

**COMPUTER ASSEMBLY
&
MAINTENANCE**

PC POWER SUPPLIES

PC power supplies deliver required DC power to the computer electronic sub-systems including Motherboard, Hard drive, CDRom drive, Keyboard, Mouse, and others. Usually, regular CRT monitors derive power separately from the mains. PC power supplies work by converting the AC mains power supply to required DC power supplies.

There are mainly two types of power supplies used in computers:

- ATX Power Supply
- ATX12V Power Supply

ATX12V power supplies are intended to be downward compatible with ATX power supplies.

As the PC components take more and more power, to enable the delivery of more +12 VDC current to the motherboard, additional 4-pins are provided for taking care of +12 V power supply. Thus, ATX12V will have a +12 V power connector, and a simple ATX power supply will not have the +12V power connector.

An ATX power supply, typically found in all Pentium class computers is shown below:



The voltages produced by ATX/ATX12V power supplies are:

1. +3.3 Volts DC
2. +5 Volts DC
3. -5 Volts DC
4. +5 Volts DC Standby
5. +12 Volts DC
6. -12 Volts DC

Motherboard Power

(+3.3V) Orange	1	13	Orange (+3.3V)
(+3.3V) Orange	2	14	Blue (-12V)
(GND) Black	3	15	Black (GND)
(+5V) Red	4	16	Green (PS-ON)
(GND) Black	5	17	Black (GND)
(+5V) Red	6	18	Black (GND)
(GND) Black	7	19	Black (GND)
(PG) Gray	8	20	Not Used
(+5VSB) Violet	9	21	Red (+5V)
(+12V) Yellow	10	22	Red (+5V)
(+12V) Yellow	11	23	Red (+5V)
(+3.3V) Orange	12	24	Black (GND)

Following are the most commonly used power supply connectors:

4 Pin Berg Connector: Used to connect the PSU to small form factor devices, such as 3.5" floppy drives. Available in: ATX & ATX12V

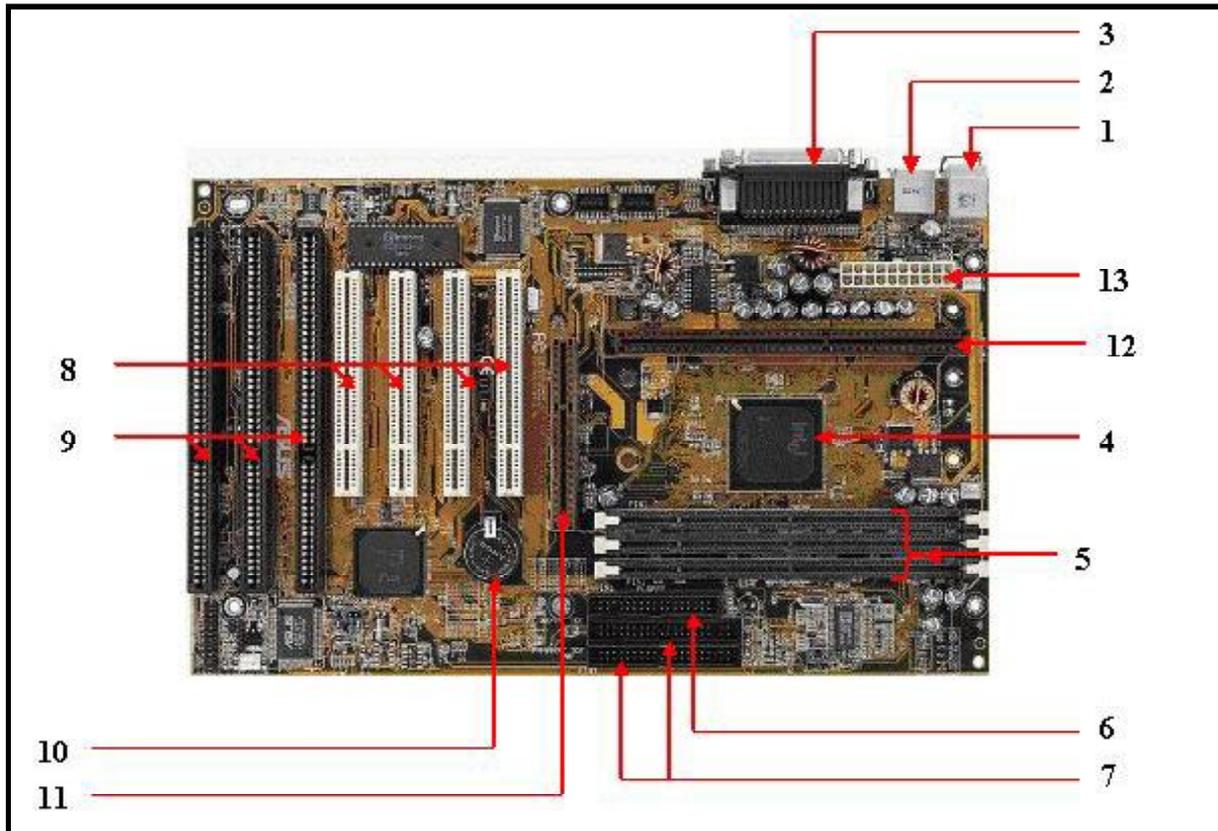
4 Pin Molex Connector: This is used to power various components, including hard drives and optical drives. Available in: ATX and ATX12V

20 Pin Molex ATX Power Connector: This is used to power the motherboard in ATX systems. Available in: ATX (ATX12V have 24 pins)

To power up an ATX or ATX12V PSU for testing, short pin 14 (PS_ON) with any of the ground pins.

MOTHER BOARD & ITS RELATED PARTS

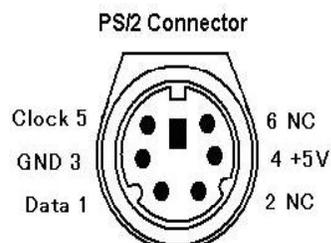
There are primarily two types of motherboards, AT motherboard, and ATX motherboard. AT motherboards are older, and not commonly used now a days. The AT and ATX motherboards differ in the form factor. Full AT is 12" wide x 13.8" deep, and Baby AT is 8.57" wide x 13.04" deep. Full-ATX is 12" wide x 9.6" deep and Mini-ATX is 11.2" wide x 8.2" deep. Other major differences include power supply connector, and keyboard connector. AT has 5-pin large keyboard connector, where as ATX has 6-pin mini connector. Similarly, AT has single row two connectors +/-5V, and +/-12V, whereas ATX motherboard has double row single connector providing +/-5V, +/-12V, and +3.3V.



The important constituent components of an ATX Motherboard are given below:

- | | | | |
|-------------------------|---------------------|------------------|--------------|
| 1. Mouse & keyboard | 2.USB | 3.Parallel port | 4. CPU Chip |
| 5. RAM slots | 6.Floppy controller | 7.IDE controller | 8. PCI slot |
| 9. ISA slot | 10. CMOS Battery | 11. AGP slot | 12. CPU slot |
| 13.Power supply plug in | | | |

1. Mouse & keyboard: Keyboard Connectors are two types basically. All PCs have a Keyboard 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.

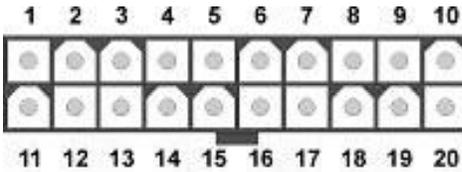
9. ISA slot: (Industry Standard Architecture) It is the standard architecture of the Expansion bus. Motherboard may contain some slots to connect ISA compatible cards.

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.

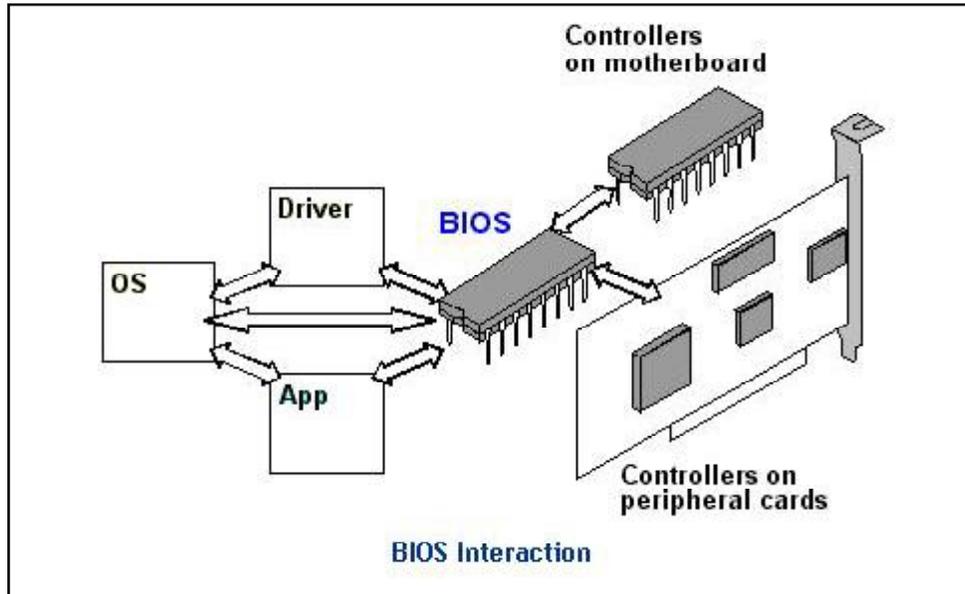
13. Power supply plug in: The Power supply, as its name implies, provides the necessary electrical power to make the pc operate. the power supply takes standard 110-V AC power and converts into +/-12-Volt, +/-5-Volt, and 3.3-Volt DC power.



The power supply connector has 20-pins, and the connector can go in only one direction.

BIOS FIRMWARE

BIOS stands for Basic Input/Output System. It contains basic instructions to interact with various hardware modules such as Motherboard controllers or that of interface cards. BIOS is the software that is run by a computer when first powered on. A computer motherboard inevitably contains a BIOS chip in the form of an onboard PROM, EPROM or flash memory. When the computer is powered on, it performs diagnostic tests on the computer hardware devices such as hard drive, FDD, and memory. It searches for other BIOS's on the plug-in boards, and takes care of them. It then loads the operating system and passes control to OS. The BIOS accepts requests from the drivers as well as the applications as shown in the figure below.

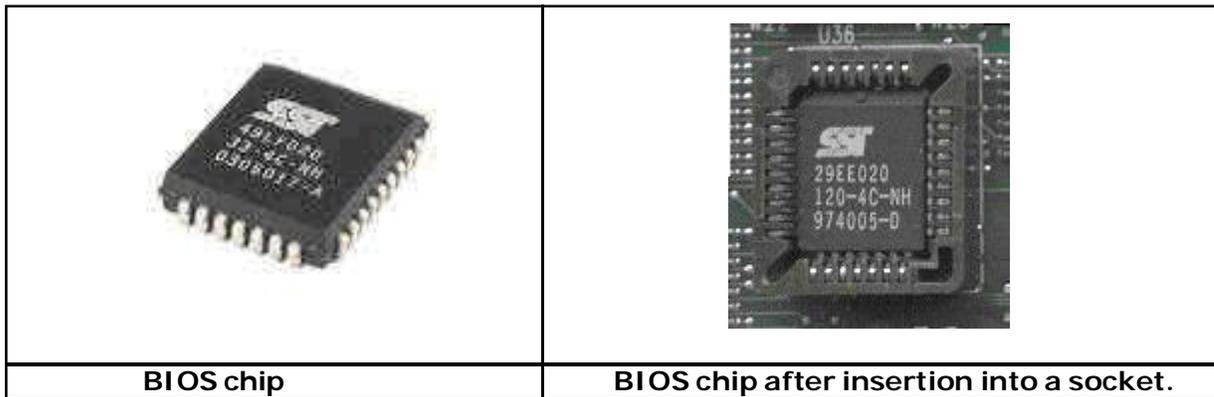


BIOS is also known as PC firmware because it is an integral part of the motherboard. Firmware on adapter cards: A computer can contain several BIOS firmware chips. The motherboard BIOS is normally used to access basic hardware components such as the keyboard, floppy drives, and hard disk controllers. Adapter cards such as SCSI, RAID, and video boards may include their own BIOS software.

Firmware generally available in different forms:

1. EPROM (Erasable Programmable ROM), for updating a BIOS firm using EPROM, you may need to get a new chip from the manufacturer.
2. EEPROM (Electrically Erasable Programmable ROM), you can update a BIOS firmware using EEPROM using "boot to floppy", and running the Firmware update program.
3. Flash ROM - faster at rewriting the chip

A typical BIOS chip used on motherboards is shown in the figure below. Though it is a square-type PLCC package, BIOS chips come in different forms. Figure 2 shows the BIOS after insertion into the socket.:



M e M o r y

PC memory stores data and programs currently being executed by the computer. It is important that the information is fetched by the CPU quickly to further processing. There are several memory types available. Important among these include the following: -

- Dynamic RAM (DRAM)
- Synchronous RAM (SRAM)
- Synchronous DRAM (SDRAM)
- Rambus DRAM (RDRAM)
- Video RAM (VRAM)
- Windows RAM (WRAM)
- EDO RAM

RAM stands for **R**amdom **A**ccess **M**emory.

Single In-line Memory Modules (SIMM):

SIMM modules have several memory chips soldered in-line on its own circuit board. A typical SIMM is shown in the figure below. There are two types of SIMM modules: 30-pin SIMM modules, and 72-pin SIMM modules. Typically, a 72-pin SIMM has 32-bit wide memory bus, whereas a DIMM has 64-bit wide memory bus. On a SIMM, the edge connector pins on either side of a SIMM are shorted, representing only one signal pin.

Dual In-Line Memory Modules (DIMM):

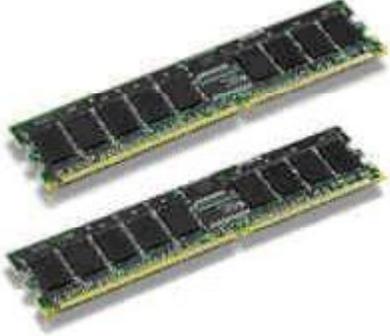
DIMMs are very similar to SIMMs. The major difference is that a DIMM has two different signal pins on each side of the module as shown in the figure. One big advantage of DIMM is that only one module can be inserted into the motherboard, whereas you need two SIMMs (paired) when working with 64-bit microprocessors like Pentium II and above. Since SIMM provides only 32-bit bus, you need to use 2-SIMMs paired together with any modern 64-bit processor.

Rambus In-Line Memory Module (RIMM):

Rambus inline memory modules (RIMMs) use Rambus Dynamic RAM (RDRAM) chips.

Double Data Rate:

DDR modules are also called DIMMs (Dual-In-Line-Memory Module). A typical DDR module (DIMM) is shown above. The DIMM package using DDR is twice as fast as the one using SDRAM.

	<p>Typical SIMM package: Memory Size: 64MB Memory Speed: 60nS Pins: 72</p>
	<p>Typical DIMM package (using DDRAM): Memory size: 256MB Pins: 168 pin</p>
	<p>Memory Size: 2X512MB Memory Speed: 400MHzPC3200 Memory Type: Dual Channel DDR Pins: 184</p>
	<p>A RIMM cusing RDRAM</p>

DIFFERENT TYPES OF MEMORY

Storage Devices, and interfaces

A computer normally contains several storage options. Commonly used storage devices include the following.

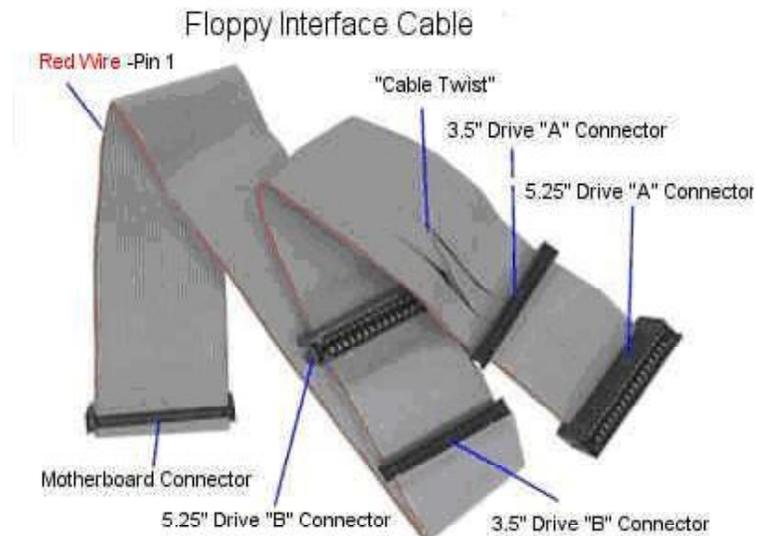
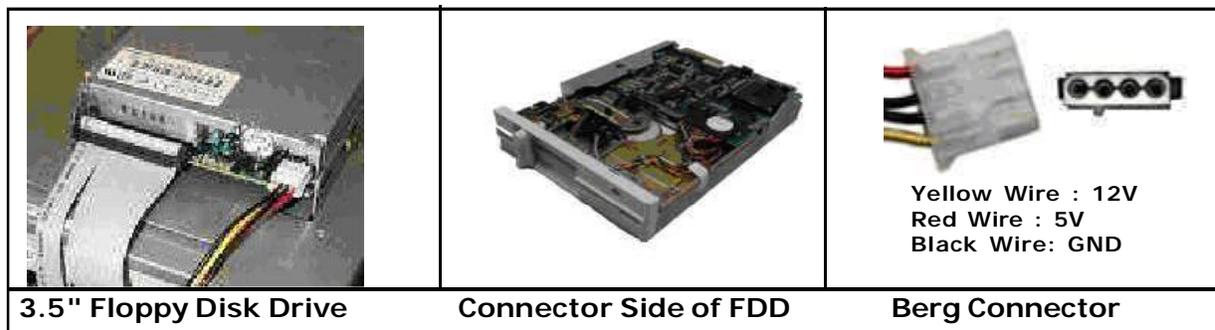
1. **Floppy Disk Drive**
2. **Hard disk drive**
3. **CD/CDRW**
4. **DVD/DVDRW**

Floppy Disk Drive (FDD)

A Floppy Disk Drive is a disk drive that enables a user to save data to removable disk. Initially, FDDs used the 5 1/4" floppy disks, which were later replaced with 3 1/2" disks. However, with the advent of removable hard disks, and flash drives, many computers no longer use floppy disk drives.

The Pentium motherboard provides a standard 34-pin connector for interfacing with FDD. A 34-pin flat ribbon cable is used to connect the motherboard to FDD. This cable connects the motherboard's FDD interface with one or two floppy disk drives. Floppy Disk Controller (FDC) uses I/O address range 370 to 37Fh. FDD divides the floppy disk into 80 tracks per side, with 9 or 18 512-byte sectors per side. This provides the system with 720KB (737,280 bytes) or 1.44MB (1,474,560 bytes) of storage. For power supply, FDD uses a Berg connector as illustrated in the figure below.

The FDD controller is assigned the IRQ-6 in PC-compatible systems. The FDD controller generates an interrupt signal each time it receives a Read, Write, or Format command from the system.



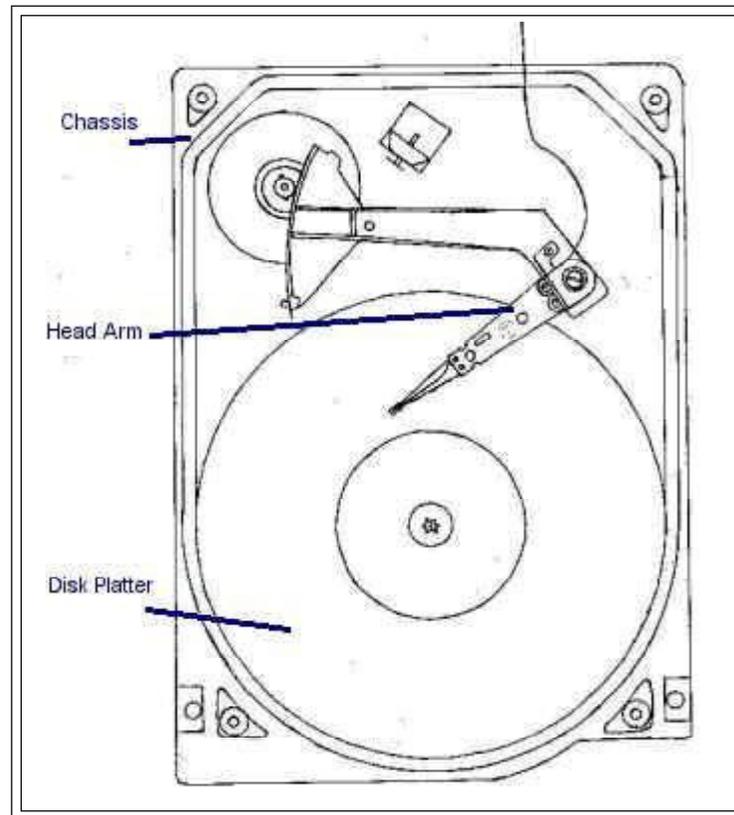
A FIVE CONNECTOR FLOPPY INTERFACE CABLE

HARD DISK DRIVE

- A) Working of a Hard Disk Drive
- B) Hard Disk Drive Interfaces

Working of a HDD:

The hard disk drive (Abbreviated as HDD or HD) holds the main storage media of a computer. A HDD consists of several platters (or hard disks) along with head actuator, head arm secured in a chassis. A schematic diagram of a HDD is shown in the figure below:



The individual hard disks (platters) are used to store the information. The storage is achieved by depositing a thin magnetic film on either side of each disk. The disks are mounted on a rotary drive.

Basically, the surface of each disk is divided into concentric Tracks. Then each track is divided into Sectors. The data is accessed by specifying the disk number, track number, and the sector number. The disks rotate at a very high speed (several thousands of revolutions per minute), enabling very fast read and write operations. The magnetically sensitive head reads/writes information when the disks rotate. The disks are sealed to prevent any dust or moisture entering the drive.

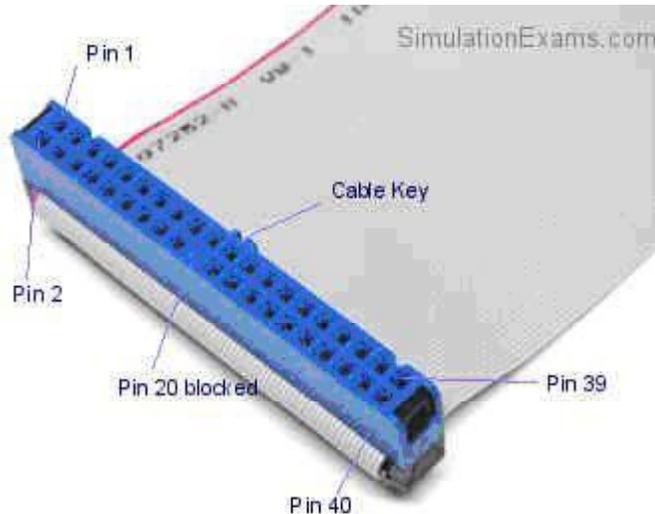
Hard Disk Drive Interfaces:

There are several standards connected with the Hard Disk Drives. These include the following:

- IDE/EIDE
- SCSI
- Serial ATA
- Notebook IDE/PATA

IDE/EIDE Hard Disk Drives:

IDE (Integrated Drive Electronics), also known as ATA is used with IBM compatible hard drives. IDE and its successor, Enhanced IDE (EIDE), are the commonly used with most Pentium computers.



A 40-pin IDE cable connector

Enhanced IDE (EIDE) is the enhanced version of IDE technology, and supports faster access to the hard disks.

Small Computer Systems Interface (SCSI): SCSI is commonly used with server grade machines. IDE supports only two drives (one master drive and one slave drive) per channel, whereas SCSI can support 8 or more hard drives. There are different versions of SCSI available today. Different versions of SCSI include the following:

SCSI-1, SCSI-2, SCSI-3, Ultra-2, Ultra-3, Ultra-320, Ultra-640., iSCSI, Serial SCSI

The various standards primarily differ in the following:

- Maximum throughput (MB/sec)
- Maximum cable length, and
- Maximum number of devices that could be connected.

For example, SCSI-I has a throughput of 5MB/sec, where as SCSI-3 can go up to 40MB/sec.

Serial ATA (SATA):

Serial ATA (SATA) is a next generation technology based on ATA, and for transfer of data to and from a hard disk. Earlier, ATA was used to mean parallel transfer of bits between the motherboard and the hard drive. However, with the advent of SATA, traditional ATA was named as PATA (Parallel ATA). IDE/EIDE is usually associated with PATA.



CD-R and CD-RW

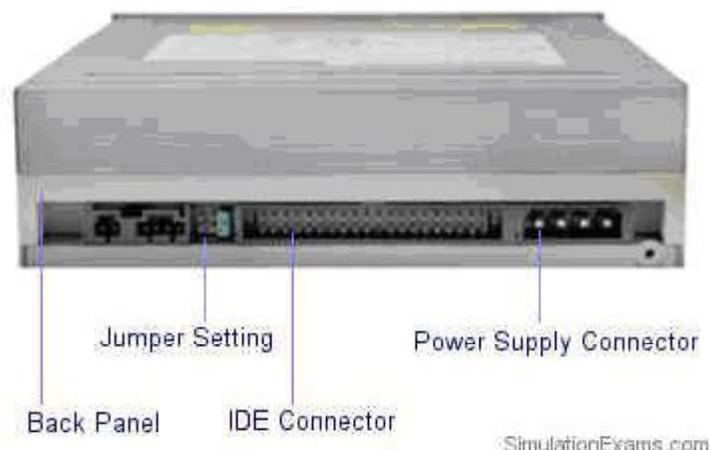
A CD-R stands for Compact Disc-Recordable. CD-R holds large volumes of data, in the range of 100s of MB, and replaced Floppy Disk Drives gradually. CD-R allows only one "Write" operation, and any number of "Read" operations. CD-RW stands for Compact Disc -ReWritable.

CD-Rs resemble DVDs as their physical dimensions are the same. The disks come in the dimensions of 120 mm (4.72 inches) or sometimes 80 mm (3.15 inches) in diameter. The technology used in CD-R, and DVD manufacture and information storage is completely different. DVDs have much higher storage density compared to CD-R or CD-RW.

CD-R or CD-RW comes in different speeds. At 1x a recorder writes 150 KB (153,600 bytes) of data per second and at a multiple of that figure at each speed increment above 1x.

<u>Specification</u>	<u>Speed</u>
Initial Speed	1x - 4x
High Speed	4x - 12x
Ultra Speed	16x - 24x
Ultra Speed	+ 32x

Majority of IBM compatible PCs use IDE connector (or EIDE) for CDROM drives. Most of the HDDs use IDE/EIDE connectors. To avoid conflict between the two, CDROM drive is designated as "Slave", and the HDD is designated as "Master". The "Master", and "Slave" setting is typically done by configuring jumpers at the back of the CDR or HDD. The IDE controller recognizes the "Master" and "Slave" settings and chooses the correct device.



Back side of an IDE CDROM drive

DVD and DVD RW

DVD stands for Digital Video Disk (Also known as Digital Versatile Disk). Essentially, DVD looks very similar to CD-R, but contains larger storage space and can hold video, audio, and/or computer data. A single-layer, single-sided DVD has a capacity of 4.7GB whereas a CD-ROM has a capacity of around 650MB. A double-layer, double-sided DVD-ROM disk can have capacity over 17GB. The DVD specification supports access rates of 600KBps to 1.3MBps.

DVD-R is a once-recordable form of DVD. DVD-RW or DVD-R/RW can be written multiple times. Many DVD drives can read data from a CD-R. But, some DVD drives may not be able to read CD-Rs. You need to ensure compatibility with CD-R when procuring a DVD drive. Normally, CD-R drives are not compatible with DVD, and you will not be able to read a DVD using a CDR.

The original speed rating for DVDs is different from that of a CD-R. For a DVD, 1x is 1352.54KB/sec. Following the convention, 2x for a DVD drive is 2,705KB/sec, 4x is 5,410KB/sec, 8x is 10,820KB/sec, and 16x would be 21,640KB/sec.



Video display devices

The display devices used commonly can be classified as below:

- ▶ Cathode Ray Tube (CRT) display
- ▶ Liquid Crystal Display (LCD) display
- ▶ Plasma Displays

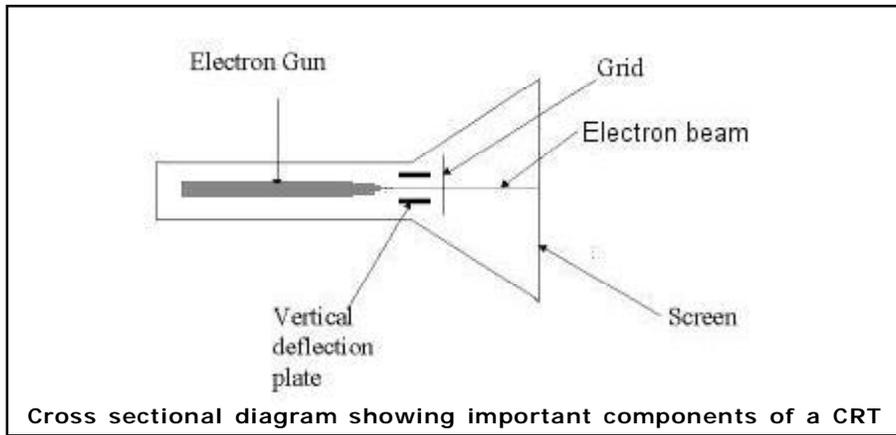
Cathode Ray Tube (CRT)

CRT display is the most commonly used form of visual displays, through it is getting gradually replaced with LCD and Plasma displays.

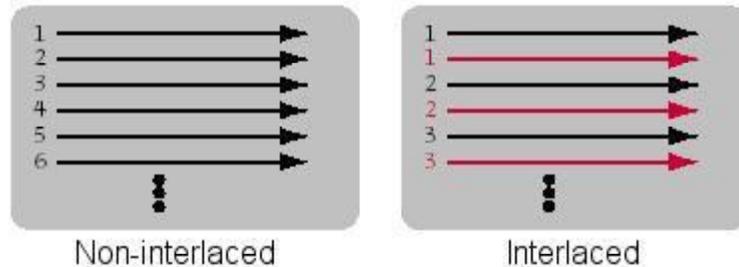


A COMPUTER MONITOR USING CRT DISPLAY

In a CRT, an electron beam sweeps the display screen horizontally, one line at a time, gradually down the screen. A synchronization (sync) signal brings the beam back to the top row of the display. This type of scanning (line-by-line) is known as raster scan.



There are two types of cathode ray displays. One is non-interlaced, and the other is interlaced. Normally, all the displays are interlaced to reduce flicker.



A black and white monitor contains only one electron gun, whereas a color display monitor will have three electron guns, each of which represent red, green, and blue.

The horizontal and vertical deflection takes place by applying appropriate voltages to the horizontal, and vertical deflection plates. Usually, the screen is refreshed between 60-100 times per second.

One basic unit of measurement is "pixel". A pixel is the smallest area in a graphics display that can be manipulated.

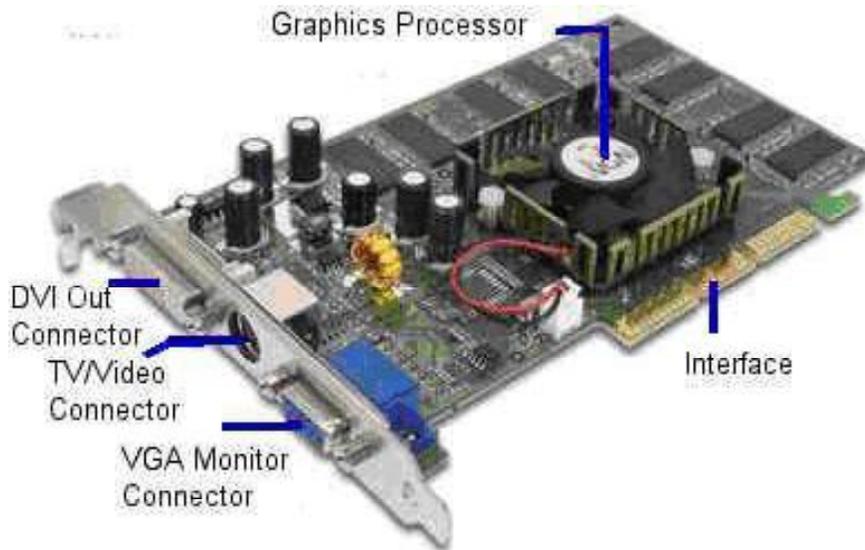
Display Type	Number of pixels
Video Graphics Array (VGA)	640 * 480 pixels
Super Video Graphics Array(SVGA)	800 * 600 pixels
eXtended Graphics Array (XGA)	1024 * 768 pixels
Super eXtended graphics Array (SXGA)	1280 * 1024 pixels

COMMONLY USED SCREEN RESOLUTIONS

Screen resolution is always stated as the horizontal number of pixels by the vertical number of pixels. A screen displaying 800 x 600 pixels has 600 rows, each 800 pixels wide.

GRAPHICS CARD

The graphics card resides in the CPU box, and drives the video display. A typical graphics card is shown below: -



The graphics card shown includes DVI connector, TV/Video connector, and a VGA connector. The card has an on-board graphics processor with cooling fan. Usually, for graphic intensive applications, you need a higher end graphic adapter card. For normal desktop usage, a video adapter will be sufficient.

CABLES AND CONNECTORS

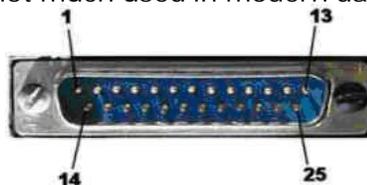
Serial Ports:-

The serial port is an Asynchronous port which transmits data one bit of data at a time. Serial port hardware usually consists of a UART (Universal Asynchronous Receiver/Transmitter).

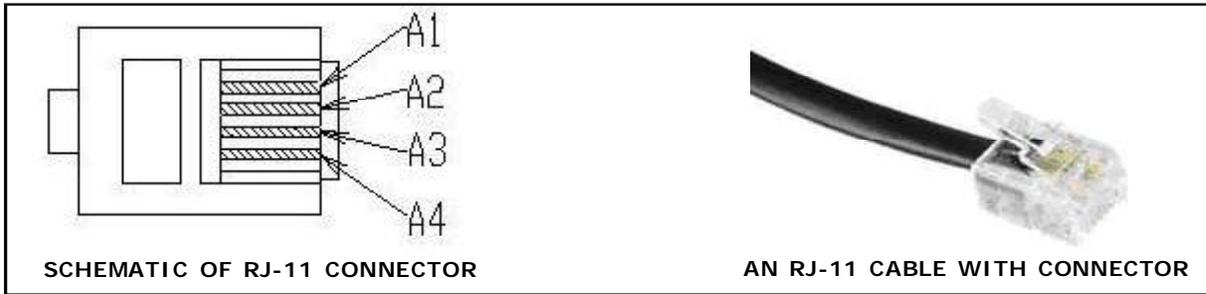
1. **DB9:** DB9 adheres to the RS-232c interface standard. It has 9 pins as shown in the figure. The connector is "D" shaped, and easy to recognize. The function of each pin is described below.



2. **DB25:** DB25 adheres to the RS-232C interface standard. It has 25 pins as shown in the figure. The connector is "D" shaped, and easy to recognize. DB-25 is normally used in older computers, and not much used in modern day computers.

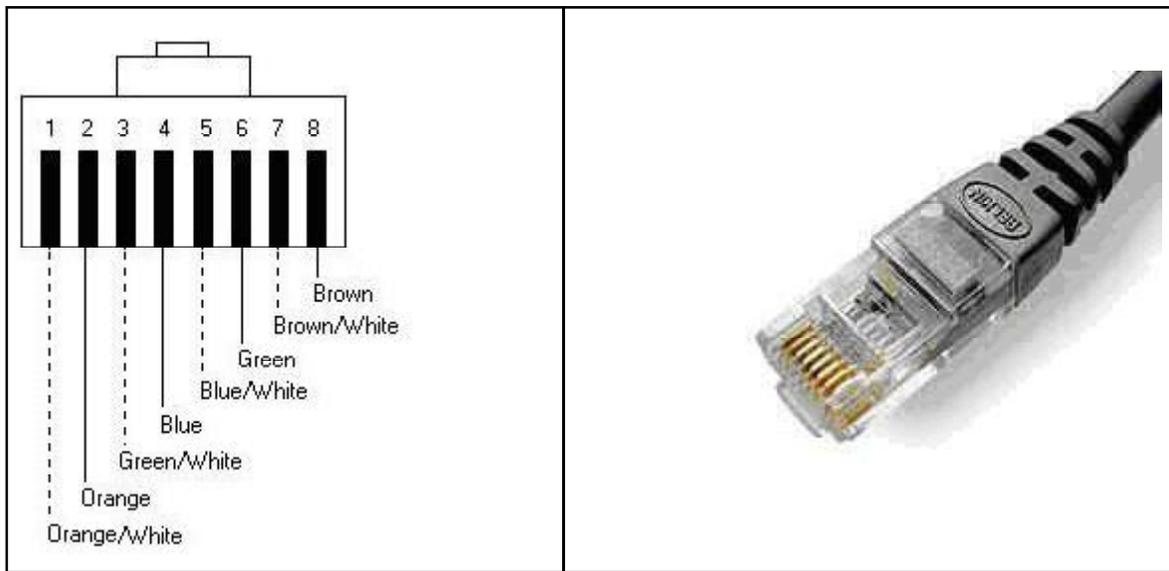


3. RJ-11: RJ-11 is a 4-wire connector, commonly used with a modem. It should not be confused with bigger RJ-45 cable and connector. RJ-45 is commonly used for Ethernet network interface card (NIC).



<u>Pin #</u>	<u>Function</u>
A1	Ground
A2	Rx (Data Input)
A3	Tx (Data Output)
A4	Vc (Power)

RJ-45: An RJ-45 connector has 4 pairs of wires as shown in the schematic diagram below. Note that an RJ-11 is a 4-wire connector, where as RJ-45 is an 8-wire connector.



RJ-45 connector schematic

RJ-45 connector crimped to a cable.

RJ-45 connector is commonly used for Ethernet Networking ports. Devices that normally use RJ-45 ports include NICs, Hubs, Switches, and Routers.

There are basically two types of cables. One is Straight-through cable, and the other is Cross-over cable. Straight-through cables are used for connecting a network device to a work station. Cross-over cables are used for connecting a hub to a switch or a hub to another hub.

Parallel Ports:

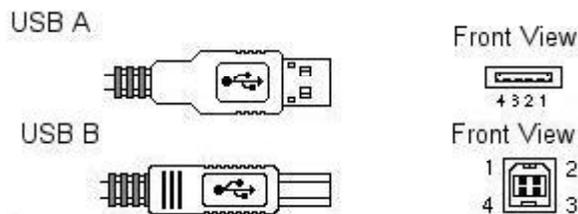
DB-25: DB-25 connector is most commonly used in conjunction with a parallel printer. It has an 8 bit data bus as shown in the figure below.



USB

USB stands for Universal Serial Bus. The most important features of USB bus include the following:

Plug'n'Play: USB is a truly plug-n-play port. The port is automatically detected by the system, and its ready to use.
Hot plug and unplug: It is possible to insert an USB device and and unplug without affecting the functioning of a computer. You dont need to power-off the computer to remove or insert a USB device.
127 physical devices: A USB can support up to 127 devices. This is much more than what is normally required.
Low cost cables and connectors. USB connectros can be broadly divided into USB A, and USB B. The difference between the two is in the physical layout of pins in the connector. Both are shown in the figure below.



<u>Pin #</u>	<u>Function</u>
Pin 1	+5V DC
Pin 2	Data-
Pin 3	Data+
Pin 4	Ground

USB "A" plugs are used towards the host system and USB "B" plugs are used towards the USB device.