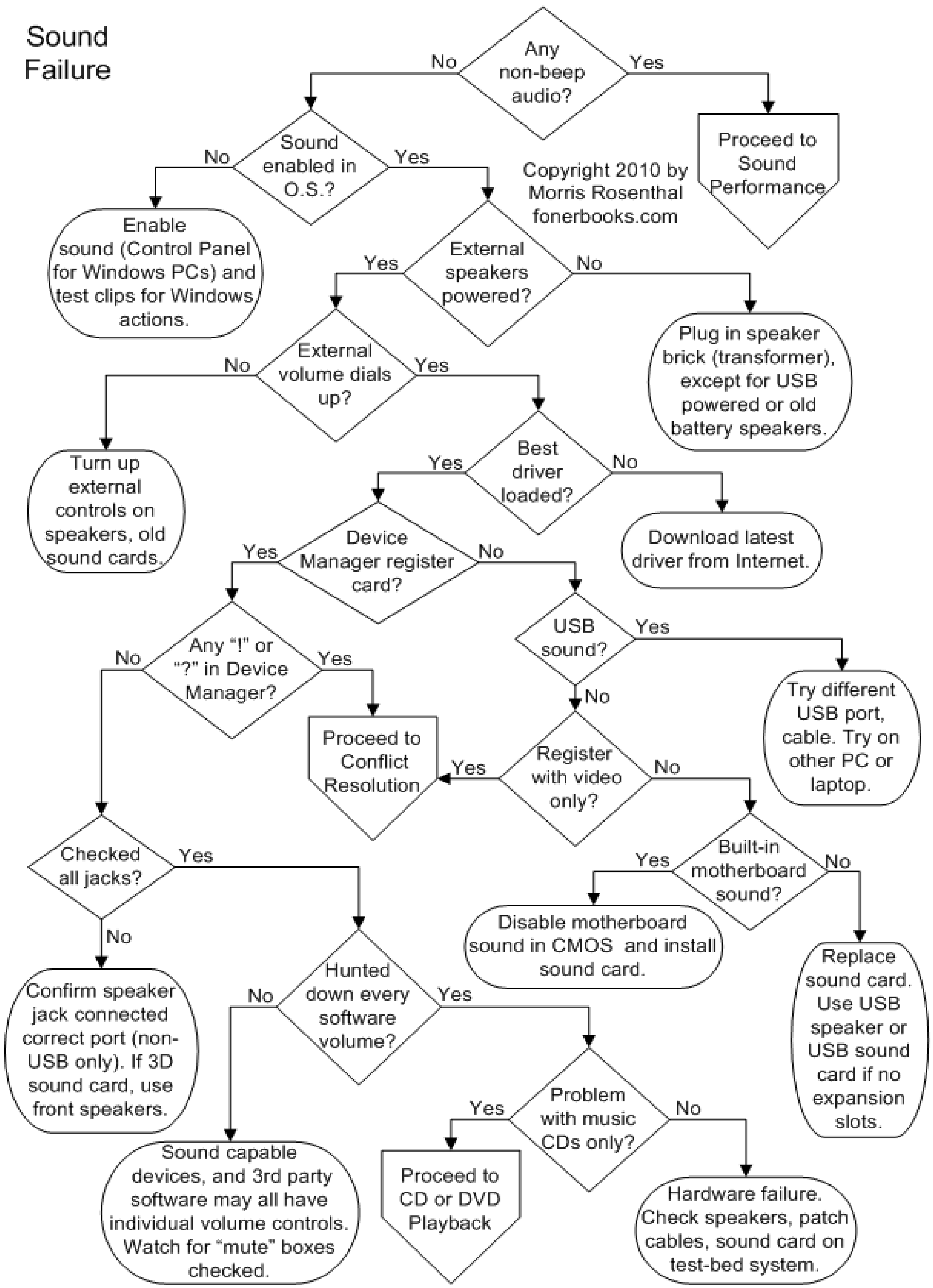
Does modem dial?
No
Power off PC and modem, retry. Line unplugged, modem failure, or service out.
ISP pick up?
Busy or ringing?
Confirm ISP's phone number, area code and prefix for outside line.
Try dialing on pulse
Gets online?
ISP confirm user info?
Get valid user name, password from ISP.
Cable?
Filters installed?
Install on ALL lines!
Connect at lowered speed?
Proceed to Modem Perform-ance
Friend w/ same?
Try borrowed DSL modem.
Connect to different ISP?
Check modem standards and brands supported with ISP.
"No dial tone"?
Try direct line or new modem.
Multi-port modem?
Likely PC networking, network adapter or software, especially firewall.
Best driver installed?
Connect line jack on modem.
Try networking cable on different modem port, USB, or test wireless function with laptop.
Device Manger report problem?
Download latest driver from web.
Pass OS modem test?
Proceed to Conflict Resolution.
Try new modem.
Reboot, try again.


Sound Failure
Any non-beep audio?
No
Yes
Proceed to Sound Performance
Sound enabled in O.S.?
No
Yes
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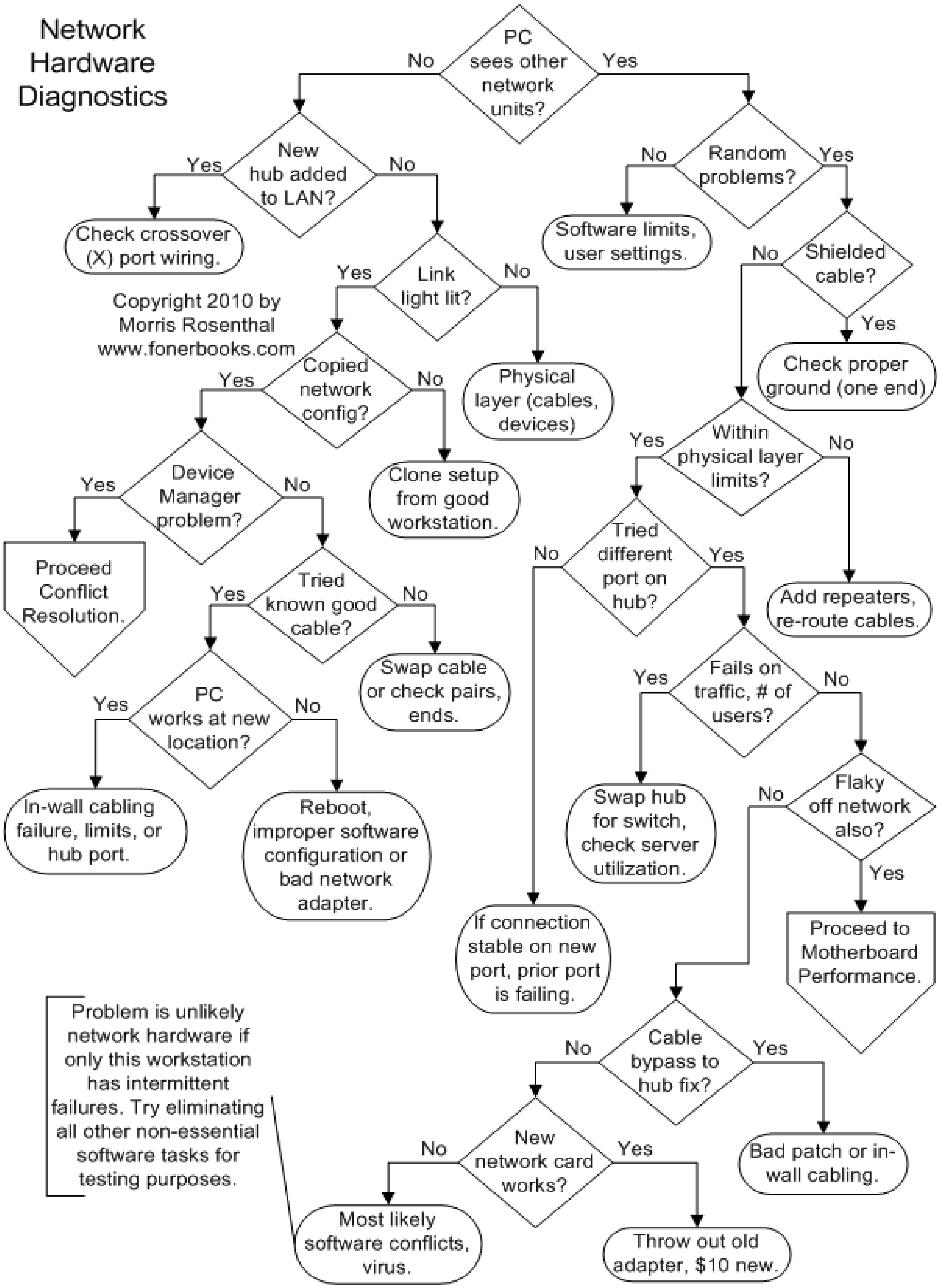
Enable sound (Control Panel for Windows PCs) and test clips for Windows actions.
External speakers powered?
Yes
No
Plug in speaker brick (transformer), except for USB powered or old battery speakers.
External volume dials up?
No
Yes
Turn up external controls on speakers, old sound cards.
Best driver loaded?
Yes
No
Download latest driver from Internet.
Device Manager register card?
Yes
No
USB sound?
Yes
No
Try different USB port, cable. Try on other PC or laptop.
Any "!" or "?" in Device Manager?
No
Yes
Proceed to Conflict Resolution
Register with video only?
Yes
No
Built-in motherboard sound?
Yes
No
Disable motherboard sound in CMOS and install sound card.
Replace sound card. Use USB speaker or USB sound card if no expansion slots.
Checked all jacks?
Yes
No
Confirm speaker jack connected correct port (non-USB only). If 3D sound card, use front speakers.
Hunted down every software volume?
No
Yes
Sound capable devices, and 3rd party software may all have individual volume controls. Watch for "mute" boxes checked.
Problem with music CDs only?
Yes
No
Proceed to CD or DVD Playback
Hardware failure. Check speakers, patch cables, sound card on test-bed system.


Network Hardware Diagnostics
PC sees other network units?
No
Yes
New hub added to LAN?
Yes
No
Check crossover (X) port wiring.
Link light lit?
Yes
No
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Copied network config?
Physical layer (cables, devices)
Clone setup from good workstation.
Device Manager problem?
Proceed Conflict Resolution.
Tried known good cable?
Swap cable or check pairs, ends.
PC works at new location?
In-wall cabling failure, limits, or hub port.
Reboot, improper software configuration or bad network adapter.
Random problems?
Software limits, user settings.
Shielded cable?
Check proper ground (one end)
Within physical layer limits?
Add repeaters, re-route cables.
Tried different port on hub?
Fails on traffic, # of users?
Swap hub for switch, check server utilization.
Flaky off network also?
Proceed to Motherboard Performance.
If connection stable on new port, prior port is failing.
Cable bypass to hub fix?
Bad patch or in-wall cabling.
New network card works?
Most likely software conflicts, virus.
Throw out old adapter, $10 new.
Problem is unlikely network hardware if only this workstation has intermittent failures. Try eliminating all other non-essential software tasks for testing purposes.

Chapter - 17
Computer Network

A computer network, often simply referred to as a network, is a collection of computers and devices interconnected by communications channels that facilitate communications and allows sharing of resources and information among interconnected devices. Computer networking or Data communications (Datacom) is the engineering discipline concerned with the computer networks. Computer networking is sometimes considered a sub-discipline of electrical engineering, telecommunications, computer science, information technology and/or computer engineering since it relies heavily upon the theoretical and practical application of these scientific and engineering disciplines.

The three types of networks are: the Internet, the intranet, and the extranet. Examples of different network methods are:

- Local area network (LAN), which is usually a small network constrained to a small geographic area. An example of a LAN would be a computer network within a building.
- Metropolitan area network (MAN), which is used for medium size area. examples for a city or a state.
- Wide area network (WAN) that is usually a larger network that covers a large geographic area.
- Wireless LANs and WANs (WLAN & WWAN) are the wireless equivalent of the LAN and WAN.

Networks may be classified according to a wide variety of characteristics such as topology, connection method and scale.

All networks are interconnected to allow communication with a variety of different kinds of media, including twisted-pair copper wire cable, coaxial cable, optical fiber, power lines and various wireless technologies. The devices can be separated by a few meters (e.g. via Bluetooth) or nearly unlimited distances (e.g. via the interconnections of the Internet). Networking, routers, routing protocols, and networking over the public Internet have their specifications defined in documents called RFCs

- **Purpose**

Computer networks can be used for a variety of purposes:

Facilitating communications
Using a network, people can communicate efficiently and easily via email, instant messaging, chat rooms, telephone, video telephone calls, and video conferencing.

Sharing hardware
In a networked environment, each computer on a network may access and use hardware resources on the network, such as printing a document on a shared network printer.

Sharing files, data, and information
In a network environment, authorized user may access data and information stored on other computers on the network. The capability of providing access to data and information on shared storage devices is an important feature of many networks.

Sharing software
Users connected to a network may run application programs on remote computers.

Network Classification Categories:

The following list presents categories used for classifying networks.

Connection method

Computer networks can be classified according to the hardware and software technology that is used to interconnect the individual devices in the network, such as optical fiber, Ethernet, wireless LAN, Home PNA, power line communication or G.hn.Ethernet as it is defined by IEEE 802 utilizes various standards and mediums that enable communication between devices. Frequently deployed devices include hubs, switches, bridges, or routers. Wireless LAN technology is designed to connect devices without wiring. These devices use radio waves or infrared signals as a transmission medium. ITU-T G.hn technology uses existing home wiring (coaxial cable, phone lines and power lines) to create a high-speed (up to 1 Gigabit/s) local area network.

- ***Wired technologies***

- *Twisted pair wire* is the most widely used medium for telecommunication. Twisted-pair cabling consist of copper wires that are twisted into pairs. Ordinary telephone wires consist of two insulated copper wires twisted into pairs. Computer networking cabling consist of 4 pairs of copper cabling that can be utilized for both voice and data transmission. The use of two wires twisted together helps to reduce crosstalk and electromagnetic induction. The transmission speed ranges from 2 million bits per second to 100 million bits per second. Twisted pair cabling comes in two forms which are Unshielded Twisted Pair (UTP) and Shielded twisted-pair (STP) which are rated in categories which are manufactured in different increments for various scenarios.

- *Coaxial cable* is widely used for cable television systems, office buildings, and other work-sites for local area networks. The cables consist of copper or aluminum wire wrapped with insulating layer typically of a flexible material with a high dielectric constant, all of which are surrounded by a conductive layer. The layers of insulation help minimize interference and distortion. Transmission speed range from 200 million to more than 500 million bits per second.

- *Optical fiber cable* consists of one or more filaments of glass fiber wrapped in protective layers that carries a data by means of pulses of light. It transmits light which can travel over extended distances. Fiber-optic cables are not affected by electromagnetic radiation. Transmission speed may reach trillions of bits per second. The transmission speed of fiber optics is hundreds of times faster than for coaxial cables and thousands of times faster than a twisted-pair wire.A recent innovation in fiber-optic cable is the use of colored light.Instead of carrying one message in a stream of white light impulses, this technology can carry multiple signals in a single strand.

- *Terrestrial Terrestrial* microwaves use Earth-based transmitter and receiver. The equipment looks similar to satellite dishes . Terrestrial microwaves use low-gigahertz range, which limits all communications to line-of-sight. Path between relay stations spaced approx, 30 miles apart. Microwave antennas are usually placed on top of buildings, towers, hills, and mountain peaks.

- *Communications satellite*– The satellites use microwave radio as their telecommunications medium which are not deflected by the Earth's atmosphere. The satellites are stationed in space,. These Earth-orbiting systems are capable of receiving and relaying voice, data, and TV signals.

- *Cellular and PCS systems*– Use several radio communications technologies. The systems are divided to different geographic areas. Each area has a low-power transmitter or radio relay antenna device to relay calls from one area to the next area.

- *Wireless LANs*– Wireless local area network use a high-frequency radio technology similar to digital cellular and a low-frequency radio technology. Wireless LANs use spread spectrum technology to enable communication between multiple devices in a limited area. An example of open-standards wireless radio-wave technology is IEEE.

- *Infrared communication* , which can transmit signals between devices within small distances not more than 10 meters peer to peer or (face to face) without any body in the line of transmitting.

➢ ***Scale***

Networks are often classified as local area network (LAN), wide area network (WAN), metropolitan area network (MAN), personal area network (PAN), virtual private network (VPN), campus area network (CAN), storage area network (SAN), and others, depending on their scale, scope and purpose, e.g., controller area network (CAN) usage, trust level, and access right often differ between these types of networks. LANs tend to be designed for internal use by an organization's internal systems and employees in individual physical locations, such as a building, while WANs may connect physically separate parts of an organization and may include connections to third parties.

➢ ***Network topology***

Computer networks may be classified according to the network topology upon which the network is based, such as bus network, star network, ring network, mesh network. Network topology is the coordination by which devices in the network are arranged in their logical relations to one another, independent of physical arrangement. Even if networked computers are physically placed in a linear arrangement and are connected to a hub, the network has a star topology, rather than a bus topology. In this regard the visual and operational characteristics of a network are distinct. Networks may be classified based on the method of data used to convey the data, these include digital and analog networks.

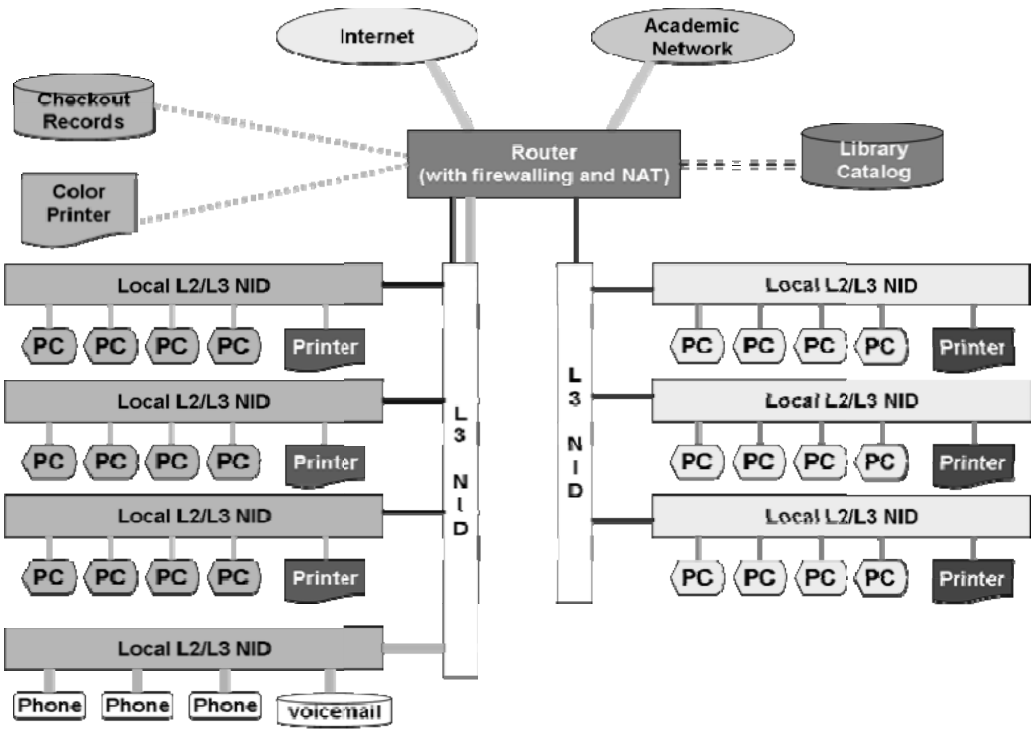
- **Network classifications:**

Networks can be classified and named by their physical extent, and intended purpose. Common types of computer networks are outlined below.

- ***Local area network***

A local area network (LAN) is a network that connects computers and devices in a limited geographical area such as home, school, computer laboratory, office building, or closely positioned group of buildings. Each computer or device on the network is a node. Current wired LANs are most likely to be based on Ethernet technology, although new standards like ITU-T G.hn also provide a way to create a wired LAN using existing home wires (coaxial cables, phone lines and power lines).

Typical library network, in a branching tree topology and controlled access to resources



All interconnected devices must understand the network layer (layer 3), because they are handling multiple subnets (the different colors). Those inside the library, which have only 10/100 Mbit/s Ethernet connections to the user device and a Gigabit Ethernet connection to the central router, could be called "layer 3 switches" because they only have Ethernet interfaces and must understand IP. It would be more correct to call them access routers, where the router at the top is a distribution router that connects to the Internet and academic networks' customer access routers.

The defining characteristics of LANs, in contrast to WANs (Wide Area Networks), include their higher data transfer rates, smaller geographic range, and no need for leased telecommunication lines. Current Ethernet or other IEEE 802.3 LAN technologies operate at speeds up to 10 Gbit/s. This is the data transfer rate. IEEE has projects investigating the standardization of 40 and 100 Gbit/s.

❖ ***Personal area network***

A personal area network (PAN) is a computer network used for communication among computer and different information technological devices close to one person. Some examples of devices that are used in a PAN are personal computers, printers, fax machines, telephones, PDAs, scanners, and even video game consoles. A PAN may include wired and wireless devices. The reach of a PAN typically extends to 10 meters. A wired PAN is usually constructed with USB and Firewire connections while technologies such as Bluetooth and infrared communication typically form a wireless PAN.

❖ ***Home area network***

A home area network (HAN) is a residential LAN which is used for communication between digital devices typically deployed in the home, usually a small number of personal computers and accessories, such as printers and mobile computing devices. An important function is the sharing of Internet access, often a broadband service through a CATV or Digital Subscriber Line (DSL) provider. It can also be referred to as an office area network (OAN).

❖ **Wide area network**

A wide area network (WAN) is a computer network that covers a large geographic area such as a city, country, or spans even intercontinental distances, using a communications channel that combines many types of media such as telephone lines, cables, and air waves. A WAN often uses transmission facilities provided by common carriers, such as telephone companies. WAN technologies generally function at the lower three layers of the OSI reference model: the physical layer, the data link layer, and the network layer.

❖ ***Campus network***

A campus network is a computer network made up of an interconnection of local area networks (LANs) within a limited geographical area. The networking equipment (switches, routers) and transmission media (optical fiber, copper plant, Cat5 cabling etc.) are almost entirely owned (by the campus tenant / owner: an enterprise, university, government etc.).In the case of a university campus-based campus network, the network is likely to link a variety of campus buildings including, for example, academic colleges or departments, the university library, and student residence halls.

❖ **Metropolitan area network**

A Metropolitan area network (MAN) is a large computer network that usually spans a city or a large campus.

Enterprise private network

An enterprise private network is a network build by an enterprise to interconnect various company sites, e.g., production sites, head offices, remote offices, shops, in order to share computer resources.

Internetwork

An internetwork is the connection of two or more private computer networks via a common routing technology (OSI Layer 3) using routers. The Internet is an aggregation of many internetworks; hence its name was shortened to Internet.

Backbone network

A Backbone network or network backbone is part of a computer network infrastructure that interconnects various pieces of network, providing a path for the exchange of information between different LANs or sub networks. A backbone can tie together diverse networks in the same building, in different buildings in a campus environment, or over wide areas. Normally, the backbone's capacity is greater than the networks connected to it. A large corporation that has many locations may have a backbone network that ties all of the locations together, for example, if a server cluster needs to be accessed by different departments of a company that are located at different geographical locations. The pieces of the network connections (for example: Ethernet, wireless) that bring these departments together is often mentioned as network backbone. Network congestion is often taken into consideration while designing backbones. Backbone networks should not be confused with the Internet backbone.

Global area network

A global area network (GAN) is a network used for supporting mobile communications across an arbitrary number of wireless LANs, satellite coverage areas, etc. The key challenge in mobile communications is handing off the user communications from one local coverage area to the next. In IEEE Project 802, this involves a succession of terrestrial wireless LANs.[11]

Internet

The Internet is a global system of interconnected governmental, academic, corporate, public, and private computer networks. It is based on the networking technologies of the Internet Protocol Suite. It is the successor of the Advanced Research Projects Agency Network (ARPANET) developed by DARPA of the United States Department of Defense. The Internet is also the communications backbone underlying the World Wide Web (WWW).Participants in the Internet use a diverse array of methods of several hundred documented, and often standardized, protocols compatible with the Internet Protocol Suite and an addressing system (IP addresses) administered by the Internet Assigned Numbers Authority and address registries. Service providers and large enterprises exchange information about the reach ability of their address spaces through the Border Gateway Protocol (BGP), forming a redundant worldwide mesh of transmission paths.

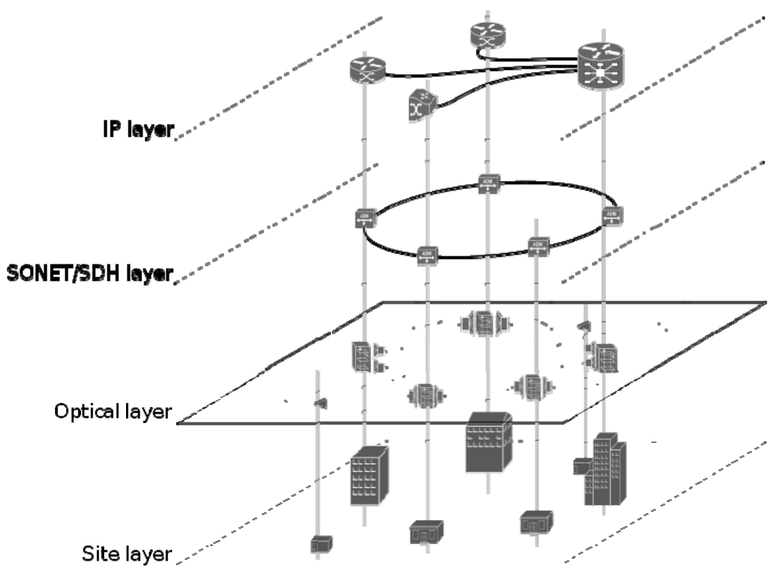
Intranets and extranets

Intranets and extranets are parts or extensions of a computer network, usually a local area network. An intranet is a set of networks, using the Internet Protocol and IP-based tools such as web browsers and file transfer applications that are under the control of a single administrative entity. That administrative entity closes the intranet to all but specific, authorized users. Most commonly, an intranet is the internal network of an organization. A large intranet will typically have at least one web server to provide users with organizational information. An extranet is a network that is limited in scope to a single organization or entity and also has limited connections to the networks of one or more other usually, but not necessarily, trusted organizations or entities—a company's customers may be given access to some part of its intranet—while at the same time the customers may not be considered *trusted* from a security standpoint. Technically, an extranet may also be categorized as a CAN, MAN, WAN, or other type of network, although an extranet cannot consist of a single LAN; it must have at least one connection with an external network.

Overlay network

An overlay network is a virtual computer network that is built on top of another network. Nodes in the overlay are connected by virtual or logical links, each of which corresponds to a path, perhaps through many physical links, in the underlying network.

A sample overlay network: IP over SONET over Optical



For example, many peer-to-peer networks are overlay networks because they are organized as nodes of a virtual system of links run on top of the Internet. The Internet was initially built as an overlay on the telephone network . Overlay networks have been around since the invention of networking when computer systems were connected over telephone lines using modem, before any data network existed. Nowadays the Internet is the basis for many overlaid networks that can be constructed to permit routing of messages to destinations specified by an IP address. For example, distributed hash tables can be used to route messages to a node having a specific logical address, whose IP address is known in advance. Overlay networks have also been proposed as a way to improve Internet routing, such as through quality of service guarantees to achieve higher-quality streaming media. Previous proposals such as

IntServ, DiffServ, and IP Multicast have not seen wide acceptance largely because they require modification of all routers in the network. On the other hand, an overlay network can be incrementally deployed on end-hosts running the overlay protocol software, without cooperation from Internet service providers. The overlay has no control over how packets are routed in the underlying network between two overlay nodes, but it can control, for example, the sequence of overlay nodes a message traverses before reaching its destination. For example, Akamai Technologies manages an overlay network that provides reliable, efficient content delivery (a kind of multicast). Academic research includes End System Multicast and Overcast for multicast; RON (Resilient Overlay Network) for resilient routing; and OverQoS for quality of service guarantees, among others

- **Basic hardware components**

All networks are made up of basic hardware building blocks to interconnect network nodes, such as Network Interface Cards (NICs), Bridges, Hubs, Switches, and Routers. In addition, some method of connecting these building blocks is required, usually in the form of galvanic cable (most commonly Category 5 cable). Less common are microwave links (as in IEEE 802.12) or optical cable ("optical fiber").

- ***Network interface cards***

A network card, network adapter, or NIC (network interface card) is a piece of computer hardware designed to allow computers to communicate over a computer network. It provides physical access to a networking medium and often provides a low-level addressing system through the use of addresses. Each network interface card has its unique id. This is written on a chip which is mounted on the card.

- **Repeaters**

A repeater is an electronic device that receives a signal, cleans it of unnecessary noise, regenerates it, and retransmits it at a higher power level, or to the other side of an obstruction, so that the signal can cover longer distances without degradation. In most twisted pair Ethernet configurations, repeaters are required for cable that runs longer than 100 meters. A repeater with multiple ports is known as a hub. Repeaters work on the Physical Layer of the OSI model. Repeaters require a small amount of time to regenerate the signal. This can cause a propagation delay which can affect network communication when there are several repeaters in a row. Many network architectures limit the number of repeaters that can be used in a row (e.g. Ethernet's 5-4-3 rule).

- ***Bridges***

A network bridge connects multiple network segments at the data link layer (layer 2) of the OSI model. Bridges broadcast to all ports except the port on which the broadcast was received. However, bridges do not promiscuously copy traffic to all ports, as hubs do, but learn which MAC addresses are reachable through specific ports. Once the bridge associates a port and an address, it will send traffic for that address to that port only. Bridges learn the association of ports and addresses by examining the source address of frames that it sees on various ports. Once a frame arrives through a port, its source address is stored and the bridge assumes that MAC address is associated with that port. The first time that a previously unknown destination address is seen, the bridge will forward the frame to all ports other than the one on which the frame arrived.

Bridges come in three basic types:

- Local bridges: Directly connect local area networks (LANs)
- Remote bridges: Can be used to create a wide area network (WAN) link between LANs. Remote bridges, where the connecting link is slower than the end networks, largely have been replaced with routers.
- Wireless bridges: Can be used to join LANs or connect remote stations to LANs.

➢ ***Switches***

A network switch is a device that forwards and filters OSI layer 2 data grams (chunks of data communication) between ports (connected cables) based on the MAC addresses in the packets. A switch is distinct from a hub in that it only forwards the frames to the ports involved in the communication rather than all ports connected. A switch breaks the collision domain but represents itself as a broadcast domain. Switches make forwarding decisions of frames on the basis of MAC addresses. A switch normally has numerous ports, facilitating a star topology for devices, and cascading additional switches. Some switches are capable of routing based on Layer 3 addressing or additional logical levels; these are called multi-layer switches. The term *switch* is used loosely in marketing to encompass devices including routers and bridges, as well as devices that may distribute traffic on load or by application content (e.g., a Web URL identifier).

➢ **Views of networks**

Users and network administrators typically have different views of their networks. Users can share printers and some servers from a work group, which usually means they are in the same geographic location and are on the same LAN, whereas a Network Administrator is responsible to keep that network up and running. A community of interest has less of a connection of being in a local area, and should be thought of as a set of arbitrarily located users who share a set of servers, and possibly also communicate via peer-to-peer technologies.

Network administrators can see networks from both physical and logical perspectives. The physical perspective involves geographic locations, physical cabling, and the network elements (e.g., routers, bridges and application layer gateways that interconnect the physical media. Logical networks, called, in the TCP/IP architecture, subnets, map onto one or more physical media. For example, a common practice in a campus of buildings is to make a set of LAN cables in each building appear to be a common subnet, using virtual LAN (VLAN) technology. Both users and administrators will be aware, to varying extents, of the trust and scope characteristics of a network. Again using TCP/IP architectural terminology, an intranet is a community of interest under private administration usually by an enterprise, and is only accessible by authorized users (e.g. employees). Intranets do not have to be connected to the Internet, but generally have a limited connection. An extranet is an extension of an intranet that allows secure communications to users outside of the intranet (e.g. business partners, customers).

Unofficially, the Internet is the set of users, enterprises, and content providers that are interconnected by Internet Service Providers (ISP). From an engineering viewpoint, the Internet is the set of subnets, and aggregates of subnets, which share the registered IP address space and exchange information about the reach ability of those IP addresses using the Border Gateway Protocol. Typically, the human-readable names of serv ers are t ranslated to IP addresses, t ransparently to users, via the directory function of the Domain Name System (DNS).

Over the Internet, there can be business-to-business (B2B), business-to-consumer (B2C) and consumer-to-consumer (C2C) communications. Especially when money or sensitive information is e xchanged, the communications are apt to be **secured** by some form of c ommunications security mechanism. Intranets and extranets can be securely superimposed onto the Internet, without any access by general Internet users and administrators, using secure Virtual Private Network (VPN) technology

Chapter - 18
History of Laptop

It is a little hard to determine what the first portable was or laptop computer, the first portable computers did not look like the book-sized and folding laptops that we are familiar with to day, however, they were both portable and capable, and lead to the development of notebook style laptops. I have outlined several potential firsts below and how each qualifies, many of the off-site links provide good photos of the computers that will let you see the progression in design.

The First Laptop may be Designed in 1979 by a Briton, William Moggridge, for Grid Systems Corporation, the Grid Compass was one fifth the weight of any model equivalent in performance and was used by NASA on the space shuttle program in the early 1980's. A 340K byte bubble memory laptop computer with die-cast magnesium case and folding electroluminescent graphics display screen.

Gavilan Computer as the First Laptop

Manny Fernandez had the idea for a well-designed laptop for executives who were starting to use computer. Fernandez, who started Gavilan Computer, promoted his machines as the first " laptop" computers in May 1983. Many historians consider the Gavilan as the first fully functional laptop computer.

The First Laptop Computer - Osborne 1

The computer considered by most historians to be the first true portable computer was the Osborne 1. Adam Osborne, an ex-book publisher founded Osborne Computer and produced the Osborne 1 in 1981, a portable computer that weighed 24 pounds and cost $1795. The Osborne 1 came with a five-inch screen, modem port, two 5 1/4 floppy drives, a large collection of bundled software programs, and a battery pack. The short-lived computer company was never successful.

More History of Laptop Firsts

- Also released in 1981, was the Epson HX-20, a battery powered portable computer, with a 20-character by 4 line LCD display and a built-in printer.
- In January of 1982, Microsoft's Kazuhiko Nishi and Bill Gates begin discussions on designing a portable computer, based on using a new liquid crystal display or LCD screen. Kazuhiko Nishi later showed the prototype to Radio Shack who agree to manufacture the computer.
- In 1983, Radio Shack released the TRS-80 Model 100, a 4 lb. battery operated portable computer with a flat and more of a laptop design.
- In February 1984, IBM announced the IBM 5155 Portable Personal Computer.
- Three years later in 1986, Radio Shack released the improved and smaller TRS Model 200.
- In 1988, Compaq Computer introduces its first laptop PC with VGA graphics - the Compaq SLT/286.
- In 1989, NEC UltraLite was released, considered by some to be the first "notebook style" computer. It was a laptop size computer which weighed less than 5 lbs.
- In September 1989, Apple Computer released the first Macintosh Portable that later evolved into the Power book.
- In 1989, Zenith Data Systems released the Zenith Minis Port, a 6-pound laptop computer. (more Zenith laptops)

- In October 1989, Compaq Computer released its first notebook PC, the Compaq LTE.
- In March 1991, Microsoft released the Microsoft BallPoint Mouse that used both mouse and trackball technology in a pointing device designed for laptop computers.
- In October 1991, Apple Computers released the Macintosh PowerBook 100, 140, and 170 - all notebook style laptops.
- In October 1992, IBM released its ThinkPad 700 laptop computer.
- In 1992, Intel and Microsoft release APM or the Advanced Power Management specification for laptop computers.
- In 1993, the first PDAs or Personal Digital Assistants are released. PDAs are pen-based hand-held computers.
- Who Invented It?
  The laptop computer was invented by Adam Osborne in 1981. It was called the "Osborne 1" and cost $1795. It came bundled with $1500 worth of programs. It had a tiny computer screen built into it.
- What is a laptop computer?
  A laptop is a computer that can be folded up and carried around.
- When was the laptop invented?
  The laptop was invented in 1981.
- Where was it invented?
  It was invented by Osborne Computers, a book company that sold books to McGraw-Hill.
- How was invented?
  It was invented by taking computer technology from that time and scaling it down to make a smaller, more portable computer

Definition of Laptop:

A laptop computer, or simply laptop (also known as notebook computer, notebook, notepad, and incorrectly laptop ;), is a small portable computer having its main components (Processor, screen, keyboard) built into a single unit capable of battery powered operation, which usually weighs 2-18 pounds (approximately 1 to 8 kgs), depending on dimensions, materials, and other variables.

It is debatable what the first notebook or laptop computer was. The first laptops did not look like the clamshell designs that are known to us today. However the first designs could still be carried with you and be used on a lap which has lead to the advancement of notebook style laptops. Outlined below are some computers that are classified as the first portable computer (laptop).
The First Laptop Computer 1981: Osborne 1

The Osborne 1 was a ccepted as the first true mobile computer (laptop, notebo ok) by most historians. Adam Osborne, an ex-book publisher founded Osborne Computer and formed the Osborne 1 in 19 81. This was a m obile computer (laptop, notebook) weighed close to 11k gs and a cost of $1795. The Osborne 1 had a five-inch screen, incorporating a modem port, two 5 1/4 floppy drives, a big collection of bundled sof tware applications, and a battery pack. The computer company was a failure and did not last for very long.

The Epson HX-20 battery powered mobile computer (laptop, notebook) was released in 1981. This Mobile Computer had a 20-character by 4 l ine LCD display and a integrated printer. It was an A4-sized computer weighing less than 4lb, with a full-size keyboard, integrated display and printer. Epson during that time planned its launch in the UK, priced below 1500. The Epson could run independently of AC power for 50 ho urs using its built-in NiCad battery cells which needed approximately eight hours fully recharge. The integrated inked-ribbon matrix printer was capable of printing graphics and upper- or lower-case characters on to plain paper rolls. The space to the right of the screen could have either been used by either a m icro cassette drive for application or information storage or a plug in ROM cartridge. The Epson ca me with 32K of R OM which had Microsoft B asic and the O/S loaded, and 16K of RAM. An o ptional expansion unit which clips on the side of the case can hold an extra 16K of RAM and 32K of ROM.

1983 – Radio Shack TRS-80 Model 100 Mobile Computer (Laptop, Notebook)

In 1983, Radio Sha ck released the TRS-80 Mod el 100 Mobile Computer (laptop, notebook), a 4 lb. battery operated computer with a flat and more of a l aptop design. The Tandy 100 was a computer made in Japan by Kyocera. All the ROM programs were written by Microsoft, and even a few of them were written by Bill Gates himself. These programs included a text editor, a t elecommunication program, which uses the built-in modem (300 b aud), and BASIC. The operating system uses 3130 bytes of the 8 KB Memory. The CMOS Processor (80c85) allows to use the Tandy 100 for 20 hours with only 4 AA batteries (5 days at 4 hours/day or 20 days at 1 hour/day).

1984 - IBM 5155

In February 1984, IBM announced the IBM 5155 Portable Personal Computer (laptop, notebook). This Portable PC was IBM's first carry around computer. It required AC power to be plugged in to wo rk and weighed 13.6Kgs. IBM would seize manufacturing the 5155 laptop in April 1986.

1989 - Zenith Data Systems Laptop

In 1989, Zenith Data Systems released the Zenith Minis port, a laptop computer weighing 2.7kgs. It is regarded by many historians as one of the early "real" laptops. It had a 20 Meg ESDI hard drive, 1.44 Meg floppy, 2400 baud built in modem, 640K of RAM, and had a CGA "color" LCD display. All connectivity ports were accessible via a door in the back.

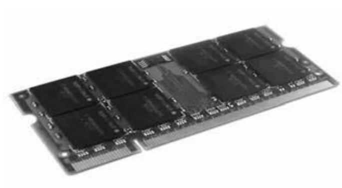
Advantages--

1. Portability - enables to carry anywhere
2. Compact - small, less space
3. Wireless Feature - enables to internet without DSL or network cable
4. "CABLE" less - no cables to attach, like cable of mouse, keyboard, etc

Disadvantages--

1. Power/Lifespan - because of batteries, laptops automatically shut down unlike desktops (but can use adapter)
2. Sensitivity - easy to break, low resistance
3. Limit - when it goes hot, sometimes Laptops turn off.
4. Mouse Sensitivity - a mouse between g and h, or a small rectangle for moving mouse.
5. Internet - even it has wireless features Laptops cannot be faster than Desktops for internet

Chapter - 19
LAPTOP MEMORY



The ability to process information that requires a attention, storage and retrieval. Or the circuitry in a computer that stores information.

Types of Memory

Following is the types of memory used in laptop:

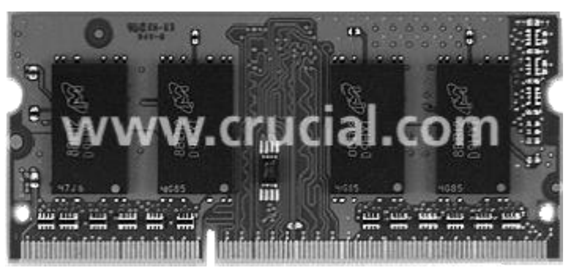
1) 204-pin SODIMM

2) 200-pin SODIMM

3) 144-pin SODIMM

4) 144-pin MicroDIMM

204-pin SODIMM

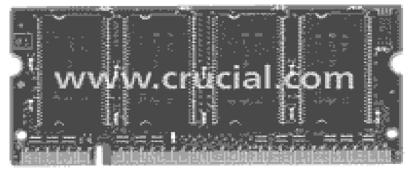


Approximately 2.6 in. b y 1.75 in. (66 mm by 44.45 mm) cru cial 204-pin SODIMMs are used in DDR3 memory for laptop computers.

In short, 204-pin small outline dual inline memory modules (SOD IMMs) are the form factor used to provide DD R3 memory modules for notebook compute rs and other small form factor computing platforms. 204-pin SODIMMs are currently available in PC3-8500 (DDR3 1066MHz) speeds. To use DDR3 memory, your system must have both a 204-pin SODIMM slot and a chipset tha t supports DDR3 memory. A DDR3 SODIMM will not fit into DDR2 or DDR memory sockets. SODIMMs are smaller and thinner than regular DIMMs, and the 204-pin SODIMM PCBs are always ~2.6 inches long and are usually around 1.75 inches high (though the heights can vary slightly). They consist of a number of memory components (usually black) that are attached to a printed circuit board (usually green). The number of memory components on a 204-pin SODIMM's printed circuit board (PCB) can vary, but the PCB will always have 102 pins on the front and the back both, for a total of 204 pins. The gold pins on the bottom of the SODIMM provide the connection between the memory module and the memory socket.

200-pin SODIMM

Approximately 2.625 in. by 1.25 in. (66.7 mm by 31.75 mm) 200- pin SODIMMs are commonly found in laptop computers.



A small outline dual inline memory module (SODIMM) consists of a number of memory components (usually black) that are attached to a printed circuit board (usually green). SODIMMs get their name because they are smaller and thinner than regular DIMMs. The gold pins on the bottom of the SODIMM provide a connection between the module and a socket on a larger printed circuit board. The pins on the front and back of a SODIMM are not connected.

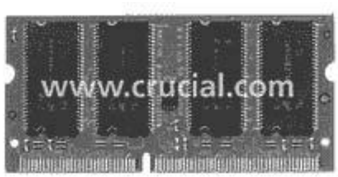
200-pin SODIMMs are used to provide DDR and DDR2 SDRAM memory for notebook computers. 200-pin SODIMMs are available in PC2700 DDR SDRAM, PC3200 DDR SDRAM, DDR2 PC2-6400 SDRAM, DDR2 PC2-5300 SDRAM, DDR2 PC2-4200 SDRAM and DDR2 PC2-3200 SDRAM. To use DDR or DDR2 memory, your system motherboard must have 200-pin SODIMM slots and a DDR- or DDR2-enabled chipset. A DDR or DDR2 SODIMM will not fit into a standard SDRAM SODIMM socket.

The number of black components on a 200-pin SODIMM can vary, but it always has 100 pins on the front and 100 pins on the back, for a total of 200. 200-pin SODIMMs are approximately 2.625 inches long and 1.25 inches high, though the heights can vary. Like 144-pin SODIMMs, 200-pin SODIMMs have one small notch within the row of pins; however, the notch on the 200-pin SODIMMs is closer to the left side of the module.

144-pin SODIMM

A small outline dual inline memory module (SODIMM) consists of a number of memory components (usually black) that are attached to a printed circuit board (usually green). SODIMMs get their name because they are smaller and thinner than regular DIMMs. The gold pins on the bottom of the SODIMM provide a connection between the module and a socket on a larger printed circuit board. The pins on the front and back of a SODIMM are not connected.

144-pin SODIMMs are commonly found in notebook computers. 144-pin SODIMMs are available in EDO, 66MHz SDRAM, PC100 SDRAM, and PC133 SDRAM. When upgrading, be sure to match the memory technology that is already in your system. The number of black components on a 144-pin SODIMM can vary, but it always has 72 pins on the front and 72 pins on the back, for a total of 144. 144-pin SODIMMs are approximately 2.625 inches long and 1.25 inches high, though the heights can vary. They have one small notch within the row of pins along the bottom of the module.



144-pin MicroDIMM

Approximately 1.545 in. by 1 in. (39.2 mm by 25.4 mm) 144-pin MicroDIMM are commonly found in sub-notebook computers.

A micro dual inline memory module (MicroDIMM) consists of a num ber of memory components (usually black) that are attached to a printed circuit board (usually green). MicroDIMM get their name because they are smaller than both regular DIMMs and SODIMMs. The gold pins on the bottom of the MicroDIMM provide a connection between the module and a socket on a larger printed circuit board. The pins on the front and back of a M icroDIMM are not connected, providing two lines of comm unication paths between the module and the system.

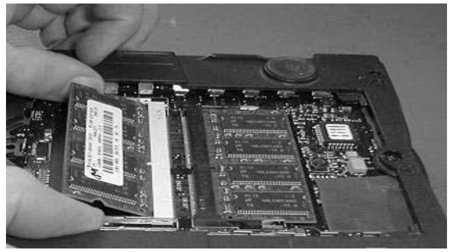
144-pin MicroDIMM are commonly found in s ub-notebook computers. 144-pin MicroDIMM are available in PC100 SDRAM. When upgrading, be su re to match the memory technology that is already in your system. (Information about which memory technology your system uses is included in the Crucial.

The number of black co mponents on a 144-pin MicroDIMM can vary, but they always have 72 pins on the front and 72 pins on the back for a total of 144. 144-pin MicroDIMM are approximately 1.545 inches long and 1 inch high, though the heights can vary. Unlike SODIMMs, MicroDIMM do not have any notches along the bottom edge.

Installing Memory into slot

This set of photos of swapping SODIMM's is a web based illustration for The Laptop Repair Workbook. In many troubleshooting scenarios, it laptop memory will be tagged as a possi ble culprit. The only way to eliminate memory as a potential problem is to swap it out and see if the problem is fixed. Most laptop users don't have access to a pile of spare parts to play the swapping game, but in the case of memory, the spare may already be available in the laptop for you. This particular Dell running Windows 2000 was equi pped with 512 MB of RAM. One scre w removes the access panel so we can see what we have.

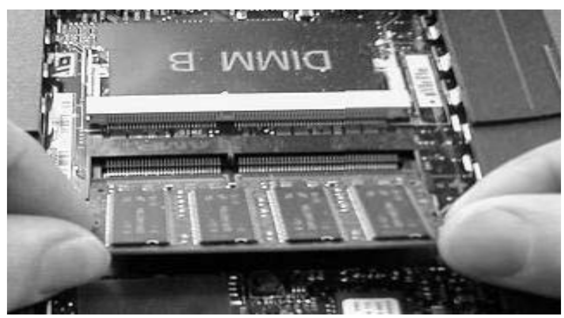
Sure enough, the laptop memor y is split between two SODIMM's, 256 MB each. As the modules are facing each other in this design, you see a different side of each module in the picture to the right. Many designs have the two SODIMM's stacked over each other in a deeper bay, though the connectors are usually staggered a little so they aren't exactly in line. Many older laptops had some or all of the system memory soldered to the motherboard, which is a real dr ag if you're troubleshooting, or if a memory chip has indeed failed. Unless you have advanced soldering skills and decent equipment, replacing a surface mounted RAM DIMM is just not a likely repair Laptop memory modules are held in place a little spring clip on either end. You can pretty much always spring them back so the SODIMM pops up on i ts own with just your fingernails for tools. N ote the angle of the module to the left. That's its unstrung or relaxed position. You have to a ngle it about the same when you go to install it. If I kept raising the SODIMM until it f lipped over the connector and sat on the other side, it wou ld look just like the second module, wit h the label down. The two connectors are Mirrored



Top the left I'm pulling out the second memor y module, you can see the two sided connector that it s its in pretty clearly. When you have two memory modules in a lapto p, it may work with either memory slot filled, or one the design may require that one slot is always filled first. In this Dell, even though the slots are labeled "A" and "B", it turns out the laptop wil l run with either one filled. So it's a trivial matter to put one module aside and install the other.

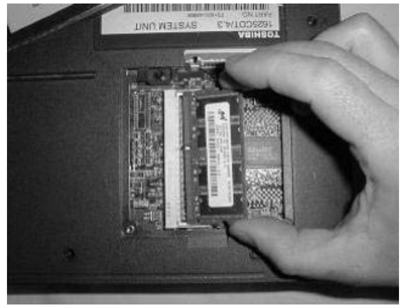
I've put aside the first SODIMM removed and I'm installing the second one from Slot A into Slot B. It turns out the laptop wor ked fine. So I took it out and put the other SODIMM in Slot A. Laptop still worked fine. So the problem with the video in this case had nothing to do with the memory. If I'd been troubleshooting a blu e screen of death (BSOD) failure on ov erheating, I'd have run th e laptop fo r a while with just one module, and if it didn't have problems, I'd have tried it for a while with the other.

The last thing you want to see when you open up your laptop to tr y a memory swap is permanently installed RAM. That's the deal with this older Toshiba to the left, the 256 MB of factory installed RAM is in the form of DIP chips soldered to the motherboard. There is a SODIMM memory slot in the foreground which allows you to upg rade the memory capacity, but it's usually not possible to bypass failed RAM on the motherboard. In other words, if one o f those chips fails, adding a SOD IMM to th e system won't help unless there's some way to inf orm the BIOS to ignore the soldered RAM. I didn't find a jumper! Once the battery is out, we remove the two screws that secure the memory cavity cover. There's a sc ary warrantee sticker right on the cover, scary because this notebook



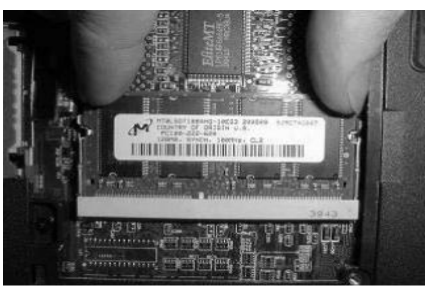
went out of warranty 4 years ago and I'm still using it. I never buy the extended warranty on anything, including laptops, and it drives me a little nuts whe n friends and family members tell me, "and I bought the extended warranty you suggested." People hear what they want to hear.

The lid lif ts away exposing the SODIMM socket, which is mounted p arallel to the motherboard. There's only one expansion memory socket in this laptop, so up grading from 64MB to 192MB wit h a 128MB SODIMM was pretty much the only option.



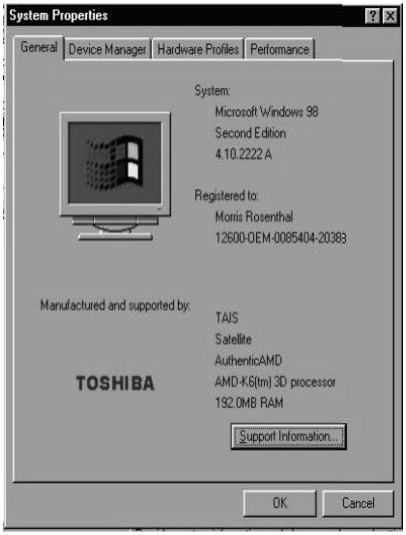
Static electricity can kill computer parts. In over 20 years of working with computers I've only ever blown up one component with a static discharge, a hard drive, and I felt it when it happened. Lots of experts will tell you that parts are always accumulating micro-damage from imperceptible static electricity shocks from handling. Frankly, while I understand the theory, I don't see it in practice, and the anecdotes I've been told about mysterious component failure usually have far more practical explanations. I keep the memory in it's static bag right up until I'm ready to install it in the laptop and I ground myself on a metal lamp that first, and that's good enough for me.

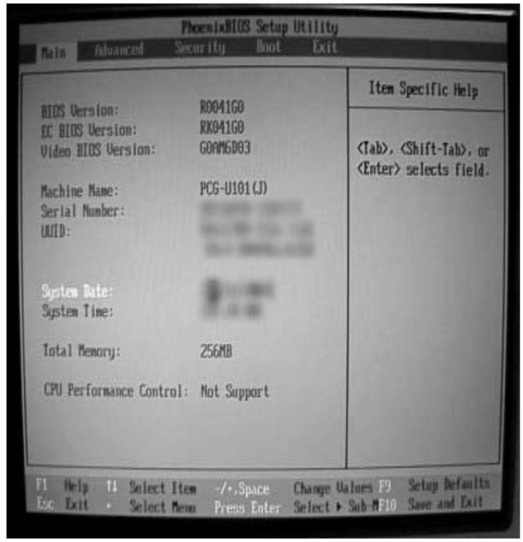
Unlike regular PC DIMMs, SODIMMs for laptops are installed on an angle and then leaned down into the latches. The picture above shows the SODIMM being inserted with the notch in the contact edge matching the key in the laptop memory socket. The picture to the upper right shows the inserted SODIMM sitting at its insertion angle, about 30 degrees over the horizontal. The final picture in the sequence to the right illustrates pushing the SODIMM down against the latches on the laptop motherboard, which engage in the notches. You can also see the white plastic key coming through the contact edge of the SODIMM, right below the corner of the second memory chip from the left.



Once the SODIMM is snapped into place, we reinstall the cover, secure it with two screws, and reinstall the battery. When I'm working on desktops, I usually test upgrades and repair before closing up the case, but I don't like firing up a laptop without fully assembling it first if I don't have to. Either the laptop will register the memory or it won’t, but the way the sockets are designed, a SODIMM that snaps into place is installed correctly and should work. The Windows System Properties screen below provides a simple check that not only does laptop recognize the new memory, but Windows sees is as well. Memory upgrades are about the easiest laptop upgrade you can do, because if the memory is upgradeable, you can usually get at the socket without taking the whole laptop apart.

Verifying the capacity of RAM|





Chapter - 20
MICRO PROCESSORS

Certainly one of the most important parts in any computer is the central processing unit, or CPU. The CPU can also be referred to as a microprocessor, or just processor, for short. Several types of processors are used in portable systems from several different companies. Processors for portable systems can be the same as those used in desktop system, but several processor companies also make special processors specifically optimized for use in portable systems. These are generally referred to as mobile processors. This chapter examines primarily the mobile processors used in laptop/notebook and other portable systems.

Currently, Intel and AMD both manufacture processors designed for either desktop or mobile use, and Transmeta makes a series of processors under the Crusoe name that are exclusively for mobile use. As with desktop systems, the majority of mobile systems use Intel processors, and creating chips designed specifically for mobile systems is a major part of Intel's development effort. Over the years, Intel has introduced many different processors for mobile use. Intel has focused on mobile processors since the 386SL came out October 1990, and since then has dramatically expanded mobile processor technology and features, up to the Pentium M first introduced in March 2003. By comparison, AMD was late in catering specifically to the mobile processor market. AMD's first major mobile-only processors were mobile versions of the K6-2 and K6-III released in 1998. In May 2001, AMD announced a line of mobile Athlon 4 (Palomino) and Duron CPUs. The mobile Athlon XP came in April 2002, and the mobile XP-M processor was introduced in March 2003.

Microprocessor Progression: Intel

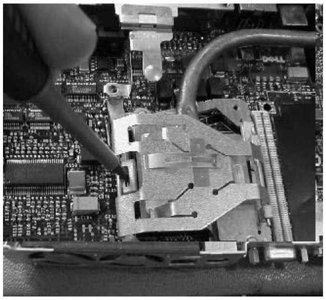
The following table helps you to understand the differences between the different processors that Intel has introduced over the years.

Name	Year	No. Of Transistors	Microns	CPU Clock speed	Data width	MIPS
8080	1974	6,000	6	2 MHz	8 bits	0.64

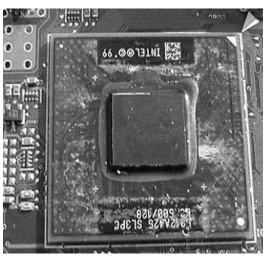
8088	1979	29,000	3	5 MHz	16 bits 8-bit bus	0.33
80286	1982	134,000	1.5	6 MHz	16 bits	1
80386	1985	275,000	1.5	16 MHz	32 bits	5
80486	1989	1,200,000	1	25 MHz	32 bits	20
Pentium	1993	3,100,000	0.8	60 MHz	32 bits 64-bit bus	100
Pentium II	1997	7,500,000	0.35	233 MHz	32 bits 64-bit bus	~300
Pentium III	1999	9,500,000	0.25	450 MHz	32 bits 64-bit bus	~510
Pentium 4	2000	42,000,000	0.18	1.5 GHz	32 bits 64-bit bus	~1,700
Pentium 4 "Prescott"	2004	125,000,000	0.09	3.6 GHz	32 bits 64-bit bus	~7,000

LAPTOP PROCESSOR

Installing a laptop CPU rarely makes sense and is often impossible. Laptops are engineered products, with limited clearance and few exchangeable parts. If your laptop CPU works, but you think the laptop is slow, add memory or defrag the hard drive. Even if the CPU is socketed rather than surface mounted (soldered to the motherboard) there will be a very limited range of choices for upgrades, if any at all are available. The upgrade CPU must be explicitly supported by the motherboard or you're wasting your time, not to mention potentially damaging the motherboard. Even if it's possible to install a CPU that's 20% faster, it won't make your laptop 20% faster, and in most applications, you probably won't see any noticeable increase in performance at all.

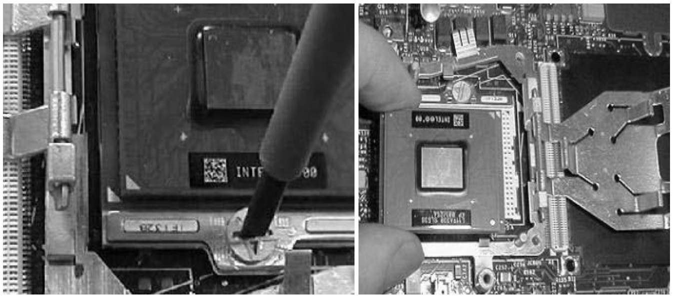


The CPU heat sink in a laptop is just as critical as the CPU itself. Every time you hear the fan come on, it's trying to cool the heat sink metal, which in turn conducts heat away from the CPU. There are nearly an infinite number of designs for heat sinks, but laptops offer a special challenge because the heat sink has to fit in a tight space and promote airflow through the cooling fins. The active heat sink I'm removing above and which is shown to the left is an integrated unit, where the fan is part of the heat sink structure. You can see the vent to the outside right above the CPU, which is covered with a white and blue thermal pad To the right, I've stripped the thermal pad off the CPU, and you can clearly see that this Toshiba has a surface mounted CPU. There's no space between the substrate and the motherboard for pins, it's a BGA (Ball Grid Array). Some super ambitious do-it- yourselfers might try to desolder the CPU with a hot air gun, and it might work to remove it, but I wouldn't give good odds for getting a replacement CPU to operate with hot air soldering. Surface mounting the CPU saves the laptop manufacturer money and time in production. The main reason for socketing laptop CPU's is probably to allow for last-minute changes in market targeting as CPU prices comes down and the competition heats up.



The copper pipe and radiator arrangement in the Dell to the left is cooled by dual fans in direct communication with the outside air. The copper pipe is a heat conductor, not an air transfer mechanism. Copper is a terrific heat conductor and efficiently transfers heat over short distances. The end of the pipe is flattened out and attached to the thick metal plated that contacts the CPU. To the bottom left, I'm prying up the spring loaded retainer for the heat sink, and right below, the screwdriver is in the slotted release mechanism for the CPU socket. Once the spring is released, the cover holding the heat sink in place lifts right up. The heavy heat sink plate is aligned and held from shifting by two metal pins through the motherboard.

So the CPU in this Dell can be replaced if it's fried, but you'd have to do your homework for the model family to determine if it can upgraded to a slightly faster unit. All CPU packages come labeled with a little arrow that aligns with the proper corner of the socket (below). They are also keyed with a missing pin, so it's usually impossible to insert a CPU wrong unless you use brute force and bend a pin. The prize for using force is that the CPU will fry. Laptop manufacturers use different methods for thermally connecting the CPU with the heat sink, where DIY types exclusively use thermal paste. If the CPU appears to be coated or blanketed with a permanent thermal substance, I would advise slathering on a new compound unless the CPU arrives with up grade instructions that instruct you to use thermal paste. Below right you see the field of pins on the bottom of the CPU package along side the holes in the socket.



Mobile Processor Features

As with most portable system components, the main concern with mobile processors is reducing their size, power usage, and heat generation. This allows them to function in the tight confines of a laptop system without overheating, while allowing the longest possible battery life. Mobile processors usually differ from desktop processors in packaging and power consumption, and they can have special features not found in desktop processors. Some of the special features first debuted in mobile processors are subsequently implemented in desktop processors as well. Features unique to mobile processors are discussed in the following sections.

SL technology and SL architecture are terms that Intel used to describe the first power-management improvements that were specially designed for mobile processors and later incorporated into all desktop processors. This technology was first introduced in the 386SL processor in October 1990 and was the first mobile-specific PC processor on the market. The 386SL was based on the 386SX core (16-bit data bus), with added power-management features that Intel then called SL technology. The 386SL was followed by the 486SL processor in November 1992, which was essentially a 486DX with the same SL technology included in the 386SL. At first, the 486SL was a unique model. However, starting in June 1993, SL technology was available in all desktop 486 processors and all Pentium processors from 75MHz and faster. Every Intel x86 processor introduced since then, from the Pentium II through the Pentium 4 and beyond, has incorporated SL technology.

Chapter - 21
MOTHERBOARD

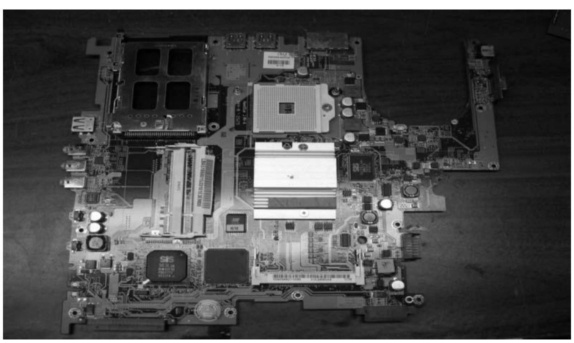
Factors of the Motherboard:

System Bus Types, Functions, and Features
Types of I/O Buses
Motherboard Components
System Resources
Plug-and-Play

Form Factors

One of the drawbacks of laptop systems is that they use many nonstandard parts, including the motherboard. Unlike desktop systems, there really aren't any industry-standard form factors for laptop motherboards. The mobile module versions of certain Intel Pentium through Pentium III processors included the processor and main chipset component and were somewhat of an attempt at laptop system motherboard standardization, but they have since been dropped because of the higher costs compared with using discrete chips.

Generally, this means that whatever motherboard came in the system will be the one it will keep for life. A motherboard can be replaced, but in most cases only with another example of the same board from the same manufacturer. This is suitable for a repair, but obviously not an upgrade. Although the motherboard cannot be replaced, most newer processors are socketed, making various types of processor upgrades possible even without changing the motherboard.



Motherboard components

Laptop systems use the same basic types of memory chips as desktop systems, but not the same types of modules. Instead of the standard SIMMs (single inline memory modules) or DIMMs (dual inline memory modules) that desktop systems use, laptops and other portable systems use different modules with smaller form factors, intended to better fit the more compact design of most portables. This chapter examines the different types of memory chips and modules found in modern laptop and other portable systems, and it discusses how to upgrade memory in these systems as well.

Memory Standards

Older portables often used proprietary memory modules, meaning that they were custom designed by the system manufacturer and normally could be purchased only from that manufacturer. That not only meant that replacing or upgrading memory was expensive, it was also harder to find, because in many cases the memory could only be purchased from the original manufacturer. Some of the first laptop systems in late 80s and early 90s used proprietary memory cartridges that looked like modern PC Cards but plugged into a dedicated PCMCIA (Personal Computer Memory Card International Association) memory socket inside the system. Gradually, most of the manufacturers shifted their designs to using industry-standard memory modules, which are interchangeable, much easier to find, and much less expensive overall. Most modern systems now use industry-standard memory modules that are specifically designed for smaller or portable systems. Most of these industry-standard memory chip and module designs are created by the JEDEC (Joint Electron Device Engineering Council) Solid State Technology Association.

JEDEC

JEDEC (Joint Electron Device Engineering Council) is the semiconductor engineering standardization body of the Electronic Industries Alliance (EIA), a trade association that represents all areas of the electronics industry. JEDEC was originally created in 1960 and governs the standardization of all types of semiconductor devices, integrated circuits, and modules. JEDEC has about 300 member companies, including memory, chipset, and processor manufacturers as well as practically any company involved in manufacturing computer equipment using industry-standard components.

The idea behind JEDEC is simple: If one company were to create a proprietary memory technology, for example, then other companies who wished to manufacture components compliant with that memory would have to pay license fees, assuming the company who owned it was interested in licensing at all! Parts would be more proprietary in nature, causing problems with interchangeability or sourcing reasonably priced replacements. In addition, those companies licensing the technology would have no control over future changes made by the owner company. The idea behind JEDEC is to prevent that type of scenario for items such as memory, by getting all the memory manufacturers to work together creating shared industry standards covering memory chips and modules. JEDEC-approved standards for memory could then be freely shared by all the member companies, and no one single company would have control over a given standard, or any of the companies producing compliant components. FPM, SDRAM, DDR SDRAM, and DDR2 SDRAM are examples of JEDEC memory standards used in PCs, whereas EDO and RDRAM are proprietary examples. You can find out more about JEDEC standards for memory and other semiconductor technology.

This chapter covers power for portable systems. Normally laptop or portable systems have options for several sources of power, including AC (alternating current; found in the wall sockets of most buildings), power sockets in automobiles and airplanes, and several types of batteries. This chapter examines all the power sources found in a modern portable system and also focuses on power management for portables.

AC/DC Power Supplies

All portable systems at one time or another must depend on an external power source either for operation, to recharge their batteries, or both. The most commonly used external power sources are:

- 120V 60Hz AC wall current (USA)
- 240V 50Hz AC wall current (Europe)
- 12V DC current (auto/airplane)

Expansion Buses

In an effort to give notebook computers the kind of expandability users have grown used to in desk top systems, the Personal Computer Memory Card International Association (PCMCIA) has established several standards for credit card–size expansion boards that fit into small slots found in laptop and notebook computers. PCMCIA was founded in 1989 as a non-profit trade association with more than 85 member companies worldwide, to establish technical standards for PC Card technology. The development and evolution of the PCMCIA's PC Card interface standard has proven to be a successful feat of engineering in a market full of proprietary designs.

The words "Memory Card" in the PCMCIA name allude to the original 1.0 specification it released in September 1990, which was for memory cards only. The 2.0 release that came in September 1991 added support for I/O (input/output) cards as well. Subsequent releases have enhanced the standard further, adding higher performance modes, lower power consumption, and greater compatibility. The current PC Card Standard (Release 8.0) has added many capabilities, features, and functions, and has grown well beyond its simple memory card origins.

PC Cards (PCMCIA)

Although they were originally called PCMCIA Cards, after the second release of the specification in 1991, these cards are more accurately (and officially) called PC Cards instead. Still, to this day many people (including myself) often call them PCMCIA Cards, even though that is no longer technically correct.

Modern PC Cards support a variety of applications; the functionality that can be added to a system through PC Card technology is enormous. Virtually any type of interface or adapter that can be added to a desktop system via ISA (industry standard architecture) or PCI (peripheral component interconnect) bus cards can also be added to a laptop or notebook system via PC Cards.

Graphics and Sound

Modern laptop computers feature integrated graphics and sound. Some recent laptops feature powerful 3D graphics acceleration and high-quality sound. However, in general, the graphics and sound features found in laptop computers lags behind the features available with the best add-on graphics and sound cards available for their desktop siblings.

In this chapter, you'll learn about the basic graphics and sound technologies as they apply to laptop computers and how to look for laptops that have the graphics and sound features you need. You will also learn how to improve onboard graphics and onboard sound through internal and external upgrades and how to troubleshoot problems you might encounter.

Video Display System

The video subsystem of a modern laptop/notebook system consists of two main components:

- Video display—An LCD panel in most laptop/notebook systems
- Video adapter (also called the video chip or graphics adapter)— Built in to the motherboard in virtually every laptop/notebook systems. Some laptops integrate the graphics as part of the motherboard chipset, but some high-end and gaming optimized models use a discrete graphics chip with its own video memory.

Portable System Accessories

A great many add-on devices are available for use with portable systems, providing functions that cannot practically or economically be included inside a system itself. Indeed, many of the most common uses for portable systems might require additional hardware, either because of the computer's location or the requirements of the function.

Note that when it comes to laptop accessories, the range of available options may actually exceed those available for desktops. Consider that laptop owners can choose not only from a wide array of desktop accessories, they can also take advantage of a large group of accessories that are meant for use exclusively by portable systems. The only desktop accessories not available to laptops are internal expansion cards and storage drives—and in some cases even these components can be installed in certain laptop configurations. The following sections discuss some of the most common peripherals used with portable systems.

Carrying Cases

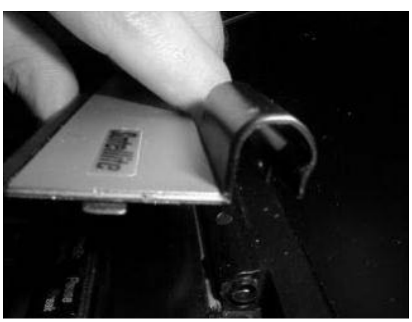
Perhaps the most popular accessory for laptops is the carrying case—and for good reason. Anyone who takes an expensive laptop computer out in to the real world wants to be sure it will survive undamaged. People can and do carry their laptops in briefcases, backpacks, and probably everything short of a paper grocery bag, but for real protection, laptops should be carried in cases specifically designed for that purpose, with special cushioning to limit any damage from accidental knocks and drops.

Over the years, several different types of cushioning have been employed in laptop carrying cases. The simplest and most common form of cushioning is a layer of foam rubber. A handful of cases have enhanced this type of cushioning by suspending the laptop in an elastic sling. A small number of other carrying cases used inflatable cushions. The inflatable cases provided a good degree of cushioning but often required partial deflation in order to remove the laptop.

Chapter - 22
POWER SUPPLY

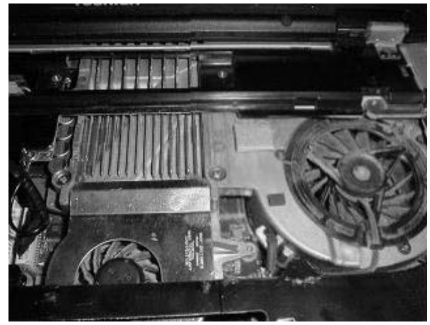
Many of us own laptops where the fan seems to run an annoying amount of the time, but it's better than a laptop fan that doesn't run at all. When the fan in your notebook fails, the usual symptom is an overheating CPU and automatic shutdown. Sometimes the laptop runs for 10 minutes, sometimes for a half hour, it depends on the task and the power. Troubleshooting a hot CPU can be as simple as making sure you isn't blocking the airflow outside the laptop. Often times, you can access the fans and heat sink without a huge job, on this Toshiba A65, all it takes is some careful prying and two screws. As always, remove the battery before working on any laptop. The first step is removing the combination blank and hinge cover that allows access to the two screws securing the keyboard. It is snapped into place with little tabs on the long edge and a big tab on each end.

The picture to the right shows how the blank and the hinge cover are all one piece of plastic, so you have to open the screen to fully remove the blank. I should mention for desperate people with no mechanical skills, one non-invasive way to extend the length of time a notebook with poor cooling will run between shutdowns is to run it on battery and choose the most aggressive (i.e., longest life) power saving mode. BTW, I'm working on this notebook because I was asked to bypass the power connector as a favor. However, the owner's got five kids in the house and I burned my finger on the metal part of the 100 BaseT port after I got it charging again, so I'm

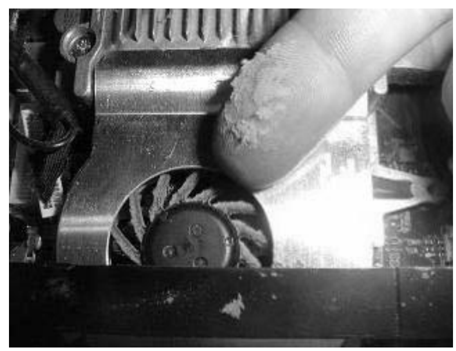


afraid to return it for The problem I was originally asked to fix should have tipped me off to the overheating issues this notebook would suffer. The pin had broken out of the center of the power connector on the motherboard, which meant the battery couldn't be charged. My fix (really a kludge) was to solder a new wire directly to the connector and bring it out the I/O port blank on the back of the notebook. The coax power cable was HUGE. Turned out to be rated for 2.0 amps. Two screws secure the keyboard in the laptop, and it's not even necessary to disconnect the ribbon connector from the motherboard to access the fans. This Toshiba laptop uses two fans, a large exhaust fan that pulls cooling air through the body of the notebook, and a smaller CPU fan on top of the large heat sink

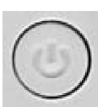
The large fan to the right draws cooling air in the bottom of the laptop; the smaller fan in the center is directly cooling the CPU. Troubleshooting overheating is pretty much limited to making sure the laptop fans operate and aren't completely buried in lint. This is a pretty robust cooling system and likely to keep most laptops from shutting down from thermal overload protection, but they stuck a P4 2.8 GHz CPU in this puppy! When I went out on the web and read some reviews of how this laptop performed when new, I saw comments like "Keyboard gets too hot to type" and "Frequent shutdowns from overheating." Sony made a WIO with the same CPU; HP made an Pavilion and Dell an Inspiron. I've seen similar overheating and battery life complaints for them As well.



As you can see to the left, there was a build-up of dust on the CPU fan which I blew out with compressed air, but not enough to cause any thermal shutdown issues. The reason I burned my finger on this boat anchor is it just runs too hot as a design flaw. OK, I didn't get a blister, but I'm afraid to put this laptop with a kludged power connector in a family home. I really don't know how they could have forced more air through this thing than with the big intake fan they are already using, so troubleshooting includes making sure you have unobstructed airflow to the BOTTOM of the laptop for the fan to function. If you run the thing on a bed or on your lap with the fan grille blocked by your leg, it's going to cook for sure.



What if laptop does not turn on? Is the power adapter plugged in both to the wall and to the laptop?
Is the battery light illuminated? (The battery light is in the shape of a battery; it is to the lower-right of the display. It should be on—green or orange—whenever the laptop is plugged in.)



Did you press the power button? (The power button is in the lower-right corner of the display unit.)Note that you need only press the power button; you do not need to hold it down.

Is the power light illuminated? (The power light to the right of the battery light, to the lower right of the display. The power light should come on—green—after you press the power button.)

How do I turn off my laptop?
You turn off the laptop by holding down the power button for 10 seconds (or you can use the hover menu on the Home view—select the shutdown option).

What if my battery does not work? Is it properly inserted into the laptop? Did you allow for a full charge?

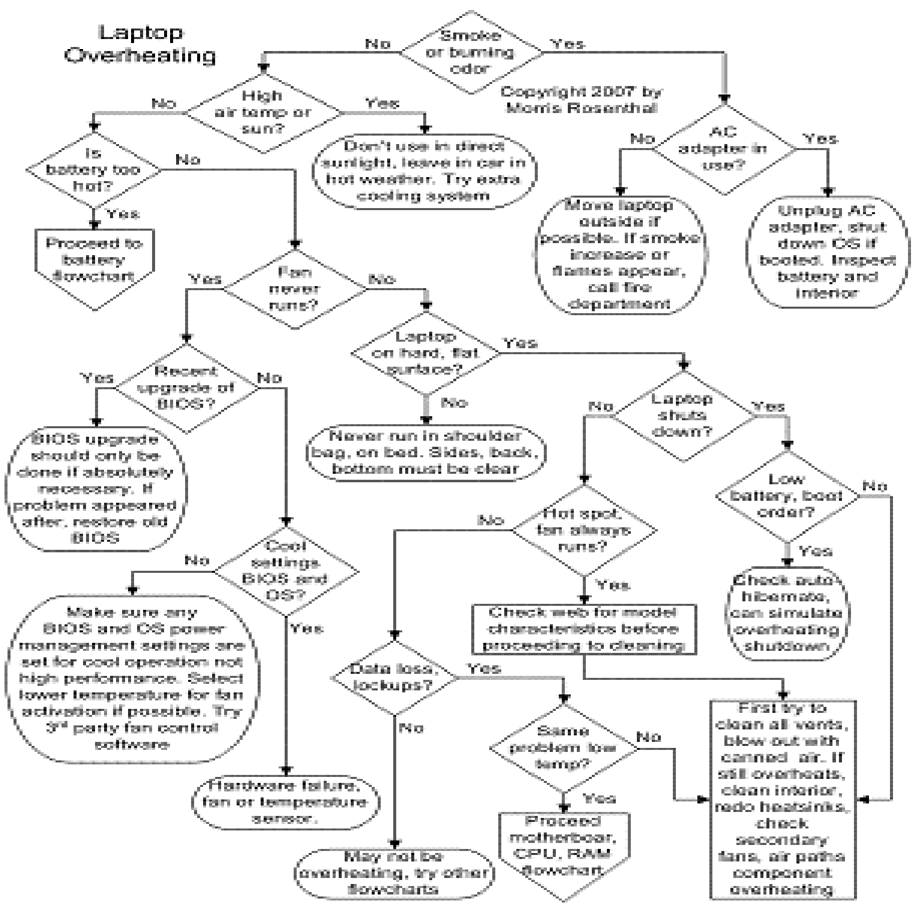
What does the battery indicator-light color mean?

- green means the laptop is plugged in and the battery is fully charged;
- yellow/orange means the laptop is plugged in and the battery is charging;
- no light when the laptop is powered on means it is running on battery power;
- no light when the laptop is powered off means the battery is *not* recharging;
- red means the battery is low; it should be recharged.

How long should a fully charged battery last?

With standard operation, the battery should last approximately 3–5 hours. Certain applications, such as video, may reduce overall battery performance. Turning the backlight off saves battery power. (Future software releases are expected to improve battery life.

Resolving Laptop Overheating Issues



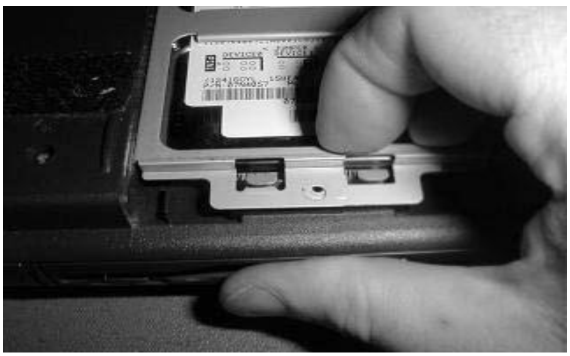
Chapter - 23
STORAGE DEVICES

The worst thing that can happen to most laptop users, aside from the loss of the whole laptop, is ha rd drive failure. The hard drive holds all of your data, files, and all your e-mails and contacts if you use Outlook, Eudora, or an y other non-portal based e-mail. But I'm sure many more laptops have gone to the recycling facility with live hard drives than dead hard drives. If you have any files you value on your hard drive that aren't backed up, you should invest $10 or $1 5 in a USB she ll and attempt to r ecover the data. Hard drive data recovery is t hought to be an arcane art, requiring expensive equipment and a high level of tech nical skill, but a ll of that only comes into play if the onboard electronics or the motor have failed. In that case, the drive platters are removed from the metal case in a special clean room, and the data is recovered by reading it off on a universal reader.

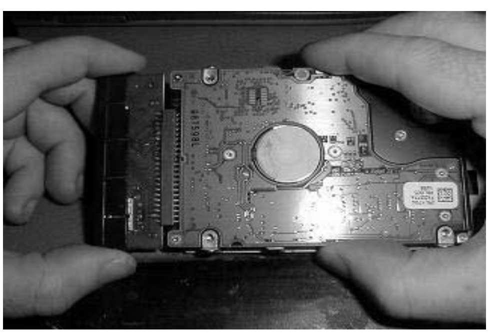
Most laptop owners are still very foggy as to where their data resides and consider the whole lower part of the l aptop (everything except the screen) to be part and parcel with the hard drive. In reality, laptop hard drives are 2.5" wide, about 4" long and about a qu arter inch thick. They weigh a couple of ounces, and can normally be accessed by removing a single screw from the laptop, as shown above. You s hould always unplug the laptop and remove the battery before attempting to do any repair work. I'll admit I left the battery in here, because I knew it had been stone dead for some six months or more, since the AC adapter died. After removing the single screw, you can see the 2.5" laptop hard drive installed in its c age. This hard drive is an IBM Travel star, perhaps the most common hard drive used in laptops the past couple years. Because it's an older laptop, th ere's no shock mounting for the drive, little rubber washers that have become a popular wa y to partially shield the hard drive from the vibrations that can cause head crashes, in which case you can't recovery the data with a million dollar lab.

The next step is to remove the whole cage from the laptop, which involves pulling back on the cage to free the drive's IDE interface from the laptop connector. You can see to the right that the drive cage is held from lifting by two metal tabs, and that the screw that held the plastic lid on the drive bay went all the way through and secured the cage in the laptop. That's all that held it together, one screw, and it's a typical arrangement. It turns out that removing the old hard drive from the cage, once it's out, is generally a bigger job than removing the cage from the laptop, because there are four screws involved and they are often over tightened and strip when you try to remove them. But it's not necessary to take it apart any further if all you want to recover your old files.

To the left, I'm holding the new USB 2.0 interface that came with the hard drive enclosure The



interface is really all you need to gain access to the old hard drive, if it's healthy, and recover your data. The kit comes with software from Mac users as well as Windows based machines, but modern operating system versions don't even require the software. They'll just find the new USB hardware when it's plugged in, recognize that it's a hard drive, and allow you to recover your files as long as the file system types were compatible. I'm holding the interface card over the aluminum enclosure in which you could install the drive if you wanted to use it as a permanent external hard drive. But when I started taking the screws out of the cage, three out of four fought me and the fourth stripped, despite the fact I was using a high quality screw driver. It would be easy to bend and break the remaining tab off to remove the cage, but why bother, when the only point of the job is to recover some old files? So I plugged the interface on (to the right), then set the whole thing down on my table with the new laptop and plugged it into the USB 2.0 port. You can see that the little green LED on the drive is lit and active, if you have good eyes and a better imagination.

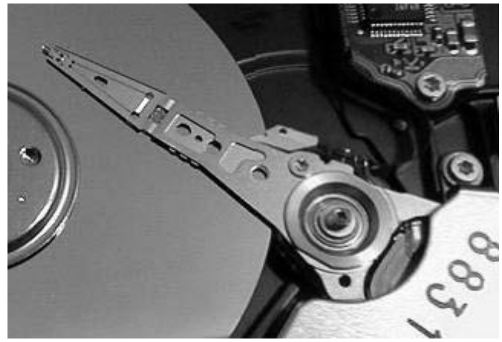


Immediately after plugging in the USB cable, Windows XP picked up on the drive, and asks what you want to do with it. Choose "View with Explorer" and you'll gain access to all of the old folders, drag them onto your new laptop hard drive, and your data recover job is complete. Well, after you burn the recovered files on a DVD it will be complete, and you won't face the worry again. If the LED doesn't light up, you could be plugging the USB into an old port that doesn't source the 500 mA required, or the interface could be bad out of the box, or the drive could really be dead. If you don't hear the drive spin up, you can try picking it up gently, a few inches over the table, and try rocking in slowly to see if you can feel the centripetal force of the disk spinning.

This set of photos of hard drive photos is a web based illustration for The Laptop Repair Workbook. To the right is a dead hard drive with the cover removed. If it wasn't dead when the cover was removed, it would be dead now, because it's not a clean room environment. The slightest spec of dust getting into a hard drive can get in between the read/write head, which floats on a cushion of air a few millionths of an inch above the spinning platter, and cause a head crash. In a head crash, the head actually touches the surface of the disk, or a bit of foreign matter gets stuck between the head and the disc, with the same results. The magnetic coating on the platter gets plowed up, and the data is lost forever.

Just in case the actuator arm that moves the head in and out the platter wasn't clear above, I manually

pushed it out onto the surface to the left. The arm is controlled by a voice coil, the same sort of technology (sort of) as a loud speaker. The drive electronics position that read/write head through the magic of feedback loops. The voice coil doesn't "know" where the head is, but the drive is factory prepared with formatting sign posts that let the electronics determine the position by reading the magnetic position markers for tracks and sectors. In any case, there are no user serviceable parts inside hard drives, you replace them as whole units if they fail, or send them out for expensive data recovery if you are desperate. If you aren't sure whether the failure is with the hard drive or the laptop, try mounting it in a USB enclosure.



The two hard drives to the right are mounted in different style cages that in turn are secured in the laptop by a single screw. The laptops are generally secured in the cages by four screws, and the cages have tabs that hook or get hooked over the laptop's metal structure. Unfortunately, the screws that secure the hard drives are often over-tightened and over secured with thread locking glues. It's a real pain if you have to replace a drive, and a screw head strips out, even if you're using the exact size Phillips screwdriver bit.

The Toshiba hard drive to the left is nestled in a lightweight Toshiba business laptop, in rubber shock mounting. The shock on opening up the hard drive bay by removing a single screw from the bottom of the laptop was to find that the drive isn't secured at all. It just sits tightly in the rubber shock mountings located at the corners of the bay (they show up as black rubber), and pops out if you pull up on the transparent plastic tab. Because the object of shock mounting is to isolate the drive from the rest of the laptop, should it be dropped or hit, even the connector has to float. In normal laptop mounting, the male pins on the drive fit right into a female connector that's attached to the laptop structure or motherboard, and provides some of the mounting strength. For the shock protected drive, the connector is attached by flexible wires.

The picture to the right shows the standard IDE interface on a 2.5" laptop hard drive. If you open up your laptop, remove the hard drive, and find that there's a female connector on the drive, it's almost certainly a removable gender changer. Some new laptops feature SATA hard drives, the serial version of ATA or IDE drives. It makes no difference to the user, unless it's a higher performance version, but the connector is smaller since it uses a serial rather than a parallel bus. Laptop hard drives are amazingly rugged little things, they often get noisier as they age, but a noisy hard drive may run for five years without failing.

DVD

The worst thing that can happen to most laptop users, aside from the loss of the whole laptop, is hard drive failure. The hard drive holds all of your data, files, and all your e-mails and contacts if you use Outlook, Eudora, or any other non-portal based e-mail. But I'm sure many more laptops have gone to the recycling facility with live hard drives than dead hard drives. If you have any files you value on your hard drive that aren't backed up, you should invest $10 or $15 in a USB shell and attempt to recover the data. Hard drive data recovery is thought to be an arcane art, requiring expensive equipment and a high level of technical skill, but all of that only comes into play if the onboard electronics or the motor have failed. In that case, the drive platters are removed from the metal case in a special clean room, and the data is recovered by reading it off on a universal reader.

Most laptop owners are still very foggy as to where their data resides and consider the whole lower part of the laptop (everything except the screen) to be part and parcel with the hard drive. In reality, laptop hard drives are 2.5" wide, about 4" long and about a quarter inch thick. They weigh a couple of ounces, and can normally be accessed by removing a single screw from the laptop, as shown above. You should always unplug the laptop and remove the battery before attempting to do any repair work. I'll admit I left the battery in here, because I knew it had been stone dead for some six months or more, since the AC adapter died. After removing the single screw, you can see the 2.5" laptop hard drive installed in its cage. This hard drive is an IBM Travel star, perhaps the most common hard drive used in laptops the past couple years. Because it's an older laptop, there's no shock mounting for the drive, little rubber washers that have become a popular way to partially shield the hard drive from the vibrations that can cause head crashes, in which case you can't recovery the data with a million dollar lab.

There are quite a few reasons the DVD tray in your laptop might fail to open when you hit the eject button. About the worst thing it can be is if the motor or gear train failed, which would mean replacing the drive. If the disc in the drive plays OK, you know that the power and the connector are fine. If not, you should try reseating the drive in the bay. It's also possible for the drive to be locked in software by the operating system, or for a power management scheme to have cut power to the drive. Check these by right clicking the drive icon and checking properties, or looking at you power management settings. But, when all else fails and you can't get the disc out of the drive; there's always, THE MIGHTY PAPERCLIP.

In the picture to the right, I haven't used any force at all, beyond gently pushing in the paperclip, and the CD tray popped out that far by itself. From here, it's an easy task to pull it out all the way so the disc can be removed. Below, I'm opening the DVD drive out of a Sony Vaio, but the tray didn't spring out when the paperclip pushed in the release, which you can tell by feel. So I had to pull on it with my fingernail behind the plastic facade while depressing the release. It opened pretty stiffly for the first fraction of an inch, and then pulled right out the rest of the way. That pretty much covers what you'll encounter with manually opening an optical drive, either it will pop open as soon as the paperclip works the latch, or you'll have to help it along.

But there are instances in which the emergency release won't get the tray to eject. The worst of these is if a disc shattered at high speed and jammed all the mechanics up with little shards of plastic. You'll know this is the case by the noise if you gently tilt the drive back and forth. Another possibility is that an adhesive label peeled off in the drive and has gummed up the works. In either case, the odds of the drive being salvageable aren't very good, but if it was a label failure, you should be able to rescue the disc by disassembling the drive around it until the tray ejects or the disc is accessible. And before you rush out and buy a supposed generic replacement for the drive, remember that while the connector may be standard, the drive shell is customized, and you may not be able to transfer all of the shell hardware from one drive to another for mounting.

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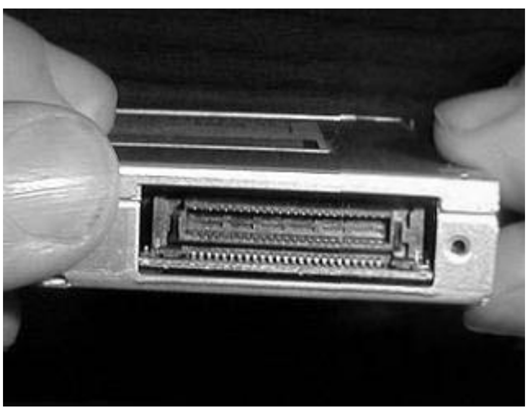
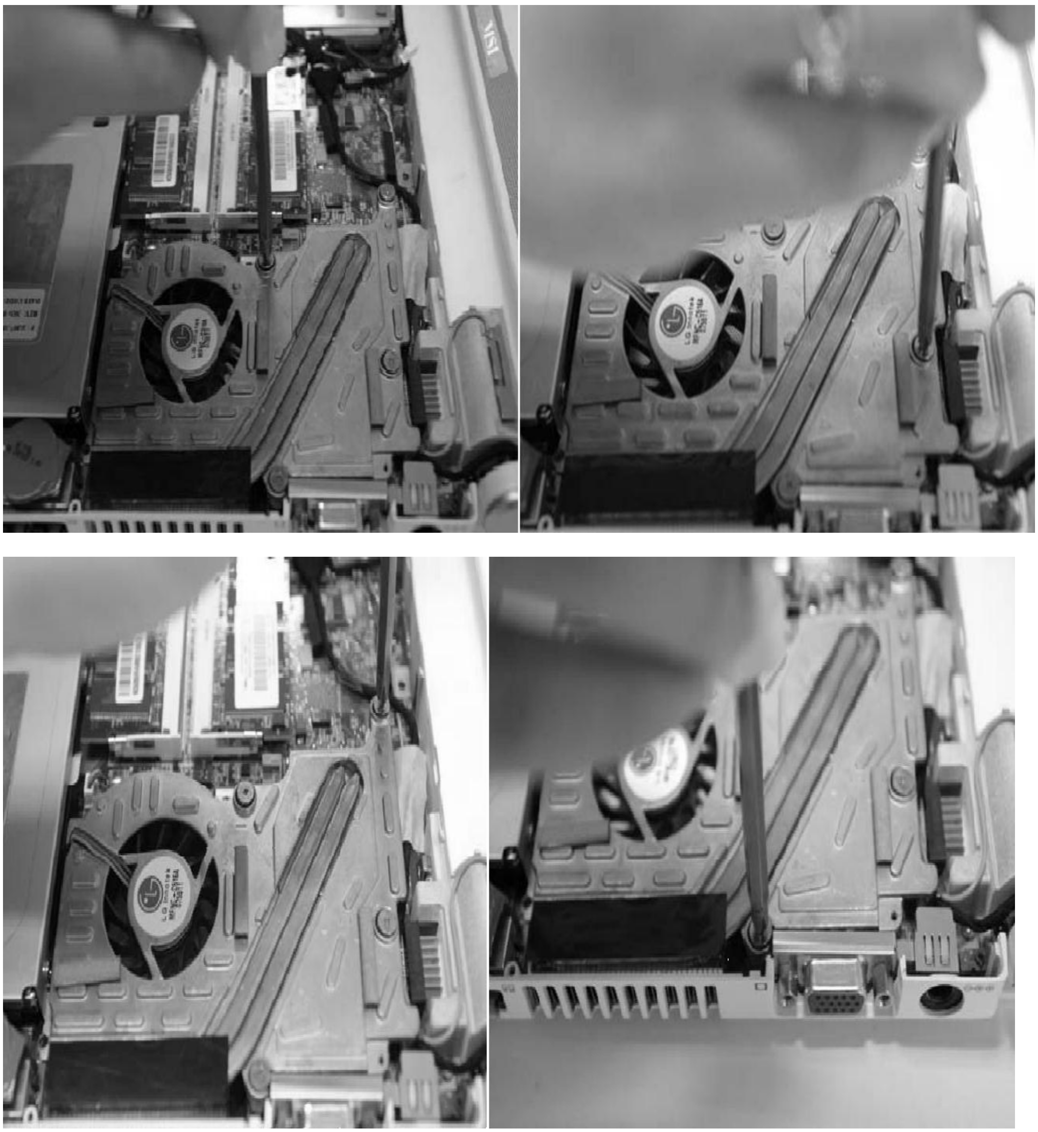


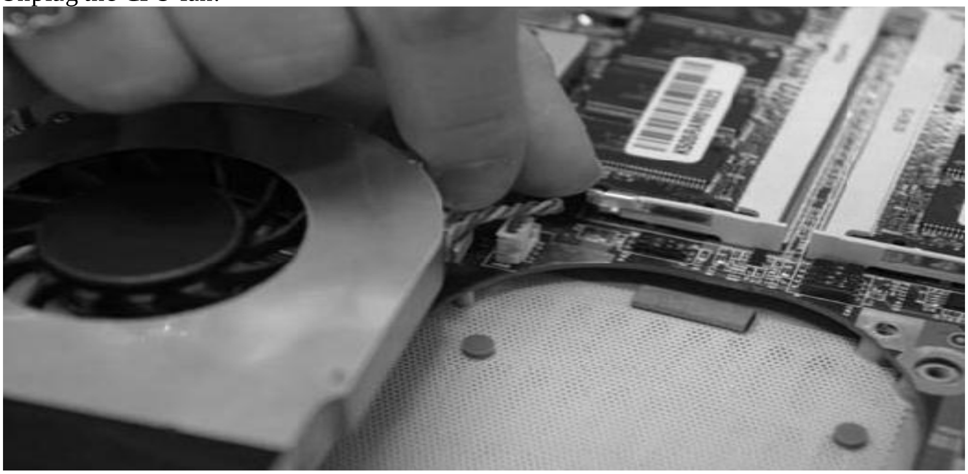
Chapter - 24
ASSEMBLING OF THE LAPTOP

Installing the CPU

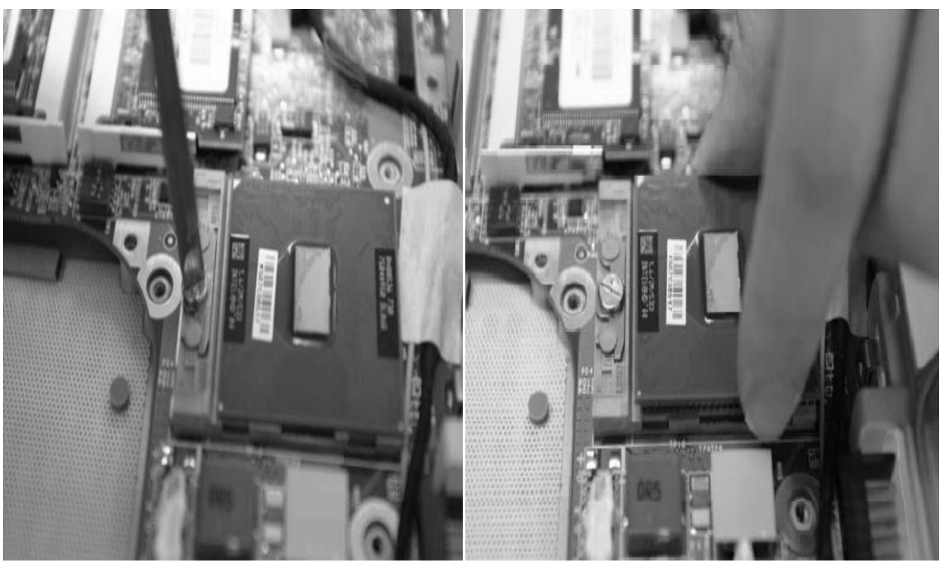
Unlock the CPU heat sink diagonally or according to "1-2-3-4" shown on the CPU heat sink. Improper unlocking or locking of the CPU heat sink nuts will damage the CPU.



Unplug the CPU fan.



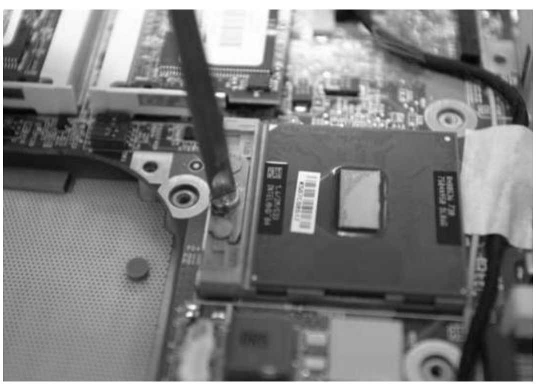
Use a flathead screwdriver to disengage (Open) the socket actuator, as shown in figure 2-3a below. The socket actuator should open after only a half turn, and then you should be able to remove the processor with your fingers.
Hint: Make sure your system can accommodate the Intel Pentium M /Celeron M Processor that you want to install. Check for motherboard, BIOS, and thermal compatibility by using the given documentation, or by contacting the vendor if necessary. This processor should only be installed in systems supporting the Intel Pentium M Processor.



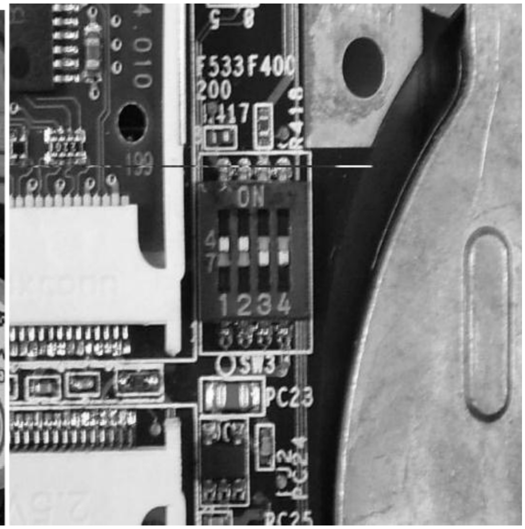
Place new processor into the socket. Align processor's pin A1 (shown in figure 2-4) with the arrow on the micro-FCPGA socket. Pin A1 of the processor is identified with an embroidered corner and pin A1 of the socket is identified with a small arrow. If the processor does not drop completely into the socket, turn the actuator until the processor drops in completely.

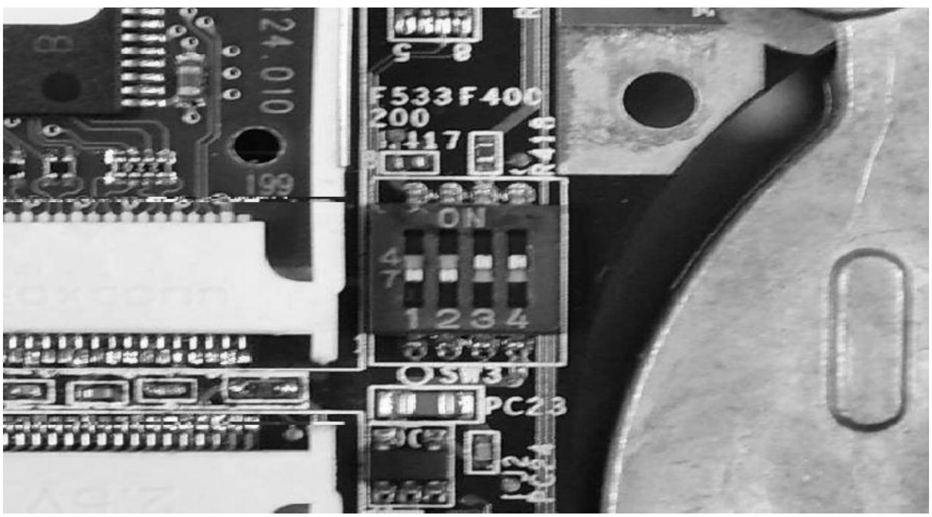
You do not have to pre ss down the processor. If the processor does no t drop completely into the socket, turn the actuator until the processor drops in completely.

While gently holding the processor down with your finger, secure the processor in the socket by closing the socket actuator with a screwdriver.

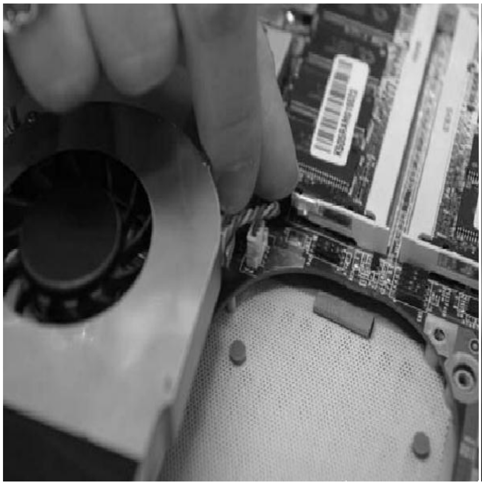
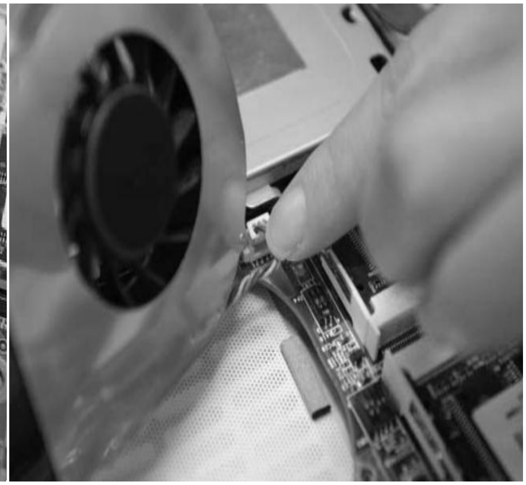


Your system is set with dip-switches in order for the new processor to function correctly. The dipswitches can be found next to the CPU. Consult processor documentation to determine the correct dipswitches setting shown in figure

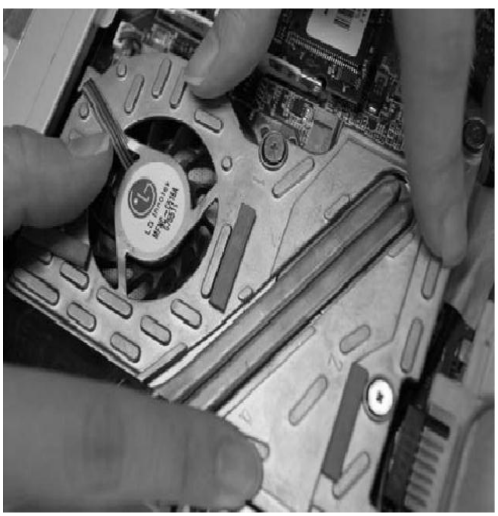


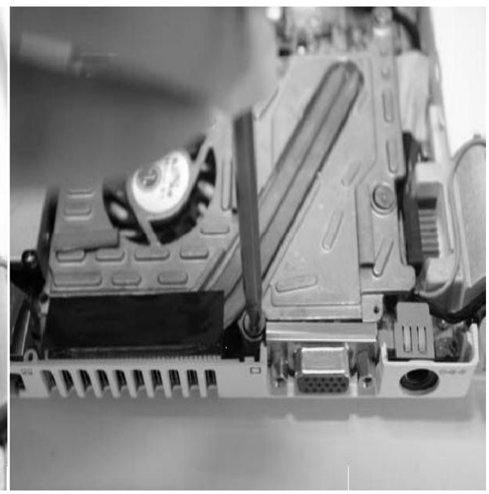


(Dothan 533) (Dothan 400 & Celeron M) plug the CPU fan.
Improper connection of the CPU heat sink fan and/or without plugging the fan connector will Damage the notebook and CPU.

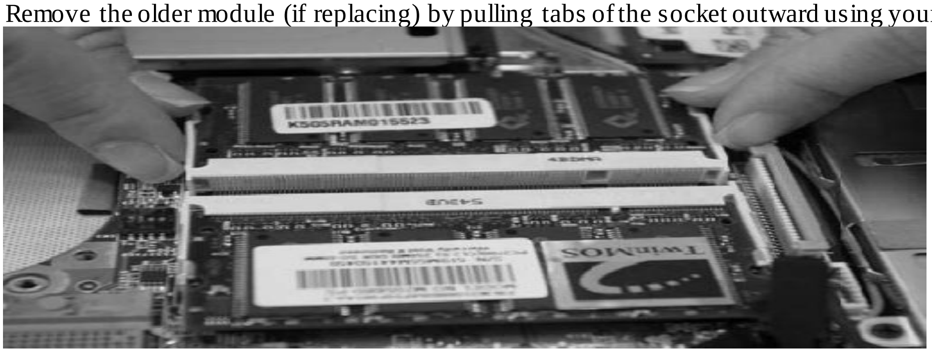
Lock the CPU heat sink diagonally or according to figure shown on the CPU heat sink.
Improper unlocking or locking of the CPU heat sink nuts will damage the CPU
Hint: We recommend you to apply the given thermal grease for better heat conduction between your CPU and the heat sink. Hint: Please check the heat sink and make sure it is in good contact with the CPU before you turn on your notebook. Poor contact will cause overheat and may damage your CPU



Step 3: Installing Notebook Memory

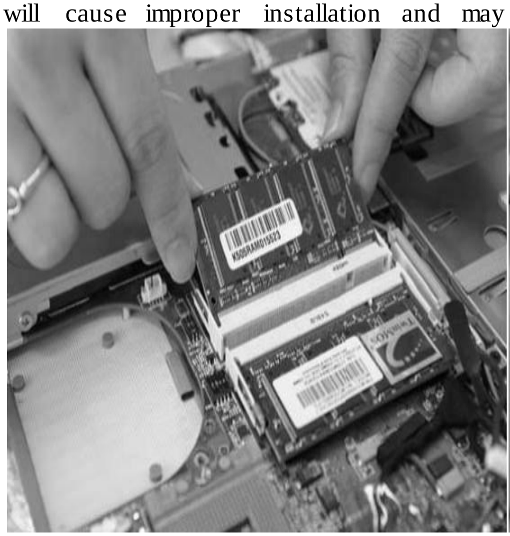
Remove the older module (if replacing) by pulling tabs of the socket outward using your thumbs.

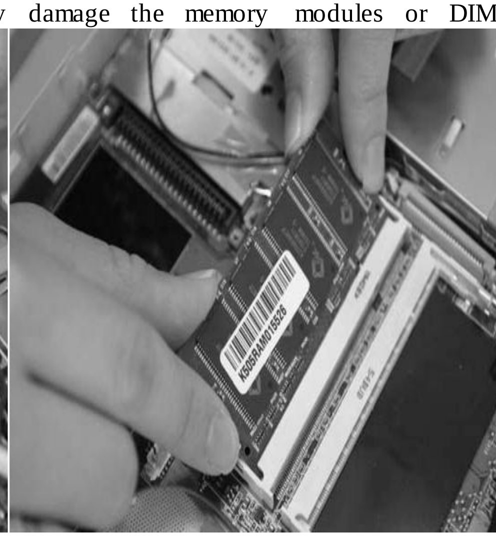


The module should pop up into a 45 degree angle. Remove the module by pulling it gently backward. Use side-to-side motion, if necessary, to remove. Push down the memory module gently until the metal locking levers aside from the DIMM socket 1 is fastened.

The location of the notch along the gold edge of the memory module needs to be lined up with keyed notch in the socket. Memory module can only fit in one direction due to the keyed notch. Wrong orientation will cause improper installation and may damage the memory modules or DIMM sockets

If you have more than one memory module, please align the 2nd memory module to the DIMM socket 2. Memory should be inserted firmly at a 45 degree angle and pushed down until module snaps into place. Memory module can only fit in one direction due to the keyed notch. Wrong orientation will cause improper installation and may damage the memory modules or DIMM soc.





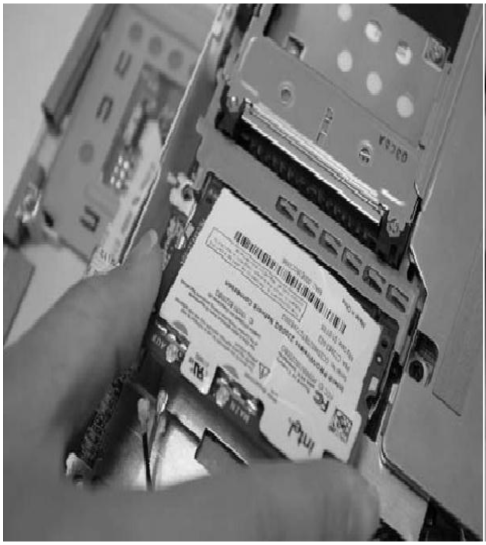
Step 4: Installing Mini PCI WLAN Card

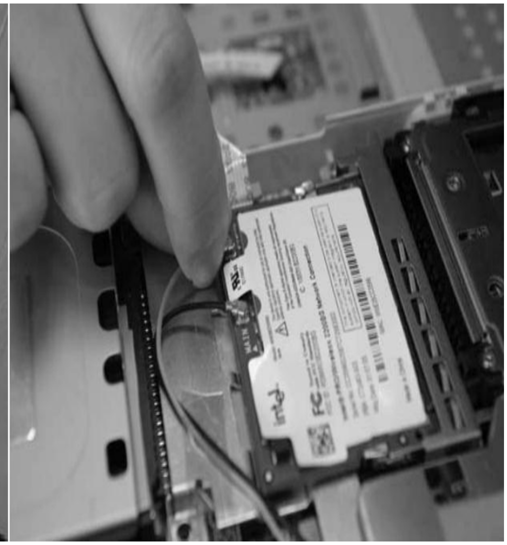
Remove the older module (if replacing) by pulling tabs of the socket outward using your thumbs.

The module should pop up into a 45 degree angle. Remove the module by pulling it gently backward. Use side-to-side motion, if necessary, to remove. Unplug the antennas. Mini PCI module should be inserted firmly at a 45 degree angle and pushed down until module snaps into place. After the module snaps into place, connect antennas on the Mini PCI card.

The location of the notch along the gold edge of the Mini PCI module needs to be lined up with keyed notch in the socket. Mini PCI module can only fit in one direction due to the keyed notch.

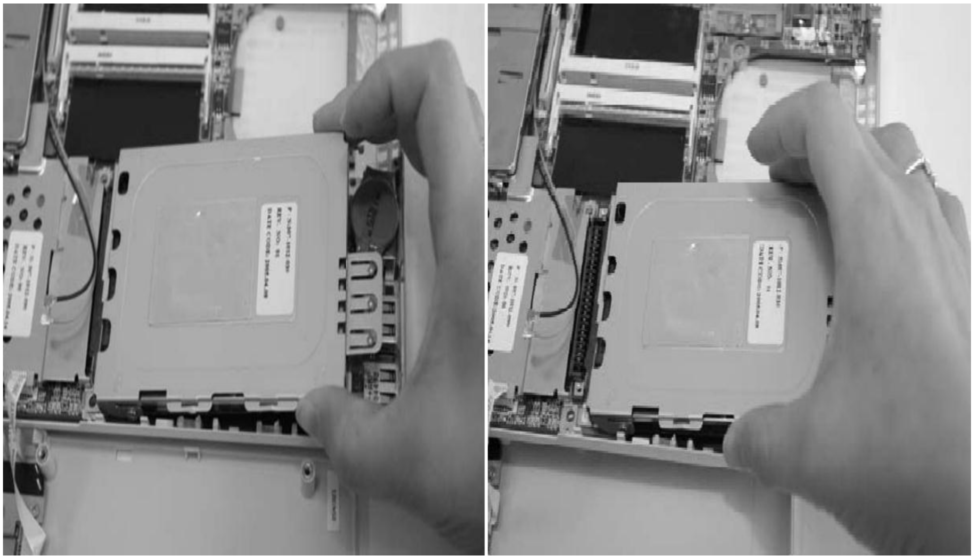
Wrong orientation will cause improper installation and may damage the Mini PCI module or Mini PCI socket



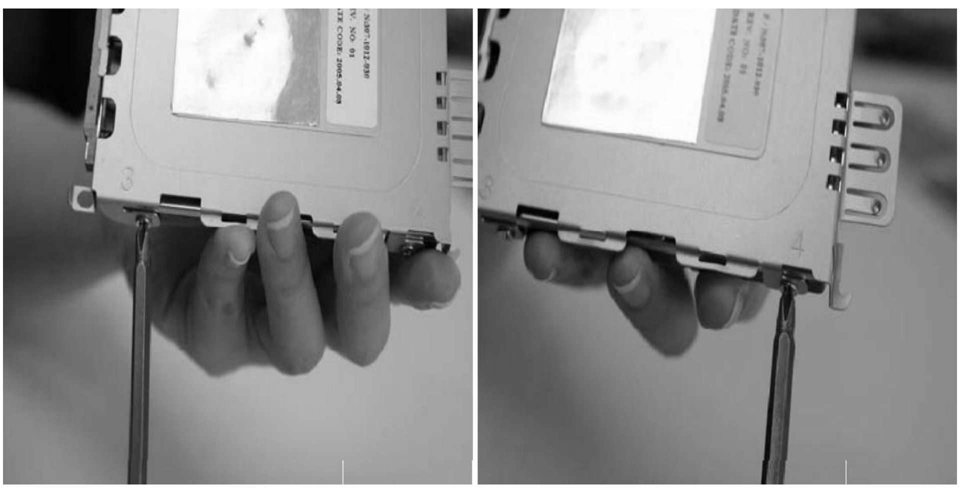


Step 5: Installing Notebook Hard Drive (HDD)

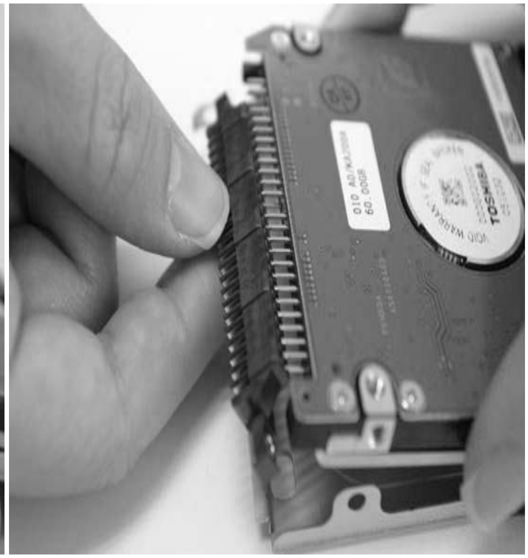
Tilt up the rear of the hard drive case and pull it gently by its edges only, because static electricity can permanently damage the computer parts. Please use the given HDD shielding tray

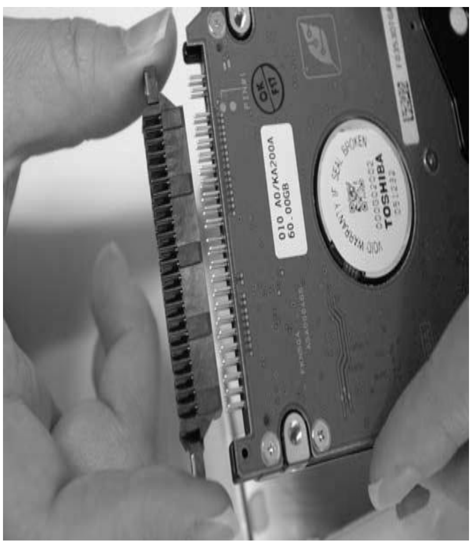


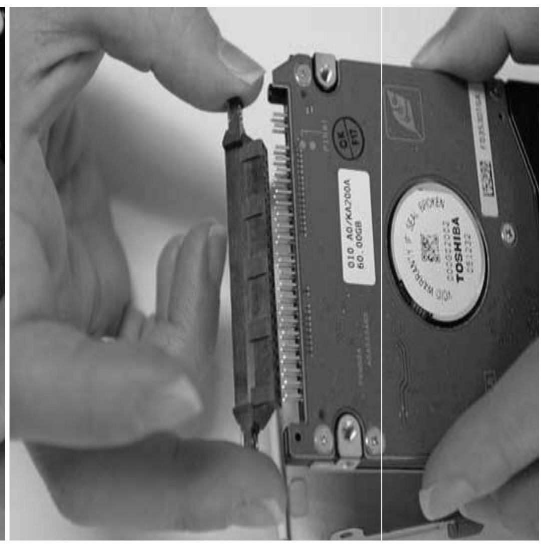
Unscrew all 4 Phillips screws that are on the side of the HDD.



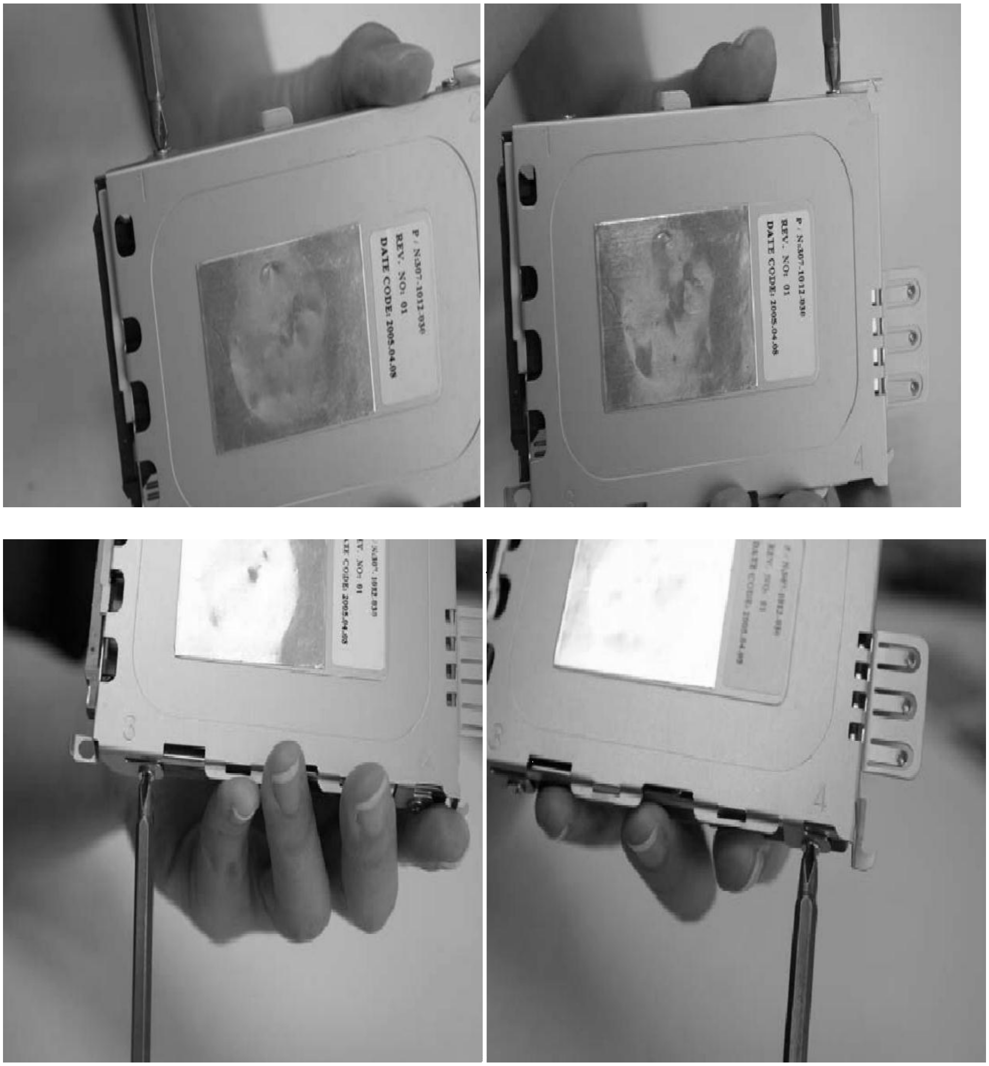
Remove the HDD connector (if replacing the older hard drive) by pulling it away from the hard drive. Insert the HDD connector to HDD. Make sure to align the connector and the hard drive pin. Improper alignment will cause damage to the hard drive and notebook. There is only 1 correct alignment and orientation in installing hard drive and hard drive connector



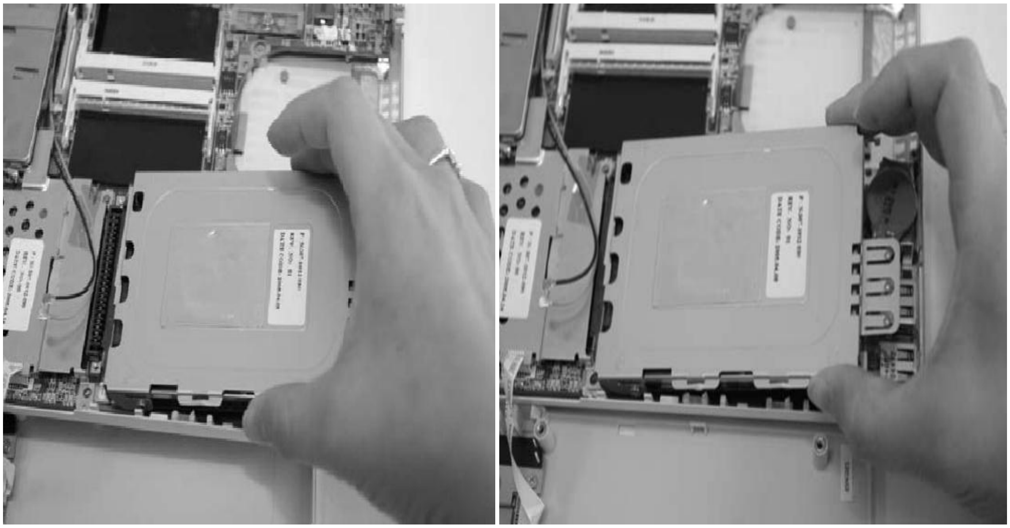




Slide the hard drive (with the connector) into the given hard drive shielding bay and fasten the hard drive you want to install with the 4 attached Phillips screws on the side.
Failure to apply 4 screws may cause hard drive assembly to fall off in the notebook hard drive area and will damage the hard drive and notebook.



Carefully place the entire hard drive assembly into the notebook hard drive area.



Step 6: Installing Notebook Optical Storage Device (OSD)

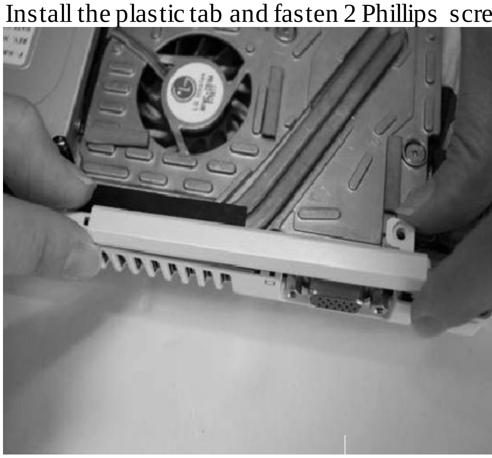
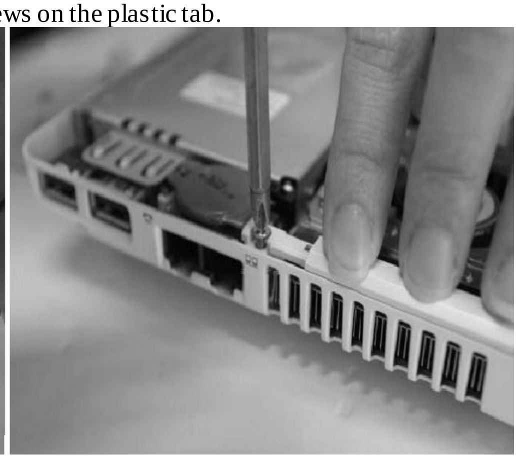
Remove the two screws in order to secure the optical storage device on the bottom case.

Pull out the optical storage device from the notebook, then insert the new optical storage device.

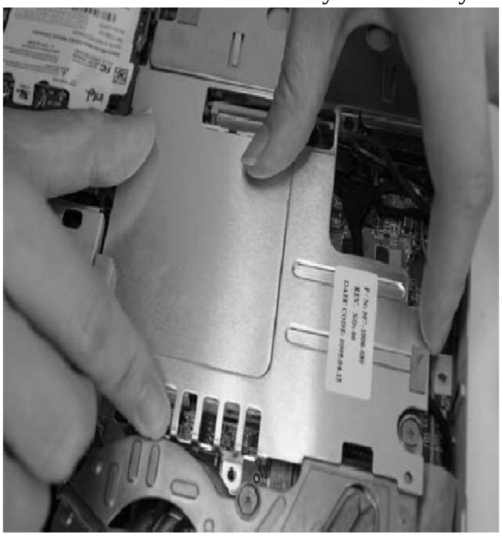

Make sure these screws are i nstalled in th e correct locations when reinstalling the optical stor age device.

Step 7: Wrapping Up

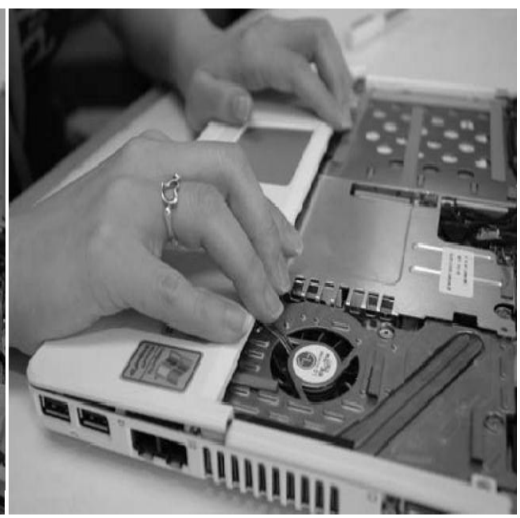
Install the plastic tab and fasten 2 Phillips screws on the plastic tab.

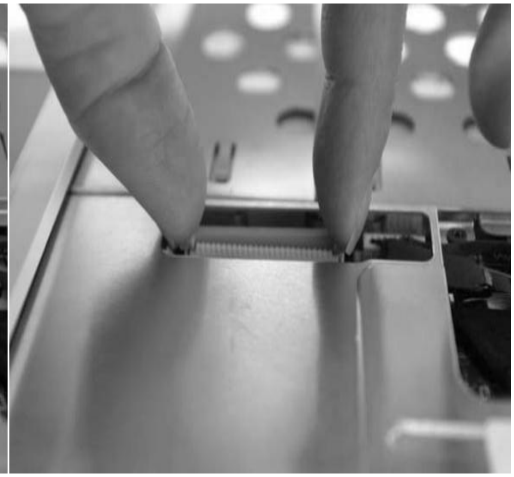
Install the metal shielding near the memory area and secure it with 1 Phillips screw.
Move the cables out of the way if necessary.



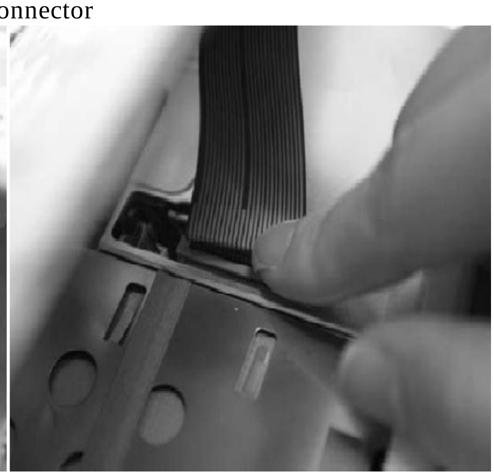
Align the plastic cover that is below the keyboard area and snap the plastic cover in place. Move the cables out of the way if necessary

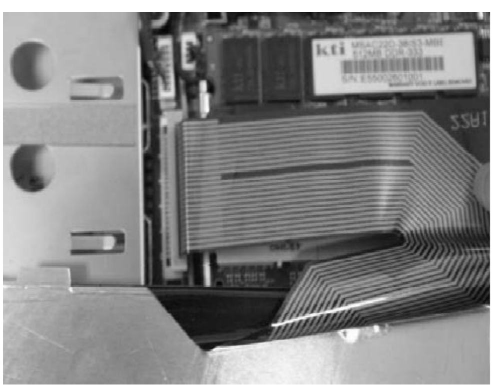


Actuator on the connector should be in disengaged "OPEN" position.

Lay the keyboard face down on top of the case. Connect the keyboard cable and engage the cable and connector in place by pressing down the actuator. Do not excessively bend or fold the keyboard cable. Excessive flexing can damage the keyboard connector

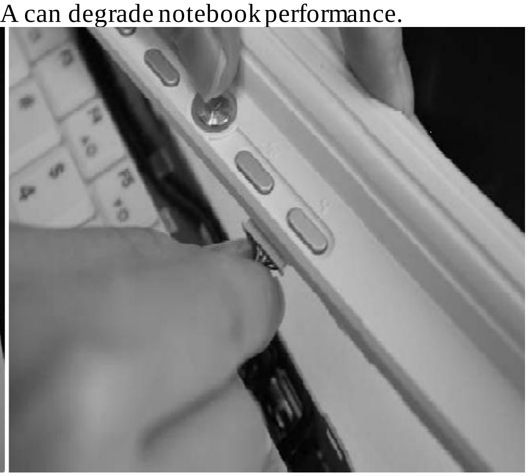






Correct Keyboard Cable connection Incorrect Keyboard Cable connection.Then put the keyboard in its normal position. Slide the metal tabs on the bottom of the keyboard into their slots in the top case and lower the keyboard into place.Do not excessively bend or fold the k eyboard cable. Excessive flexing can damage the keyboard

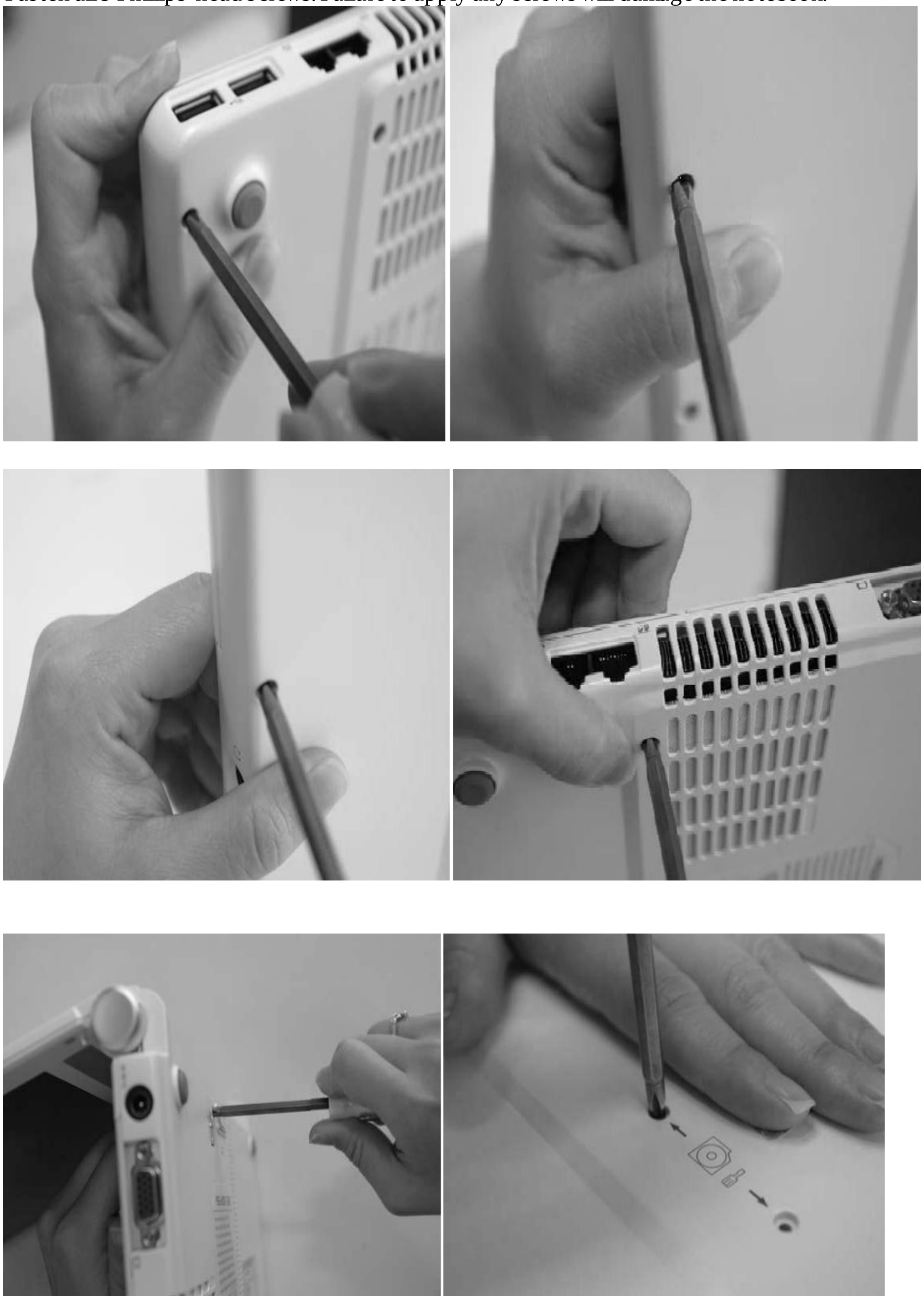
There is only 1 correct connection of connecting keyboard cable

Connect the cable under neath the hinge cover. There is only 1 correct connection of connecting the cable. Be careful not to damage the antenna PCA that is connected to the left and right display assembly hinges. Damaging either antenna PCA can degrade notebook performance.



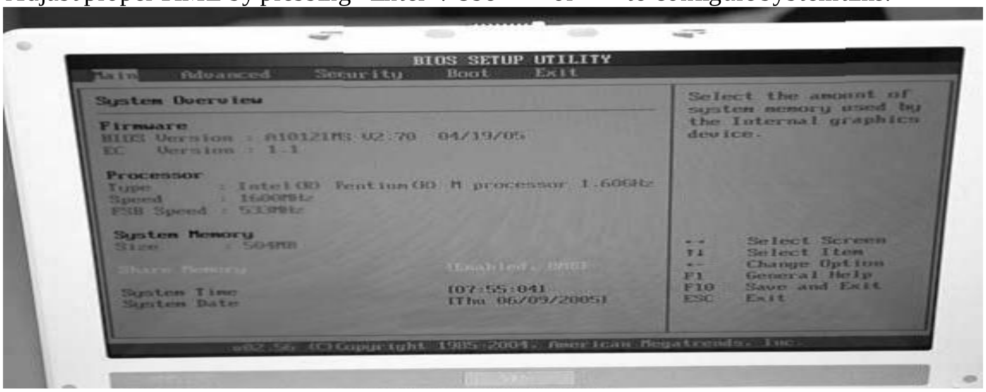
Hold the hinge cover and snap it in place. Push downward at each end of the cover to secure it.

Fasten all 9 Phillips-head screws. Failure to apply any screws will damage the notebook.

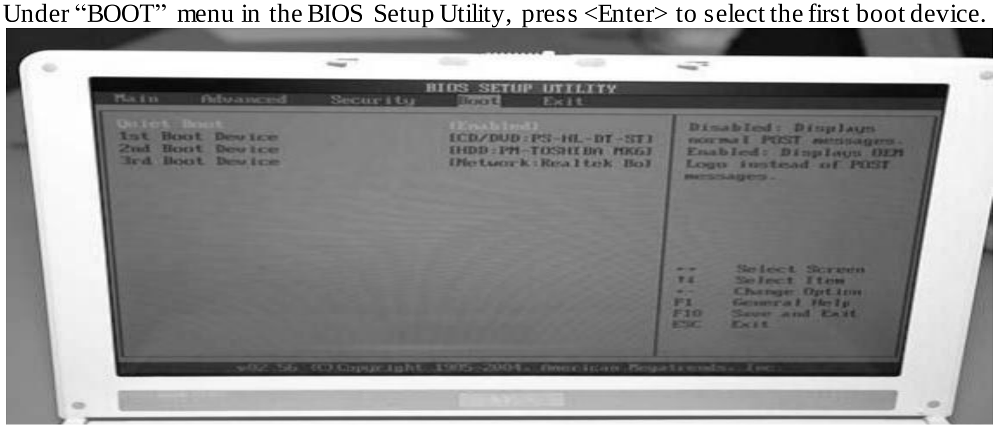


Step 8: Entering BIOS

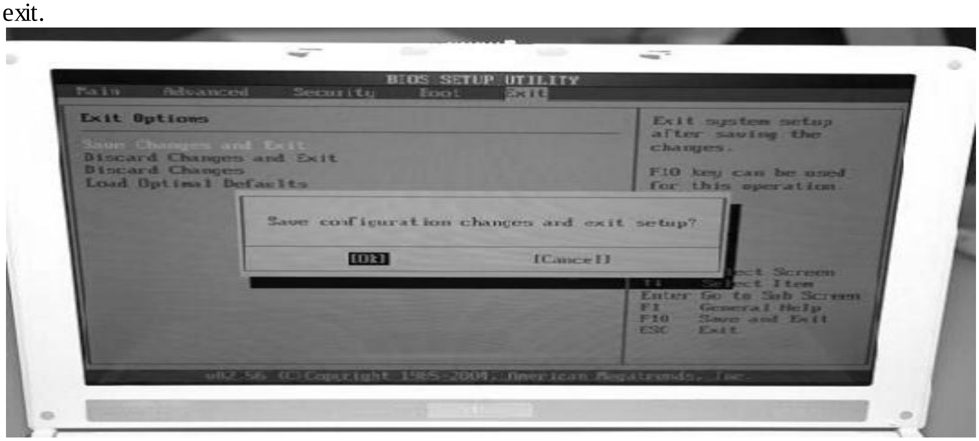
Before powering on the notebook, plug in notebook power adapter into the notebook. After pressing the power button, press <Del> immediately which will take you to the BIOS CMOS Setup Screen.
Adjust proper TIME by pressing <Enter>. Use <+> or <-> to configure system time.



Under "BOOT" menu in the BIOS Setup Utility, press <Enter> to select the first boot device.



Insert a bootable OS CD into the OSD tray. To save/ exit the BIOS Setup Screen, press "Y" to save/ exit.



Chapter - 25
TROUBLESHOOTING

Fixing Common Laptop Problems

Liquid Spills on Laptop

I have repaired many Laptops exposed to accidental liquid spills. This is a recoverable condition in most cases. It is most important to respond to the cleaning up process as soon as possible (before corrosion or internal soakage occurs)! Liquid intrusion can cause the following types of laptop damage:

- Short circuit due to conductive nature of wet liquid (problem may clear as liquid dries)
- Short circuit due to dried liquid residue
- Corrosion occurs (particularly volatile with some acidic soft drinks - Coke)
- Electronic components damaged by above short circuits

Immediately when a spill occurs, turn off the laptop, invert the laptop and leave the unit upside down (drainage) for at least 20-30 minutes. Then, remove any attached leads, remove the power unit and battery, and allow the unit to air-dry overnight.

To remove any liquid residual: Have someone remove the keyboard assembly and perform additional cleaning. It may help to use cotton buds and distilled water to remove any contamination. Where corrosive side effects may be suspected (with coke), gently rub any suspect areas with a cotton bud dampened with CRC or WD-40. Dry the treated areas so that only a light film of the WD-40 anti-corrosive solution remains. While the keyboard is removed, use a bright light and magnifying lens to inspect areas where the liquid made contact.

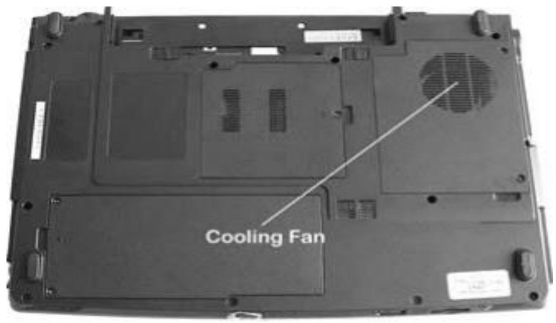
Laptop randomly turns off

This is often due to:

- AC power adaptor sensing an overload of power drain
- Overheating processor due to a build of internal dust (clogged fan)
- AC power adaptor not able to sustain normal power needs (faulty power adaptor)
- Battery overheating, due to internal battery fault, or charging levels

- Intermittent short circuit or open connection (check condition of power leads)

On older Laptops, the most common reason is poor cooling. Try going somewhere air-conditioned and see if that helps. Inspect the areas near the internal cooling fan; see if there is a build up of dust fibers. Easy way to check this; with the unit running, feel the flow of air from the cooling outlet(s) - is the airflow very low? If yes, and the unit is at normal operation temperature, this may indicate the internal cooling system is partially clogged.



Troubleshoot Laptop LCD Video Display problems

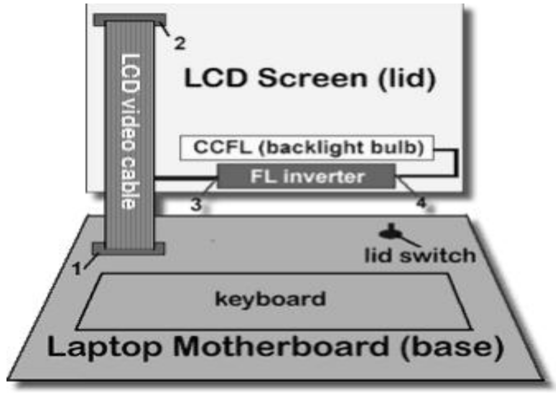
Here are some tips and tricks for troubleshooting and fixing laptop video problems. Video issues are very common within portable computers and with the following tips you should be able to detect and eliminate basic laptop video problems.

Laptop LCD screen has a faint image or is very dark

Look closely at the laptops LCD screen, and see if you can see a very faint image. If you can then it is possible that the Laptop's LCD lid close switch is stuck in the closed position. In this mode the backlight stays off, even with the LCD lid open. This is to conserve power when the laptop is ON with the LID closed. Check the LCD lid close switch. It is a small plastic pin located close to the back LCD hinges. Try tapping the lid switch a few times to see if you can turn on the screen backlight. If that does not help, then I would suggest replacing the FL inverter board.

Laptop LCD screen is solid white color or garbled

Connect an external computer monitor to the laptop. If the external monitor display is fine, then you have a problem with the Laptop LCD screen or the LCD cable connection. If the external monitor image is the same as on the Laptop LCD, then it is likely to be a faulty integrated onboard video, this means replacing the motherboard of the Laptop.



A typical Laptop LCD display assembly

The above simplified block diagram illustrates the basic components that are involved on a Laptop LCD video display problem.

Connector Locations 1 - 2 - 3: Video data is sent from the motherboard through to the LCD screen at connector 2. The video cable also feeds voltage to the FL inverter board at connector 3.

FL inverter PCB Locations 3 -4: This section converts the low voltage DC source (connector 3) to high voltage AC (connector 4), as required to energize the backlight bulb. If the FL inverter PCB is faulty, the LCD screen will appear as a very dim image on the Laptop display screen.

CCFL (backlight bulb): When the backlight bulb is working, you can see the image on the LCD screen. With some Laptops, the backlight bulb is a part of the LCD screen assembly and needs to be replaced with a complete LCD screen assembly. It requires a specialized Laptop repair workshop to replace the backlight bulb.

Laptop Lid close switch: This switch is a small switch (mechanical or magnetic) that is located close to the rear display hinges. Most laptops will either hibernate or operate in standby mode when the LCD is closed. This is achieved by interfacing with the Laptop's BIOS power management software. In turn this is linked to the Windows operating system.

The Laptop is very likely infected with spyware. Spyware is software that hides on your computer and attempts to collect information about your activity on the internet. Spyware is sometimes transferred to your computer when you download 'unknown' free software or when you link to free music Internet programs (KaZaA, Limewire, BearShare, etc). The best method to remove and further prevent spyware is to use Spybot.

Laptop is frozen, no response to keyboard or mouse, cannot Shutdown

With most Laptops I have seen that this will happen from time to time! The easy method to solve this problem is:

1. Disconnect the laptop power cord
2. Remove the battery from the laptop
3. Wait a short while (10 seconds)
4. Replace the Laptop battery into the unit
5. Reconnect the Laptop Power cord
6. Turn the Laptop on

The Laptop will start normally and be fully operational. If you were working on a Microsoft Word or Excel document at the time of the problem, then you may find that the data has been auto-recovered for you. In this case, you will be auto matically prompted to view the last document you worked on when you open the Microsoft program.

Troubleshoot Laptop Hibernate and Standby problems

Power management options on laptops sometimes to cause problems. Hibernate and Standby modes are power saving modes of operations to battery powered laptops.

Hibernation is a procedure by which the working state (contents) of your work is stored to disk before the computer goes into hibernation or standby. When the Laptop is woken up, you are restored to the exact place you were before. Standby and Hibernation use a low power consumption mode, with enough power to preserve the content of such memory. This means that Laptop computer can wake up without a full restart and loss of work.

Laptop does not wake up from Standby or Hibernation

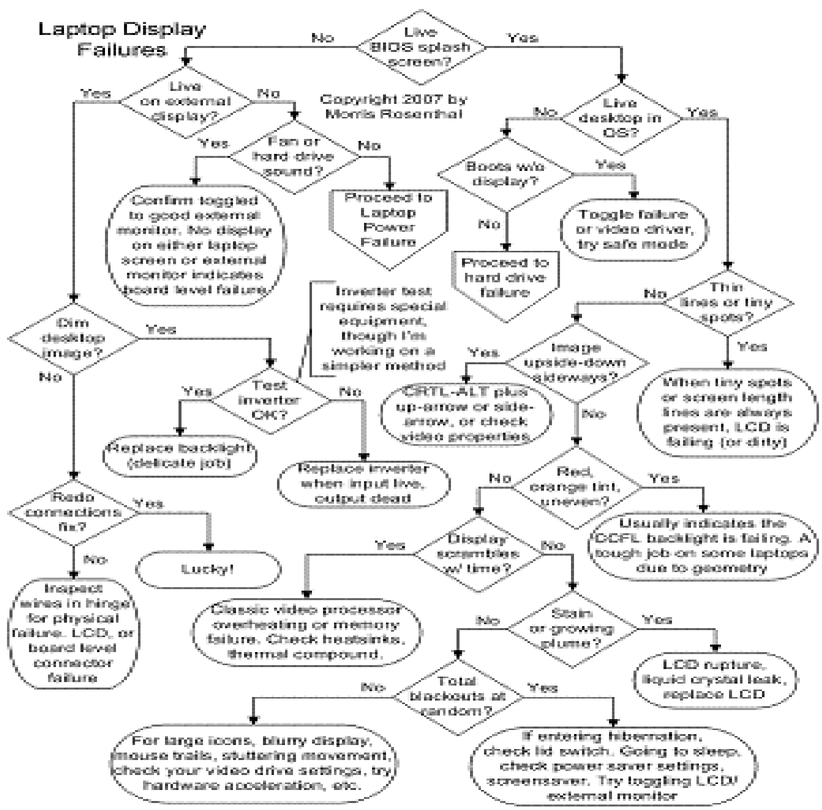
Here are my tested suggestions:

- Give it time - some older Laptops may take up to 30 seconds to wake up - fully
- Some Laptops have special keys or buttons for 'Wake Up' - read the manual
- Press and hold the Laptops power button for five seconds or more. Some Laptops are configured to Suspend or Hibernate with a press of the power button. Holding the power button for 5+ seconds will usually reset and reboot the Laptop
- As a last resort, remove the laptop battery and the power cord, wait 30 seconds, replac e the batteries and reconnect the power cord

Now that the Laptop is operational, you should research the underlying problem. Typically, such problems arise from a disagreement either between the power management features of the Laptops BIOS and Windows.

Laptop display

A conflict with the Laptops BIOS power management and Windows power management is the most common cause of such wake-up failure. Try different settings in the BIOS to see if that might solve the problem. Look to see if the Laptops BIOS is configured to suspend the computer, and how it compares with the value configured in Windows. In most cases let Windows control the power management.ve been looking for an easy way to test for live laptop inverters for a couple years and I finally found a cheap, non-invasive method. The funny thing is I'd just ordered up a couple PC modding CCFL lamps with inverters to do a page about testing inverters with cheap replacement lamps. I'm not sure that would have worked given the impedance differences and the way inverters have to go through a timed sequence of voltage ramp up and down to strike and hold the plasma. Since the impedance drops when the tube lights and the plasma conducts, it's quite a bit more complicated than simply providing an RF power source. But as I was taking apart my old Toshiba screen today to expose the inverter leads for testing, it occurred to me to try the new Cen-Tech meter I picked up at Harbor Freight a couple weeks ago for $20. To the right I'm showing the zero (well, 10Hz is well within 1% of zero on a 20KHz scale) reading with no power to the inverter.



Inverters put out fairly high voltage, in the 500 V to 700 V range, and a very low radio frequency, between 35 KHz and 60 KHz on data sheets I've looked up. That's something you could easily pick up with a spectrum analyzer and a probe for either the electric or magnet field component, but the last spectrum analyzer I worked with cost around $ 30,000, so it's a bit out of the reach of the home consumer. Now, the neat thing about the Cen-Tech meter is it comes with a Hz measurement. It's limited to 20 KHz, after which the display will simply show a "1" for over scale. Rather than equipping the meter with a special probe, I just held the two standard probes a fraction of an inch apart, and the son-of-a-gun picked up the cyclic field for the live screen almost an inch away from the inverter output, as shown to the left.

The weak signal results in a lower than reality frequency reading, and as I moved the probes close to the inverter output, it simply went off scale. I'd try to be more technical, but the instructions that came with the meter were so vague about its capabilities and what it's supposed to read that I'm just assuming here. The important thing is that the inverter test worked, and at no point am I touching the probes to exposed wires or terminals. This beats the heck out of a test I saw a guy recommending where he sets a multimeter to high voltage and shorts out the live inverter. He reported he could get a transient reading before the inverter shut itself down, and with luck, it would still work after rebooting a few times. The inverter is designed for an RF impedance, not to drive into a simple DC resistive load like a multimeter, and I wouldn't be surprised if that voltage test has ruined more than a few inverters.

With my cyclic field test, I don't see how it can do any damage, unless you're careless with the probes and short out something in the screen. Then it occurred to me that the test could be truly non-invasive since laptops screens are so thin. To the left, I'm showing my newer Toshiba which I normally run plugged into a 19" Samsung monitor so I can see what I'm typing. A little hunting around on the outside with the spread probes and the meter picked up the field to the left. A further small move and to the lower left, you see the "1" indicating the field is off scale, higher than the 20KHz maximum frequency the meter can handle. Below, just as a proof, I'm holding the probes in the same spot with the laptop live, but the image diverted to the Samsung. Hunted around forever, no reading. So, this is probably the best use I've gotten from that MSEE I earned in the RF/Radar concentration 16 years ago!

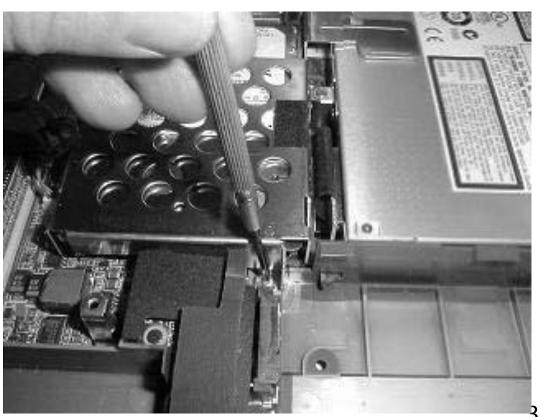
Of course, into every test procedure some rain must fall, and when I went out and tested some other random laptops, as well as a simple CCFL tube and inverter for molding , my $20 meter failed to register anything! So I borrowed a better meter from my neighbor, a Fluke 110 true RMS meter. The Fluke specs show it's rated to 50 KHz, which turned out to be critical in the inverter test application. As the measurement to the right shows, the Toshiba I'd originally tested has an inverter frequency of around 33 KHz. The reading varies a little with the exact positioning of the probes, the air gap, and the noise on the leads, but something in the sub 40 KHz was clear. That's why my cheap meter that is spec'd to 20 K Hz was able to pick up the field, even though it was over range, it was still within an octave. But higher frequencies are just filtered out or immeasurable.

Hard disk

The first step when working on any notebook or laptop is to pull the battery. Sometimes the power button appears to be protected, like under the lid, but it may fire up due to a mechanical jolt or a short cause by a screwdriver, so I always take it out. This Sony VIO unit slides out of the left side after popping off a small door. Oddly enough, some laptops use a similar method to replace hard drives

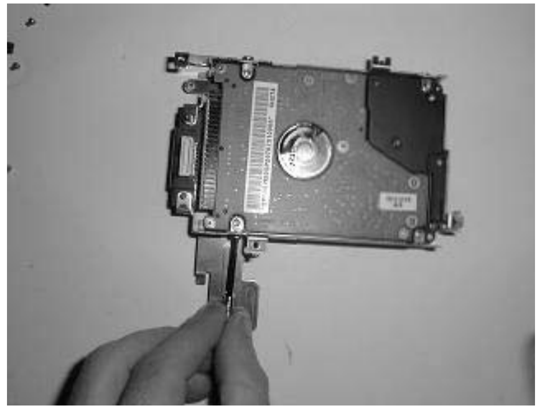
When it comes to replacing hard drives in laptops, there are easy types and hard types. But even if yours is the easy type, don't waste money replacing it unless .The easy type of notebook hard drive to replace is reached by removing a lid on the bottom of the notebook, or slid out from the body, almost like I mentioned above. This Sony VAIO laptop, and many others, contains the hard drive within the body. Fortunately, this design doesn't make up rip the whole top off the body, just the blue sound cover (I call it that because it holds the speakers), which is secured in at one point. It slides off to the right after the screw is removed

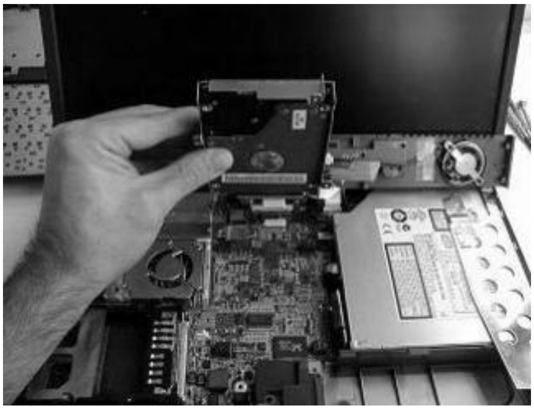
The inside of the Sony notebook computer body. The ribbon cable that powers the speakers is removed above, simply by pushing back the edges of the white connector, then pulling out the ribbon. There's a similar connector on the back of the keyboard, which we lift out to the left, giving us access



to. OK, I got my hand in the way a little here, but there's a standard 2.5" laptop hard drive in the metal cage with all the round holes in it. The cage is held in place with three screws, the first of which I'm taking out. To the right is the DVD drive, and if we were replacing the DVD, the single screw on the tab to the right of the hard drive is all that's holding it in place.

The second fasteners holding the laptop hard drive cage is exposed easily enough but try getting it out of the guts of the notebook if it rolls off on its own. The third is in the back, after which the whole hard drive and cage lifts right out of the laptop. Note the white connector on the end of the cage that mates to the board.





Getting the any laptop hard drive out of the cage is simple enough if you have a quality screwdriver and strong wrists. There are four fasteners holding the drive itself into the cage, plus the add-on connector that often fools people into thinking that the laptop hard drive is something other than a standard 2.5" IDE drive.

Like all things Sony, they sure do secure parts beyond any chance of breaking loose. It's possible at this point to pull the 2.5" hard drive out of the cage and leave the connector in place, but I figured I take it apart just for the sake of illustration. The IDE connector is secured on both sides, after which the VIO notebook hard drive with the connector can be lifted from the cage. Below I'm showing how the custom connector sits over the standard IDE connector. Installation is simply reversing all of the steps above.

How can I reset CMOS / BIOS SETTINGS?

Answer:

If your computer is having issues booting, has errors during boot, after adding hardware is running into issues, and/or you're having other abnormal system behaviors that cannot be resolved though any other method it may be necessary to reset the CMOS settings and/or load the default or fail-safe defaults. To do this follow the below steps.

Load / Reset defaults

1. Enter CMOS setup, additional information about entering CMOS setup can be found on document CH000192.
2. In CMOS setup look for an option to reset the CMOS values to the default setting or an option to load the fail-safe defaults. With many CMOS setup screens there will be a function key to do this; for example, the F6, F11, or F12 key. Other setups may actually list an option that you can arrow over to using the arrow keys and press Enter.
3. When found and selected you'll likely be asked if you're sure you wish to load the defaults press Y for yes or arrow to the yes option.

Reset Configuration Data

In addition to restoring the system defaults if you've recently added new hardware or resetting the default values did not help resolve your boot issues you may also want to reset the configuration data. Below are some examples of how this can be done. Keep in mind that unfortunately all CMOS screens are different and these instructions may not be exact steps for your CMOS.

Under advanced

If you're working on a computer with a Phoenix BIOS that has Main - Advanced - Security - .... across the top of the screen you can get to this setting by using the right arrow to move over to Advanced and under Advanced arrow down to Reset Configuration Data and changing the value from Disabled or No to Enabled or Yes.

Once the above has been done press the F10 key and save and exit CMOS setup.

In PnP/PCI Configurations

If you're working with a Phoenix BIOS that has several different options and one of them is PnP/PCI Configuration move the cursor down to this option and press Enter. Within the PnP/PCI Configurations change the Reset Configuration Data from Disabled to Enabled. Once the above has been done press the F10 key and save and exit CMOS setup.

Hardware Practical session

Session – 01

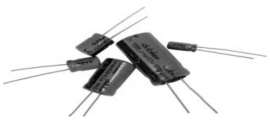
1. Perform this practical after lecture no. 1, 2, 3 and 4.
2. Time duration for the same will be **30 Min**.

Identification of computer parts				
Sr. No.	**Computer Components**	**Components Specification**	**Students remark**	**Faculty suggestions**
1	Motherboard	Mother model no.		
		Type of Processor (Slot/Socket)		
		Processor socket type		
		Processor Speed (Mhz/Ghz)		
		Type of Memory slot (SIMM/DIMM/RIMM)		
		How many no. of IDE connectors		
		How many no. of FDC connectors		
		No. of Pins in Display connector		
		Type of Graphics slot available (AGP/PCI EXP.)		
2	Hard disk	Type of hard disk (IDE/SATA/SCSI)		
		Capacity of Hard disk provided (MB/GB)		
		No. of pins in SATA data cable		
		No. of pins in SATA power cable		
		Expected rotation speed of HDD		
3	RAM	Type of RAM (EDO/SDRAM/DDR I ,II & III)		
		Capacity of RAM (MB/GB)		
		Speed of RAM		
		No. of Pins in RAM		
4	ROM	Name of company		
5	USB Ports	No. of Ports (On the back side)		
		No. of Ports (for the front side)		
6	Expansion Slots	Types of slot provide on MB (ISA/MCA/EISA/PCI)		
		No. of Slot provided		
7	Input/output Connector	Type of keyboard		
		Type of Mouse		
		No. of pins in COM port		
		No. of Ports in Printer port		
8	Power Supply (SMPS) on MB	Type of power supply (AT/ATX/BTX/Micro BTX)		
8	Onboard NIC card available (Y/N)			
9	Onboard Sound available (Y/N)			
10	Onboard CNR Port available (y/n)			

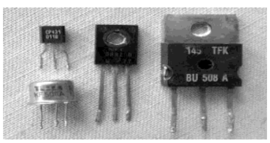
Session – 02

Identify the computer Components: Write the name.

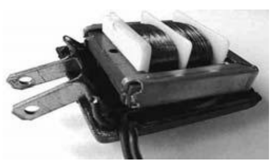
1. ____________________.



2. ____________________.



3. ____________________.



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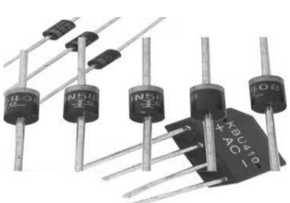
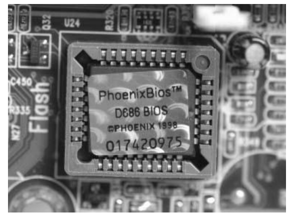
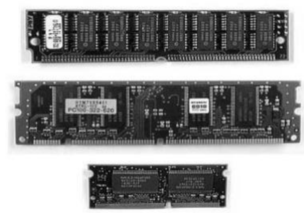


5. ____________________.

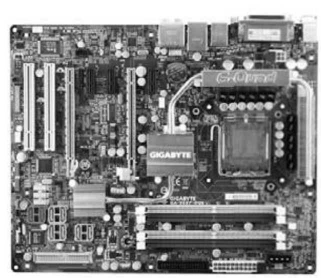
6. ____________________.



7. ____________________________.



8. ____________________________



9. ____________________________.

10. ____________________

3. Test Your Knowledge.

a. To make changes in CMOS setting, which password you should know?

Ans:

b. Which details are stored in a standard CMOS setup?

Ans:

c. You made some changes to CMOS, and now some options are not working properly which were running before you made changes. Which option would you use?

Ans:

Prepare the checklist:

Sr. No.	Activity	Results
1.	Write down main menus available in main window.	
2.	Note down the IDE devices attached to your PC.	
3.	List the size of RAM and the cache memory	
4.	Set and change user password.	

Session – I (Lec. 5 to 8) uration: 60 MinD

Partitioning and Formatting of HDD:

To complete this experiment, you must have:

- DOS installed in your computer.
- Hard disk and startup disk.

Perform the practicals:

1. Switch on the machine and press Del. Or F2 Key to enter into BIOS.
2. Insert windows XP bootable CD into Cdrom drive.
3. Press any key to boot from CD while it prompts.
4. Press enter button to continue with booting and installation.
5. Navigate with the "C" or "D" button to create or delete partition of HDD.
6. After creating the partition format the disk.

Test your Knowledge:

1. Maximum, how many primary partitions can you have?
   Ans:

2. Before deleting the extended partition, is it necessary to delete logical partitions inside the same? Yes or No.
   Ans:

3. UNIX or Linux partitions are recognized by which type, by DOS FDisk utility?
   Ans:

4. Note the steps to use complete hard disk as a primary partition.
   Ans:

5. What are the benefits of using FAT 32 file system compared to NTFS?
   Ans:

6. How defragmentation helps improve the performance of system?
   Ans:

7. It is possible to mark a bad sector with the help of scandisk?
   Ans:

8. What is formatting?
   Ans:

Prepare the check list

Sr. No.	Activity	Results
1.	Delete a logical DOS drive and give the steps.	
2.	Create 10 partitions of the HDD and give partition sizes.	
3.	What is partition table?	
4.	Perform surface scan and give the detailed information of a disk.	
5.	Perform the disk defragmentation and watch the how files are arranged with the help of surface scan.	

Session – II
Installation of windows XP

Objective

. To check necessary hardware requirements for installing windows XP.

. To install windows XP operating system on a new PC.

To complete this experiment you should have

. Windows XP CD.

. Hard disk Minimum 1.8 GB free space

Observation Table (Write Machine Configuration)

Sr. No.	Item	Specification
1	CPU Type	
2	CPU Clock	
3	RAM	
4	Hard Disk Space	
5	Disk Drive A & B	
6	Hard Disk/s	
7	Mouse Type (Normal/PS2)	

Test Your Knowledge:

1. Note down the estimated time required for windows XP installation.
   Ans:

2. In which directory windows will install?
   Ans:

3. What is the minimum hardware requirement of installing windows XP?
   Ans:

4. List different versions of windows XP?
   Ans:

5. What is the command for console repairing of windows XP OS?
   Ans:

6. Which command would you use, to check for bad sectors in HDD?
   Ans:

Lecture 9 and 10 (Lec 9 to 10) **Input & Output Devices** **Duration: 30 Min.**

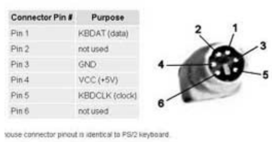
Session – I

To complete this experiment, you must have

- Different types of keyboard, Keyboard cable, connectors, Toolkit and cotton and PC etc.
- Different types of mouse, cable, connectors etc.
- Monitor CRT, LCD, monitor cable, connector etc.
- PC, printer cables (USB, Serial & parallel)

Steps that can be taken to do the practical are:

1. To identify different types of key boards, mouse you can do it by seeing their connectors

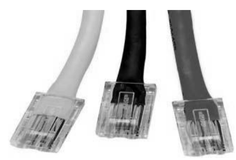


Connector Pin #	Purpose
Pin 1	KBDAT (data)
Pin 2	not used
Pin 3	GND
Pin 4	VCC (+5V)
Pin 5	KBDCLK (clock)
Pin 6	not used

__________connectors __________connector

2. Different types of cables and connectors are as follows:

__________Cable __________connectors



3. Different types of monitors are as follows:

__________Monitor __________Monitor

4. Different types of printer are as follows:

__________Printer __________ Printer __________printers

Test your knowledge:

1. What are the different types of keyboard?
   Ans:

2. Why you require cleaning of keyboard?
   Ans:

3. Tea/Coffee has been spilled on a keyboard. What will you do?
   Ans:

4. Can you connect an external keyboard to laptop?
   Ans:

5. What is the function of 'Sleep' key?
   Ans:

6. What is the unit of measurement of resolution of a mouse?
   Ans:

7. How does mouse pad work?
   Ans:

8. What type of LED is used in optical mouse?
   Ans:

9. What is spooling in printers?
   Ans:

10. Explain the printing in laser printer.
    Ans:

Prepare the check list:

Sr. No.	Activity	Results
1	Identification of keyboard type	
2	Keyboard connector type	
3	Keyboard cleaning	
4	Troubleshooting of keyboard	
5	Connection of mouse to PC	
6	Study of mouse button	
7.	Cleaning of mouse	
8.	Troubleshooting of mouse	

Test your knowledge (Lecture 11 -15) **Memory** **Duration: 15 Min.**

1. What is cache memory?
   Ans:

2. Differentiate between RAM and ROM?
   Ans:

3. SCSI port (pronounced skuzzy) stands for
   Ans:

4. How many pins on a standard DDR RAM DIMM?
   Ans:

5. What is Virtual Memory?
   Ans:

6. __________is a command used to switch directories in MS-DOS

7. ___________is used to copy the system files from one drive to another drive allowing that drive to be bootable

8. ______________allows the user to delete and or create partitions on the hard disk drive.

9. _____________is a command which allows the user to clear the complete contents of the screen and leave only a prompt.

10. _____________allows you to create your own directories in DOS.

11. __________allows you to list all the files in a directory.

Session – I (Till Lec 20) **Assembling of Computers** **Duration: 30 Min.**

To complete this experiment, you must have

- PC cabinet with SMPS,Motherboard,RAM,Floppy drive,CD/DVD ROM,HDD,Cable set, Keyboard, Mouse, Monitor & screws .
- Windows installer CD/DVD
- Screw Driver set.

List the different hardware components required for assembling.

Sr. No.	Components Required	Brand name, Type and Capacity	Use of components/Function of components	Faculty Remark
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				

Perform the following procedure to assemble the machine:

1. Fix the SMPS in the cabinet.
2. Prepare the motherboard.
   a. Install the processor on the motherboard and fix the processor fan on the same.
   b. Install RAM in the memory slot of motherboard.
3. Fix the motherboard in the cabinet and check the screw fittings.
4. Connect the 20 -4 pin power connector to the motherboard.
5. Fix the HDD, FDD & CD/DVD drive in slot provided.
6. Connect the data cable and power connector to the HDD, FDD and CD/DVD.
7. Connect the other end of data cables to the motherboard.
8. Install AGP/PCI Express graphics card if required.
9. Connect the front panel connection on the motherboard. (On/off, Reset, HDD Led & power led).
10. Connect Front panel USB connector.
11. Connect the input and output peripheral.

Test your knowledge:

1. What are the types of PGA sockets, for installing the processor?
   Ans:

2. Twisted cable of floppy drive cable is connected on which side either on back of floppy drive device or on the motherboard?
   Ans:

3. How will you distinguish between hard disk cable and floppy drive cable?
   Ans:

4. How many pins are there in SATA data cable?
   Ans:

5. How to select a SMPS for assembling a PC?
   Ans:

Session 1: Laptop Maintenance and Troubleshooting (Lec 28) Duration: 25 min.

Objective: To physically study the different parts of the Laptop.

To perform this experiments the student must have the following requirements:

1. A completely dead laptop.
2. Tool kit to physically open the laptop.

Steps to perform the above objective:

1. First take a dead laptop and physically open the laptop from the back side by un-winding the screws. There will be a sliding lock you can slide it to remove the battery of the laptop. The battery looks like this

2. In one small box you can see the RAM of the laptop and it's two small slots to attach it. It looks like this

3. Besides that slot normally in most of the laptops you can see the HARD DISK of the laptop. It looks like this

4. If you see the front panel of the laptop then you can see howhe laptop screen and keyboards are connected to the laptop motherboard.
5. Further if you see inside the board then you can see the small components same as in our normal one viz. capacitors, transistors, diodes, IC's, etc

Test your knowledge:

1. Describe some advantages of laptop?
   Ans:

2. What is cache memory?
   Ans:

3. Where the laptop battery is exactly situated? And can it be changed?
   Ans:

Check List:

Sr. No.	Activity	Result
1	Dead laptop is available	
2	A toolkit is available	
3	The laptops screws un-winded properly	

Session 2:

Objective: Troubleshooting various problems in laptop.

To perform this experiment the students must have the following requirements:

1. A laptop which is facing some problem.

Steps to be performed to achieve the objective:-

Normally now a days the new laptops does not face much problem but then too there are some common problems that can be solved easily.

1. If there is continuous beep sound without display while you turn on your laptop then you can just open the panel of RAM from the back side of the laptop and just clean RAM and just attach it again to the same slot.
2. If the laptop turns down frequently even after the battery is fully charged then you can just have a watch on the battery of the laptop. You can also change the battery of the laptop and then
3. See its performance.
4. During the windows installation if the setup is unable to take you to the partitioning and formatting step then you can just check out with the hard disk.

Test your knowledge:

1. What is the first step that is to be performed when the display of laptop does not come?
   Ans:

2. What is troubleshooting?
   Ans:

Check List:

Sr. No.	Activity	Result
1.	RAM cleaned due to display problem and attached to the same slot	
2.	Battery changed due to frequent shut down of laptop even if the battery is fully charged	

I-TECH Computer Education
COURSE WARE FEEDBACK FORM

Course Name :-		
Name of Faculty :-		
Subject Start Date :-	Subject End Date :-	Date of Feedback :-

I. Content

1. Is the depth of coverage in the book enough for the course requirements?

Yes	No	Average	If you have ticked 'Average', please list topics to be added. If the depth of coverage is in excess, please list topics to be removed.
(Please tick the appropriate answer)			

2. Is the material in the chapters relevant to the course?

Relevant	Not Relevant	If you have ticked ' Average ', please list topics to be Covered in more detail. If the depth of coverage is excessive, please list topics to be covered to a lesser
(Please tick the appropriate answer)		

II. Organization

1. Is the material in the book organized well?

Organized Well	Not Organized Well	If you have ticked 'Not Relevant', please list the topics That is irrelevant.
(Please tick the appropriate answer)		

2. What is your opinion about the layout and design of the book?

Excellent	Good	Average	If you have ticked 'Average', please give your Suggestions on how the layout and design has to be improved.
(Please tick the appropriate answer)			

3. Are the figures and illustrations informative and useful?

Useful	Not Useful	If you have ticked 'Not Useful', please list the items that are not useful.
(Please tick the appropriate answer)		

III. Readability

1. Is the language used in the book simple?

Simple	Too Complicated	If you have ticked 'Too Complicated', please list the chapters where the language needs simplification.
(Please tick the appropriate answer)		

2. Is the use of examples / programs in the book adequate?

Too Many	Adequate	Too Few	If you have ticked 'Too Many' or 'Too Few', please indicate the topics where this is applicable.
(Please tick the appropriate answer)			

[Note: Please tear off this perforated sheet and send it to the Head Office]

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