

## 1.0 Different Input and Output Devices

### 1.1 cables

### 1.2 Connectors

### 1.3 Computer Ports

A Computer Port is an interface or a point of connection between the computer and its peripheral devices. The main function of a computer port is to act as a point of attachment, where the cable from the peripheral can be plugged in and allows data to flow from and to the device.

A computer port is also called as a Communication Port as it is responsible for communication between the computer and its peripheral device.

In Computers, communication ports can be divided into two types based on the type or protocol used for communication. They are Serial Ports and Parallel Ports.

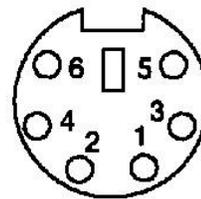
A serial port is an interface through which peripherals can be connected using a serial protocol which involves the transmission of data one bit at a time over a single communication line.

A parallel port, on the other hand, is an interface through which the communication between a computer and its peripheral device is in a parallel manner i.e. data is transferred in or out in parallel using more than one communication line or wire. Printer port is an example of parallel port.

#### PS/2

PS/2 connector is developed by IBM for connecting mouse and keyboard. It was introduced with IBM's Personal Systems/2 series of computers and hence the name PS/2 connector. PS/2 connectors are color coded as purple for keyboard and green for mouse. PS/2 is a 6-pin DIN connector. The pin out diagram of a PS/2 female connector is shown below. Even though the pinout of both mouse and keyboard PS/2 ports are same, computers do not recognize the device when connected to wrong port.

PS/2 port is now considered a legacy port as USB port has superseded it and very few of the modern motherboards include it as a legacy port.



Pinout on Female Port

Pin Number	Description
1	Data
2	No Connection
3	Ground
4	+5V
5	Clock
6	No Connection

#### Audio Ports

Audio ports are used to connect speakers or other audio output devices with the computer. The audio signals can be either analogue or digital and depending on the port and its corresponding connector differ.

#### VGA Port

VGA port is found in many computers, projectors, video cards and High Definition TVs. It is a D-sub connector consisting of 15 pins in 3 rows. The connector is called as DE-15.

VGA port is the main interface between computers and older CRT monitors. Even the modern LCD and LED monitors support VGA ports but the picture quality is reduced. VGA carries analogue video signals up to a resolution of 648X480. With the increase in use of digital video, VGA ports are gradually being replaced by HDMI and Display Ports.



#### Digital Video Interface (DVI)

DVI is a high speed digital interface between a display controller like a computer and a display device like a monitor. It was developed with an aim of transmitting lossless digital video signals and replaces the analogue VGA technology.



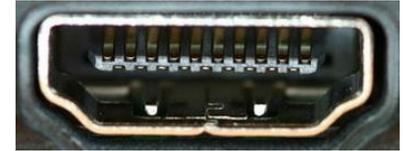
There are three types of DVI connectors based on the signals it can carry: DVI-I, DVI-D and DVI-A. DVI-I is a DVI port with integrated analogue and digital signals. DVI-D supports only digital signals and DVI-A supports only analogue signals.

The digital signals can be either single link or dual link where a single link supports a digital signal up to 1920X1080 resolutions and a dual link supports a digital signal up to 2560X1600 resolutions

**HDMI**

HDMI is an abbreviation of High Definition Media Interface. HDMI is a digital interface to connect High Definition and Ultra High Definition devices like Computer monitors, HDTVs, Blu-Ray players, gaming consoles, High Definition Cameras etc.

HDMI can be used to carry uncompressed video and compressed or uncompressed audio signals. The HDMI port of type A is shown below.



The HDMI connector consists of 19 pins and the latest version of HDMI i.e.

HDMI 2.0 can carry digital video signal up to a resolution of 4096x2160 and 32 audio channels.

**USB**

Universal Serial Bus (USB) replaced serial ports, parallel ports, PS/2 connectors, game ports and power chargers for portable devices. USB port can be used to transfer data, act as an interface for peripherals and even act as power supply for devices connected to it. There are three kinds of USB ports: Type A, Type B or mini USB and Micro USB.

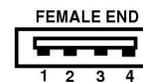
**USB Type A**

USB Type-A port is a 4 pin connector. There are different versions of Type – A USB ports: USB 1.1, USB 2.0 and USB 3.0. USB 3.0 is the common standard and supports a data rate of 400MBps.

USB 3.1 is also released and supports a data rate up to 10Gbps. The USB 2.0 is Black color coded and USB 3.0 is Blue. The following image shows USB 2.0 and USB 3.0 ports.

USB Connectors Pinout

- 1 = +5 Volts
- 2 = -Data
- 3 = +Data
- 4 = Ground



**USB Type C**

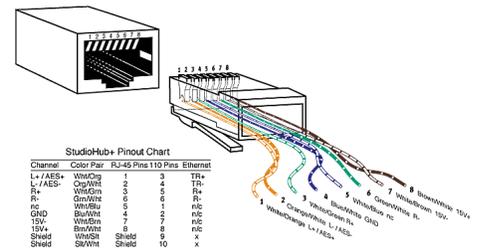
USB Type – C is the latest specification of the USB and is a reversible connector. USB Type – C is supposed to replace Types A and B. It consists of 24 pins & can handle a current of 3A. This feature of handling high current is used in the latest Fast Charging Technology.



**RJ-45**

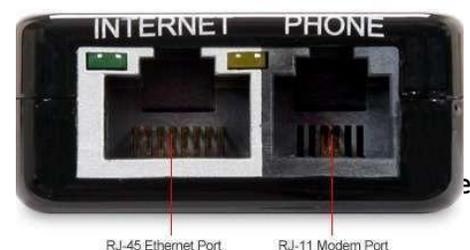
Ethernet is a networking technology that is used to connect your computer to Internet and communicate with other computers or networking devices. The interface that is used for computer networking and telecommunications is known as Registered Jack (RJ).

The latest Ethernet technology is called Gigabit Ethernet and supports a data transfer rate of over 10Gigabits per second. Often, RJ-45 ports are equipped with two LEDs for indicating transmission and packet detection.



**RJ-11**

RJ-11 is another type of Registered Jack that is used as an interface for telephone, modem or ADSL connections. Even though computers are almost never equipped with an RJ-11 port, they are the main interface in all telecommunication networks. RJ-45 and RJ11 ports look alike but RJ-



11 is a smaller port and uses a 6 point – 4 contact (6P – 4C) connector even though a 6 point – 2 contact (6P – 2C) is sufficient

## e-SATA

e-SATA is an external Serial AT Attachment connector that is used as an interface for connecting external mass storage devices. Modern e-SATA connector are called e-SATAp and stands for Power e-SATA ports. They are hybrid ports capable of supporting both e-SATA and USB. Neither the SATA organization nor the USB organization has officially approved the e-SATAp port and must be used at user's risk.

## 1.4 Types of Motherboards

### AT and ATX

Motherboard is an integral part in a computer since it is where all the components are attached to. There are many standards for motherboards and the cases that hold them. The most prominent standards are AT and ATX. AT is a very old standard that was created by IBM for their own computers. ATX was developed by Intel to address some of the shortcoming of the AT standard.

AT boards were much bigger compared to ATX boards. This results in some drives overlapping the boards inside the case which meant that in order to replace the board, you would need to take everything out. This is very inconvenient for personal computers, thus the ATX boards were made narrower by almost 4 inches to ensure that there is no overlap.

Another shortcoming of the AT system is in the ports at the back. AT boards only had the most minimal amount connectors in order to maintain compatibility with AT cases. If you like more connectors, you would need to add flying leads to unused expansion slots. ATX has most ports integrated to the board which frees up some of the expansion slots taken up by the ports.

ATX boards also introduced the 'soft off' capability. Prior to ATX, the power switch was directly connected to the power supply and the computer cannot turn itself off. ATX cases moved the switch to the motherboard. Computers then had the ability to turn itself on or off depending on its programming. You would no longer need to wait for the computer to safely shutdown before turning it off. It also paved the way for the additional features like WOL (Wake On Lan) that allows computers to be turned on remotely via its network adapter.

Summary:

1. AT is an old standard that has been totally replaced by ATX
2. AT boards are wider compared to ATX by almost 4 inches
3. ATX allows board makers to customize the ports in the back with back plates which is not possible with AT
4. AT computers had their power switches connected directly to the power supply while in ATX systems, the switch is connected to the motherboard

### Motherboard Components

The motherboard consists of various components which have their own role to play in the functioning of a computer. Let us discuss various motherboard components and know their definition and role.

#### 1. Expansion Slots

- i) **ISA slots.** These were the oldest expansion slots in the history of motherboards. They were found in AT boards and are identified by black color. Conventional display cards or sound cards were installed in these slots. The full form of ISA is **Industry Standard Architecture** and is a 16-bit bus.

- ii) **PCI Slots.** The full form of PCI is Peripheral Component Interconnect. The PCI slot is one of the important motherboard components today and is vastly used to install add-on cards on the motherboard. The PCI supports 64-bit high-speed bus.
- iii) **PCI express.** Also known as PCIe, these are the latest and the fastest component of the motherboard to support add-on cards. It supports full duplex serial bus.
- iv) **AGP slot.** Accelerated graphics port(AGP) is specifically used to install a latest graphics card. AGP runs on a 32-bit bus and both PCIe and AGP can be used to install high-end gaming display cards.

## **2. RAM (memory) slots**

- i) **SIMM slots.** The full form is a single in-line memory module. These slots were found in older motherboards, up to 486-boards. The SIMM supports 32-bit bus.
- ii) **DIMM slots.** The full form of DIMM is a Double inline memory module. These are the latest RAM slots which run on a faster 64-bit bus. The DIMM used on Laptop boards are called SO-DIMM.

## **3. CPU Socket**

Another vital motherboard component is the CPU socket which is used to install the processor on the motherboard. Some important sockets are explained below.

- i) **Socket7.** It is a 321 pin socket that supported older processors like Intel Pentium 1/2/MMX, AMD k5/K6, and Cyrix M2.
- ii) **Socket370.** It is a 370 pin socket that supports Celeron processors and Pentium-3 processors.
- iii) **Socket 775.** It is a 775-pin socket that supports Inter dual core, C2D, P-4 and Xeon processors.
- iv) **Socket 1156.** Found on latest types of motherboards, it is an 1156-pin socket that supports latest Intel i-3, i-5 and i-7 processors.
- v) **Socket 1366.** The socket is of 1366 pins and supports latest i-7 900 processors.

## **4. BIOS**

The full form of BIOS is Basic Input Output System. It is a motherboard component in the form of a Integrated chip. This chip contains all the information and settings of the motherboard which you can modify by entering the BIOS mode from your computer.

## **5. CMOS Battery**

The battery or a cell is a 3.0 Volts lithium type cell. The cell is responsible for storing the information in BIOS and the full form is Complementary Metal Oxide Semi-Conductor.

## **6. Power Connectors**

In order to receive power from SMPS, there are connectors mounted on the motherboards.

- i) **AT connector.** It consists of 2 number of 6 pin male connectors and is found on old types of motherboards.
- ii) **ATX connector.** The latest in the series of power connectors, they are either 20 or 24 pin female connectors. Found in all the latest types of motherboards.

## **7. IDE connector**

The Integrated Drive Electronics (IDE) connectors are used to interface disk drives. The 40-pin male connector is used to connect IDE hard disk drives and the 34-pin male connector connects to Floppy Disk Drive.

## **8. SATA connector**

Latest in the series, the connectors, Serial Advance Technology Attachment (SATA) are 7-pin connectors to interface latest SATA hard disks or optical drives. They are much faster than IDE interface.

## **9. Co-Processor**

The co-processor is one of the important motherboard components and helps the main processor in mathematical calculations and computer graphics.

## **10. Cabinet connections**

The cabinet in which the motherboard is installed has many buttons that connect to the motherboard. Some of the common connectors are Power Switch, Reset Switch, Front USB, Front Audio, Power indicator(LED) and HDD LED.



**Different Ports on a Motherboard**



**Front Panel Connector**

**Note:** Choosing a right type of motherboard that is compatible with other parts of computer is vital step in determining the overall speed of your PC. Once you learn about various motherboard components, you can easily assemble your own PC or solve the basic hardware issues in motherboard.

## Popular Manufacturers

Following are the popular manufacturers of the motherboard.

- Intel
- ASUS
- AOpen
- ABIT
- Biostar
- Gigabyte
- MSI

## 1.9 Different Types of RAM

RAM (pronounced ramm) is an acronym for random access memory, a type of computer memory that can be accessed randomly; that is, any byte of memory can be accessed without touching the preceding bytes. RAM is found in servers, PCs, tablets, smartphones and other devices, such as printers.

1. **DRAM (Dynamic Random Access Memory):** The term dynamic indicates that the memory must be constantly refreshed or it will lose its contents. DRAM is typically used for the main memory in computing devices. If a PC or Smartphone is advertised as having 4-GB RAM or 16-GB RAM, those numbers refer to the DRAM, or main memory, in the device.

More specifically, most of the DRAM used in modern systems is synchronous DRAM, or SDRAM. Manufacturers also sometimes use the acronym DDR (or DDR2, DDR3, DDR4, etc.) to describe the type of SDRAM used by a PC or server. DDR stands for double data rate, and it refers to how much data the memory can transfer in one clock cycle.

In general, the more RAM a device has, the faster it will perform.

2. **SRAM (Static Random Access Memory):** While DRAM is typically used for main memory, today SRAM is more often used for system cache. SRAM is said to be static because it doesn't need to be refreshed, unlike dynamic RAM, which needs to be refreshed thousands of times per second. As a result, SRAM is faster than DRAM. However, both types of RAM are volatile, meaning that they lose their contents when the power is turned off.

## Boot Menu

The **boot menu** is a menu accessible when a computer is first starting up. It can contain a number of different device options to boot to, including CD, DVD, Flash or hard drives, and a LAN (network). The boot menu allows a user to load up other operating systems or applications, even if the computer itself already has an operating system on it. It is also useful when trying to install a new operating system on a computer, and the user needs to load the installation application from a CD or DVD.

When a computer is starting up, the user can access the boot menu by pressing one of several keyboard keys. Common keys for accessing the boot menu are Esc, F2, F10 or F12, depending on the manufacturer of the computer or motherboard. The specific key to press is usually specified on the computer's startup screen. The boot menu allows a user to select what device to load an operating system or application from as the computer is booting.



## Hard drive

A **hard disk drive** (sometimes abbreviated as **harddrive**, **HD**, or **HDD**) is a non-volatile memory hardware device that permanently stores and retrieves data on a computer. A hard drive consists of one or more platters to which data is written using a magnetic head, all inside of an air-sealed casing. Internal hard disks reside in a drive bay, connect to the motherboard using an ATA, SCSI, or SATA cable, and are powered by a connection to the PSU (power supply unit). Unlike RAM a hard drive keeps all stored information even with the power is turned off.

### History

The first hard drive was introduced to the market by IBM on September 13, 1956. The hard drive was first used in the RAMAC 305 system, with a storage capacity of 5 MB and a cost of about \$50,000. In 1963, IBM developed the first removable hard drive, having a 2.6 MB storage capacity.

The first hard drive to have a storage capacity of one gigabyte was also developed by IBM in 1980. It weighed 550 pounds and cost \$40,000.

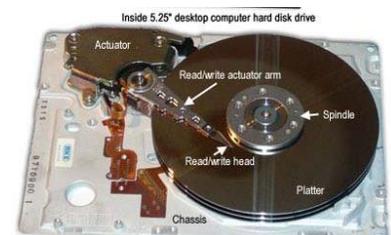
1983 marked the introduction of the first 3.5-inch size hard drive, developed by Rodime. It had a storage capacity of 10 MB.

Seagate was the first company to introduce a 7200 RPM hard drive in 1992. Seagate also introduced the first 10,000 RPM hard drive in 1996 and the first 15,000 RPM hard drive in 2000.

### Components

Hard drive consists of the following components: the head actuator, read/write actuator arm, read/write head, spindle, and platter. On the back of a hard drive is a circuit board called the disk controller or interface board and is what allows the hard drive to communicate with the computer.

An internal hard drive is connected to the computer using a data cable (IDE or SATA) that connects to the motherboard and a power cable that connects to the power supply. The hard drive is typically capable of storing more data than any other drive, but its size can vary depending on the type of drive and its age. Older hard drives had a storage size of several hundred megabytes (MB) to several gigabytes (GB). Newer hard drives have a storage size of several hundred gigabytes to several terabytes (TB).



## How is data read and stored on a hard drive?

Data sent to and read from the hard drive is interpreted by the disk controller, which tells the hard drive what to do and how to move the components in the drive. When the operating system needs to read or write information, it examines the hard drive's File Allocation Table (FAT) to determine file location and available write areas. Once they have been determined, the disk controller instructs the actuator to move the read/write arm and align the read/write head. Because files are often scattered throughout the platter, the head needs to move to different locations to access all information.

## External and Internal hard drives

Although most hard drives are internal, there are also stand-alone devices called **external hard drives**, which can backup data on computers and expand the available disk space. External drives are often stored in an enclosure that helps protect the drive and allows it to interface with the computer, usually over USB or eSATA.

Note: Solid State Drives (SSDs) have started to replace hard disk drives (HDDs) because of the distinct performance advantages they have over HDD, including faster access times and lower latency.

## CABLE

Alternatively referred to as **cord**, **connector** or **plug**, a **cable** is one or more wires covered in a plastic covering that connects a computer to a power source or other device. The power cord is just one example of thousands of other cables found in and around computers.

There are two main types of computer cables, a **data cable** and a **power cable**.

**Data Cable:** A data cable is a cable that provides communication between devices.

For example, the data cable that connects your monitor to your computer and allows your computer to display a picture on the monitor. Other examples of data cables include the CAT5, IDE/EIDE, SATA, and USB cables. Below, is a listing of the most common types of cables found with computers and electronics.

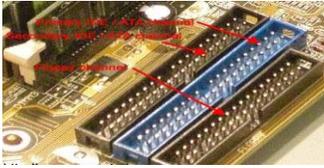


## Types of cables

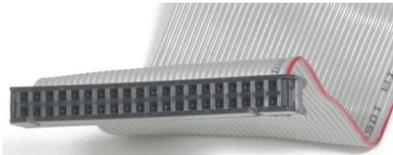
- **AT** - Used with early keyboards
- **ATA** - Used with hard drives and disc drives
- **CAT5** - Used with network cards
- **Coaxial** - Used with TV and projectors
- **Composite (RCA)** - Used with TV, projectors, and consoles
- **Display Port** - Used with computer monitors
- **DVI** - Used with monitors, projectors, and other displays
- **e-SATA** - Used with external drives
- **Firewire (IEEE-1394)** - Used with digital cameras and external drives
- **HDMI** - Used with monitors, projectors, DVD/Blu-ray players, and other displays
- **MIDI** - Used with musical keyboards and other equipment
- **Molex** - Power cable used inside your computer
- **IDE/EIDE** - Used with hard drives and disc drives
- **Parallel** - Used with printers
- **PS/2** - Used with keyboards and mice
- **S-Video** - Used with projectors, digital cameras, and other displays
- **S/PDIF** - Used with DVD and surround sound.
- **SATA** - Used with hard drives and disc drives
- **SCSI** - Used with hard drives, tape drives, and disc drives
- **Serial (RS-232)** - Used with a mouse and Modem.
- **Thunderbolt** - Primarily used with Apple displays and devices
- **USB** - Used with keyboard, mouse, printer, MP3 players, and thousands of other devices
- **VGA/SVGA** - Used with monitors and projectors

## Integrated Drive Electronics (IDE)

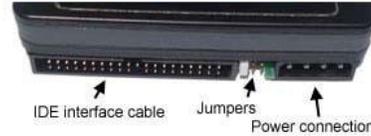
It is commonly known as Advanced Technology Attachment (ATA) or **Parallel ATA ((PATA)**. It is a standard interface for IBM compatible hard drives and CD or DVD drives. IDE is different than SCSI and Enhanced Small Device Interface (ESDI) because its controllers are on each drive, meaning the drive can connect directly to the motherboard or controller. IDE and its updated successor, Enhanced IDE (EIDE), are common drive interfaces found in IBM compatible computers.



40-Pin IDE IDC Connector and cable



Back of IDE hard disk drive



**Note:** The location of the 1 pin (first pin) on an IDE cable is usually designated by the red-colored stripe on one side of the cable. In the example picture above, the 1 pin is on the right side of the cable.

Each IDE channel can support two drives. A single IDE ribbon cable has three connections. One connection connects to the motherboard and the other two connections are available for the two drives.

There are two types of hard drive connections that a computer could have: Parallel ATA (PATA), also known as IDE, and Serial ATA (SATA). SATA is most commonly used in nearly all computers today, due to below advantages.

### Advantages

#### i) Increased data transfer rate

The primary reason SATA is used over PATA is because of the increased data transfer speeds with that SATA. PATA is capable of data transfers speeds of 66/100/133 MBs/second, whereas SATA is capable of 150/300/600 MBs/second. The improved speed of SATA allows for programs to load faster, as well as pictures and larger documents.

#### ii) Easy cable management and cable length

Another advantage of SATA over PATA is the length of the cable connecting the hard drive to the computer motherboard. The max length of a PATA cable is 18-inches, whereas a SATA cable can be up to 3.3 feet (1 meter) in length. With this extra length, you have more flexibility of where a hard drive can be mounted in a computer case.

#### iii) Increased airflow

SATA cables are also smaller in size than a PATA cable, allowing for increased airflow inside the computer case and decreased heat build-up. Better airflow can help improve the overall life of a computer.

#### iv) Support for more drives

There are typically four to six SATA connections on a computer motherboard, allowing for multiple SATA hard drives to be hooked up. There are usually only two PATA connections on a computer motherboard that supports a total of four PATA hard drives.

### Disadvantages

#### i) Drivers and support

SATA hard drives sometimes require a special device driver for the computer to recognize and use the drive. Older operating systems such as Windows 95 and 98 that were released long before SATA was introduced do not support SATA drives.

#### ii) One drive per cable

Another disadvantage with SATA is that the cable allows for only one SATA hard drive to be connected at a time. Whereas a PATA cable allows for hooking up two PATA hard drives per cable.

PATA and SATA cables

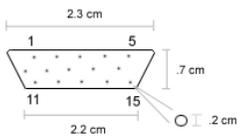


## Video Graphics Array (VGA)

Short for **Video Graphics Array**, **VGA** is a popular display standard developed by IBM and introduced in 1987. VGA provides 640 x 480 resolution color display screens with a refresh rate of 60 Hz and 16 colors displayed at a time. If the resolution is lowered to 320 x 200, 256 colors are shown. The VGA standard has been replaced by SVGA and although these cables and connectors are still referred to as VGA they are technically SVGA.

The VGA connector is used for display devices and is used to connect a computer to a monitor, projector, or TV. Although it is not uncommon to still find the VGA cable and connector with today's computers, monitors, projectors, and TV's. This type of connector is becoming obsolete and being replaced by the DVI and HDMI connector and cable.

15-Pin Video Connection



## High Definition Multimedia Interface (HDMI)

**High Definition Multimedia Interface**, **HDMI** is a connector and cable capable of transmitting high-quality and high-bandwidth streams of audio and video between devices. The HDMI technology is used with devices such as an HDTV, Projector, DVD player, or Blu-ray player. The HDMI standard was developed by multiple companies, including Hitachi, Philips, Sony, and Toshiba. A single HDMI cable replaces the three composite audio/video cables, making it easier to connect two devices together for transmitting audio and video signals. HDMI is capable of transmitting standard, enhanced, and high-definition video signals, as well as up to 8-channels of digital audio signals. The length of HDMI cables varies significantly. They can run from one foot all the way up to 50 feet, though it's not recommended that users buy more than a 25 foot cable as it may result in signal degradation or loss.

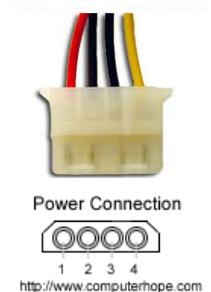
The HDMI ports are found either on the video card or motherboard on the back of the computer. It is important to note that not all computers and video cards have HDMI connects, and your computer may only have a Display Port, DVI, or VGA connector. In the picture to the right is an example of some of these connectors with an example of the HDMI connector.



## Molex

**Molex** is the name of the company who develops computer and other related connectors and products. This term is also known as the **Molex power connector**, which is the connector shown in the picture and is what connects your computer power supply to drives and devices inside the computer. Below is a diagram of

Pin	Wire Color	Signal
1	Yellow	+12v
2	Black	Ground
3	Black	Ground
4	Red	+5v



this connector with its four connectors as well an explanation about each of the pins.

## SATA

Short for **Serial ATA**, **SATA 1.0** was first released in August 2001 and is a replacement for the Parallel ATA interface used in IBM compatible computers. Serial ATA is capable of delivering 1.5 Gbps (1500 MBps) of performance to each drive within a disk array. It has the benefit of being backwards-compatible with ATA and ATAPI devices, and offers a thin, small cable solution. This cable helps make a much easier cable routing and offers better airflow in the computer when compared to the earlier ribbon cables used with ATA drives.

SATA also supports external drives through **External SATA** more commonly known as **eSATA**. eSATA offers many more advantages when compared to other solutions. For example, it is hot-swappable, supports faster transfer speeds.

However, eSATA does have some disadvantages such as not distributing power through the cable like USB, which means drives require an external power source. The eSATA cable also supports a maximum length of up to 2 meters.

The SATA cable is most often used with hard drives but is also used with drives such as disc drives.

There are two types of SATA cables. The SATA data cable that transmits the data between the drive and the motherboard has seven pins. The SATA power cable that connects to the power supply has fifteen pins.

SATA Power Cable



SATA Data Cable



ComputerHope.com

## Parallel port

The **parallel port** is found on the back of IBM compatible computers and is a 25-pin (type **DB-25**) computer interface commonly used to connect printers to the computer.

It is easy to identify and often the biggest connection on the back of the computer. The connection is in the shape of the letter D, is a female connector, and has 25 holes.

The DB25 connector has an 8-bit data bus, supported a maximum cable length of 15 feet.

Below is an explanation of each of the above purposes.

**Pin 1** - Data acknowledgement when the signal is low.

**Pin 2 - 9** - Data transfer pins.

**Pin 10** - Acknowledge that the data has finished processing and when the signal is high indicates ready for more.

**Pin 11** - When the signal goes high indicate that the printer has accepted the data and is processing it. Once this signal goes low and Pin 10 goes high will accept additional data.

**Pin 12** - Printer paper jam when signal is high or no signal if printer jam.

**Pin 13** - When high signal printer is indicating that it is on-line and ready to print.

**Pin 14** - When low signal PC has indicated that the printer inset a line feed after each line.

**Pin 15** - Printer sends data to the computer telling it that an error has occurred.

**Pin 16** - When low signal PC has requested that the printer initiate an internal reset.

**Pin 17** - When low signal the PC has selected the printer and should in return prepare for data being sent.

**Pin 18 - 25** - Ground.

Parallel Port (DB25)



## USB

Short for **Universal Serial Bus**, **USB** is a plug-and-play interface that allows a computer to communicate with peripheral and other devices. USB-connected devices cover a broad range; anything from keyboards and mice, to music players and flash drives. USB may also be used to send power to certain devices, such as smartphones and tablets, as well as charge their batteries. The first commercial release of the Universal Serial Bus (version 1.0) was in January of 1996. This industry standard was then quickly adopted by Intel, Compaq, Microsoft and other companies.

All modern computers have at least one USB port, below are the typical locations you can find a USB port on a computer.

- **Desktop computer** - A desktop computer usually has two to four ports in the front and two to eight ports in the back.
- **Laptop computer** - A laptop computer has between one and four ports on the left, right, or both sides of the laptop.
- **Tablet computer** - If a tablet has a USB port it is usually the same port as the charging port. A few laptops may have an additional port and if it is available it is on one of the sides of the tablet.
- **Smartphone** - Not many smartphones have a USB port, but many use a USB port to charge the phone that can be used as a USB port when not being charged.

Today, there are millions of different USB devices that can be connected to your computer. Below are just a few of the most common USB devices you'll likely find and use.

- Digital Camera
- External drive
- iPod or other MP3 player
- Keyboard
- Keypad
- Microphone
- Mouse
- Printer
- Joystick
- Jump drive aka Thumb drive
- Scanner
- Smartphone
- Tablet
- Webcams

**USB 1.x** is an external bus standard that supports data transfer rates of 12 Mbps and is capable of supporting up to 127 peripheral devices.

**USB 2.0**, also known as **hi-speed USB**, was developed by Compaq, Hewlett Packard, Intel, Lucent, Microsoft, NEC and Phillips and was introduced in 2001. Hi-speed USB is capable of supporting a transfer rate of up to 480 megabits per second (Mbps), or 60 megabytes per second (MBps). Hi-speed USB is backward compatible, meaning it is capable of supporting USB 1.0 and 1.1 devices and cables.

**USB 3.0**, also known as **Super Speed USB**, was first made available in November 2009 by Buffalo Technology. USB 3.0 improved upon the USB 2.0 technology with speed and performance increases, improved power management and increased bandwidth capability. It provides two unidirectional data paths for receiving and sending data at the same time. USB 3.0 supports transfer rates up to 5.0 gigabits per second (Gbps), or 640 megabytes per second (MBps). **USB 3.1**, also known as **SuperSpeed+**, was made available as of July 31, 2013 and is the latest version of the USB protocol. USB 3.1 is capable of transfer rates of up to 10 Gbps.

## **USB cables - Length and Type**

USB cables are available in multiple lengths, from around 3 feet to just over 16 feet in length. The maximum length of a USB cable is 16 feet 5 inches (5 meters) for high-speed devices and 9 feet 10 inches (3 meters) for low-speed devices. These maximum lengths are due to data transfer timing and the risk of data loss if using longer cable lengths. However, by using USB hubs, you can connect two USB cables together to effectively extend the distance between the two devices being connected.

There are different types of USB cables as well. As mentioned above, there are different transfer speeds (2.0 and 3.0) for USB. Similarly, there are different types of USB cables to match with those speeds. You can get a USB 2.0 cable for use with a device using USB 2.0 or a USB 3.0 cable for use with a device using USB 3.0.

## Connector, jack, plug, and port

### Plug

The **plug** is part of a cable that connects into a port. The most common plug is the power plug that connects your computer and monitor to a power source and allows it to turn on and boot

Power cord



Computer or other device

### Connector

A **connector** is the unique end of a plug, jack, or the edge of a card that connects into a port. For example, all desktop computer expansion cards have a connector that allows the card to be connected into a slot on the motherboard. When referring to cables, the connector is the end of the cable that connects into a port. For example, the end of a USB cable has a connector that allows it to connect into a USB port.

### Port

The **port** has either holes or a slot that matches the plug or card being connected into the port.

**Note:** There are also software ports, for example, port 80 is a network port that allows HTTP traffic (i.e. browsing the Internet) over a network.

Computer PS/2 Ports



### Jack

A **jack** is similar to a port and is a hole or other connection that allows a compatible plug to be connected into the jack. With computers jack is usually used to describe an audio jack.

### Socket

A **socket** is an opening that is designed to fit another device. A perfect example of a socket with a computer is a CPU socket, which is a socket on the motherboard that allows a CPU to connect to the computer.

Over the evolution of computers, there have been many different sockets designed for computers. Each socket supports a set of computer processors. For example, the Socket 370 is a socket that supported the first Intel Celeron processors and Coppermine processors.

### Slot

A slot is also a connection used with computers that can either describe a CPU slot or an expansion slot. Today, CPU sockets are used instead of CPU slots, but expansion slots are still used to connect expansion cards to the computer.

## Device driver

More commonly known as a **driver**, a **device driver** or **hardware driver** is a group of files that enable one or more hardware devices to communicate with the computer's operating system. Without drivers, the computer would not be able to send and receive data correctly to hardware devices, such as a printer. If the appropriate driver is not installed, the device may not function properly, if at all. For Microsoft Windows users, a driver conflict or an error can be seen in the Device Manager. If problems or conflicts are encountered with a driver, the computer manufacturer or hardware manufacturer will release a driver update to fix the problems.

## TV tuner card

A computer is capable of showing TV stations on a monitor by using a **TV tuner card**. The TV tuner card allows the user to connect a coaxial cable to the computer. The computer could then display basic cable stations and even



digital cable stations on the monitor. A TV tuner card can even provide a method for recording TV shows on the computer for later viewing, similar to how a Digital Video Recorder (DVR) device works. Internal TV tuner cards for desktop computers plug into either a PCI or PCI Express slot, and external TV tuners are also available for use with laptop and desktop computers. Some of these TV tuners also include a remote control for easy access and programming.

## **AGP**

**Accelerated Graphics Port, AGP** is an advanced port designed for Video cards and 3D accelerators. Designed by Intel and introduced in August of 1997, AGP introduces a dedicated point-to-point channel that allows the graphics controller direct access to the system memory.

The AGP channel is 32-bits wide and runs at 66 MHz, which is a total bandwidth of 266 MBps and much greater than the PCI bandwidth of up to 133 MBps. AGP also supports two optional faster modes, with a throughput of 533 MBps and 1.07 GBps. It also allows 3-D textures to be stored in main memory rather than video memory.

**Note:** Today, AGP has been replaced by PCI Express.

### **Video Card**

The video card is an expansion card that allows the computer to send graphical information to a video display device such as a monitor, TV, or projector. Some other names for a video card include *graphics card*, *graphics adapter*, *display adapter*, *video adapter*, and *video controller*.

A staggering number of companies manufacture video cards, but almost every one includes a graphics processing unit (GPU) from either NVIDIA Corporation or AMD. It is a piece of computer hardware that's rectangular in shape with numerous contacts on the bottom of the card and one or more ports on the side for connection to video displays and other devices.

The video card installs in an expansion slot on the motherboard. While most video cards are of the PCIe format, video cards come in other formats as well, including PCI and AGP. Some video cards have only one port for connection to a standard monitor or projector while more advanced cards may have ports for connections to multiple output sources including additional monitors and televisions

Like all hardware, a video card requires a device driver in order to communicate with the operating system and other computer software

## **Fax/Modem Card**

**Fax/Modem card** is a device used to route **fax** messages and connect to the Internet that is no longer typically used in modern computers. It is an internal type of modem that is plugged into the PCI slot of a PC motherboard. A modem is a communications device that allows a computer to send and receive data through telephone or cable lines.

Most modern computers connect to a home network, a local area network or the Internet using an external modem or through an Ethernet port or a wireless device such as a USB dongle. However, during the early days of the Internet and before the advent of cable Internet and DSL connection, it was more common to use a modem card, which had to be added to a desktop computer manually, like a video card or sound card. This modem card used a landline telephone to connect to an Internet service provider, a technology known as a "dial-up connection."

The main problem with modem cards was speed, which was limited to 56 Kbps. Older modems used before the advent of the Internet were even slower and were measured in "baud" rate rather than in bits or bytes per second.

## **BIOS**

**BIOS** may refer to any of the following:

1. Short for **Basic Input/Output System**, the **BIOS** (pronounced bye-oss) is a ROM chip found on motherboards that allows you to access and set up your computer system at the most basic level. In the picture below, is an example of what a BIOS chip may look like on your computer motherboard. In this example, this is a picture of an early AMIBIOS, a type of BIOS manufactured by the AMI. Another good example of a BIOS manufacturer is Phoenix.

The BIOS includes instructions on how to load basic computer hardware and includes a test referred to as a POST (Power On Self-Test) that helps verify the computer meets requirements to boot up properly. If the computer does not pass the POST, you will receive a combination of beeps indicating what is malfunctioning within the computer.

### **Main functions of a PC BIOS**

- **POST** - Test the computer hardware and make sure no errors exist before loading the operating system. Additional information on the POST can be found on our POST and Beep Codes page.
- **Bootstrap Loader** - Locate the operating system. If a capable operating system is located, the BIOS will pass control to it.
- **BIOS drivers** - Low level drivers that give the computer basic operational control over your computer's hardware.
- **BIOS or CMOS Setup** - Configuration program that allows you to configure hardware settings including system settings such as computer passwords, time, and date.

### **POST (Power-On Self-Test)**

When power is turned on, POST (Power-On Self-Test) is the diagnostic testing sequence that a computer's basic input/output system (or "starting program") runs to determine if the computer keyboard, random access memory, disk drives, and other hardware are working correctly. If the necessary hardware is detected and found to be operating properly, the computer begins to boot. If the hardware is not detected or is found not to be operating properly, the BIOS issue an error message which may be text on the display screen and/or a series of coded beeps, depending on the nature of the problem. Since POST runs before the computer's video card is activated, it may not be possible to progress to the display screen. The pattern of beeps may be a variable numbers of short beeps or a mixture of long and short beeps, depending on what type of BIOS is installed. The patterns of beeps contain messages about the nature of the problem detected. For example, if the keyboard is not detected, a particular pattern of beeps will inform you of that fact. An error found in the POST is usually fatal (that is, it causes current program to stop running) and will halt the boot process, since the hardware checked is absolutely essential for the computer's functions.

### **BIOS Password**

A BIOS password is authentication information that is sometimes required to log into a computer's basic input/output system (BIOS) before the machine will boot up.

BIOS is the program a computer's microprocessor uses to control the computer's initial boot sequence and hardware initialization. The BIOS password is stored in complementary metal-oxide semiconductor (CMOS) memory. In some computers, a small battery attached to the motherboard maintains the memory when the computer is off.

Because it provides an extra layer of security, a BIOS password can help prevent unauthorized use of a computer. A BIOS password can also be a liability, however, because if the computer owner forgets his password or a corporate user hands in his machine without disclosing the BIOS password, the computer will not boot up.

A BIOS password can be reset by contacting the vendor for directions. Resets typically involve the use of backdoor BIOS passwords. These are passwords created by the BIOS manufacturer that will work no matter what password the user has set up. User-created passwords can sometimes be cleared by removing the CMOS battery or by using special BIOS password cracking software.

### **Boot Sector**

A boot sector is a physical sector, or section, on a hard drive that includes information about how to start the boot process in order to load an operating system. A boot sector exists on an internal hard drive where an operating system like Windows is installed, as well on storage devices that you may not even need to boot from, but instead are just holding personal data on, like an external hard drive, floppy disk, or other USB device.

Once a computer turns on, the very first thing that happens is that BIOS looks for clues on what it needs to start up the operating system. The first place BIOS will look is the first sector of each storage device connected to computer. Say you have one hard drive in your computer. This means you have *one* hard drive that has *one* boot sector. In that particular section of the hard drive may be one of two things: the Master Boot Record (MBR) or the Volume Boot Record (VBR). The MBR is very first sector of any formatted hard drive. Since BIOS looks at the first sector to understand how it should proceed, it will load the MBR in to memory. Once the MBR data is loaded, the active partition can be found so that the computer knows where the operating system is located.

## **Data Recovery**

In computing, **data recovery** is a process of salvaging (retrieving) inaccessible, lost, corrupted, damaged or formatted data from secondary storage, removable media or files, when the data stored in them cannot be accessed in a normal way. The data is most often salvaged from storage media such as internal or external hard disk drives (HDDs), solid-state drives (SSDs), USB flash drives, magnetic tapes, CDs, DVDs, RAID subsystems, and other electronic devices. Recovery may be required due to physical damage to the storage devices or logical damage to the file system that prevents it from being mounted by the host operating system (OS).

As long as the drive is not physically dead, there is a chance to recover the file. Following are the free data recovery tools available.

### **1. Recuva**

With both free and pay editions, Recuva is an incredibly powerful tool for recovering data from Linux and Window partitions. With support for all Windows versions from XP through Windows 8.1, this is a great tool to bring dead data back to life. It is one tool that has saved me multiple times over the years.

### **2. Pandora Recovery**

With a free version for recovering data from secondary drives, and a pay version you can put on a USB key to recover an operating system drive, Pandora Recovery has a versatile offering that can bring back most data without issue.

### **3. PC INSPECTOR File Recovery**

Completely free, PC INSPECTOR File Recovery is a great recovery tool for Windows systems. It can recognize data types even when the header is missing, so you can recover from deletions, formatting, or even total volume loss.

### **4. PC INSPECTOR Smart Recovery**

Smart Recovery is a free tool focused on recovery files from external media, like flash drives and SD cards. It's a bit older than File Recovery, but still works great and can handle proprietary file formats.

### **5. FreeUndelete**

It's free for personal use, and it undeletes files that you have deleted, even if you SHIFT-DEL or empty the Recycle Bin.

### **6. ADRC Data Recovery Software Tools**

This suite of tools includes undelete, copy, raw copy, imaging, and boot sector repair. Data Recovery Software Tools include several standalone products that can handle almost any data recovery scenario. In addition to the free versions, there are pay versions with even more features. You can download a free trial of a bootable ISO with all of the tools on one image from <http://www.boot-disk.com>. Make sure you look closely at each tool's free version, as they include a lot when you get into the details. The set includes...

## 7. Active File Recovery

This is probably the first tool to try, as it can handle undeletes, deletes that bypass the Recycle Bin, formatted or corrupted files, lost partitions, and more.

## 8. Active Partition Recovery

This tool can help you to recover a formatted or repartitioned drive in its entirety. It can also fix lost MBR and GPTs and can read from VMware virtual disk images.

## 9. Active UNDELETE

This tool can run on Windows and recover data from non-Windows file systems including Linux Ext#, UFS, EFS, and HFS+.

## 10. Unformat

For all your external drive needs, Unformat can recover entire disks including external USB, thumb drives, and SD cards that you've accidentally deleted.

## 11. Active UNERASER

This tool can be used to recover data lost due to damaged, formatted, or deleted partitions and includes several other tools including a partition manager, a disk monitor, and more.

## 12. CD Recovery Toolbox

Designed to recover data from damaged CDs and DVDs. If they are scratched or smudged or faded, but there is still some readable data on the disk, this is a tool that can bring back as much salvageable data as possible.

## 13. Active Boot Disk Lite

Sometimes the data is not lost; it is just inaccessible because the operating system won't boot. This tool is a bootable operating system image that can be used to gain access to the hard disk when the installed operating system won't boot, so you can copy off data to external media before reinstalling.

## 14. WinHex

A multitasker that includes a disk editor, imaging software, encryption and check summing, format converter, and more. It is more targeted towards investigation and forensics than simple data recover, and has several different levels of licensing, depending upon required features. It has an evaluation version that is free to try for as long as you need.

## 15. TestDisk

Software designed to recover lost partitions or repair drives that are no longer bootable. It can repair most file systems (NTFS, FAT, EXT) and also recover data from deleted partitions. Open Source, it can run under most versions of Windows, Linux, BSD, and Mac operating systems. It also can be deployed as a bootable image to recover from unbootable systems.

## 16. Wise Data Recovery

A freeware application to recover data from hard drives and removable media. It is simple to use and fast to find data, making it an excellent choice when you need your files back quickly.

## 17. Data Recovery Wizard

This tool can recover data that has been deleted, formatted, or from drives that have been corrupted. The free version has a 2GB cap, but often the data you are trying to save is much smaller than that, so most users can do a lot with a 2GB trial. It has both Windows and Mac versions.

## 18. EaseUS MobiSaver Free

This tool offers hope for mobile devices too, with a free data recovery tool for both iOS and Android platforms. This app can recover specific data types from iOS devices and most files from Android devices.

## 19. SoftPerfect File Recovery

Also from EaseUS, this tool can restore deleted files from FAT and NTFS partitions on fixed and removable media. It is a self-contained executable and runs on everything from XP through Windows 8.

## 20. Puran Data Recovery

This tool can read files from damaged physical media, like corrupted flash or scratched optical drives. If your operating system can show the files, then this tool will read them off, ignoring any bad sectors to recover as much usable data as possible.

### System Restore

System Restore is a recovery tool for Windows that allows you to reverse certain kinds of changes made to the system. It is used to return important Windows files and settings - like drivers, registry keys, system files, installed programs, and more - back to previous versions and settings. It is like "undo" feature for the most important parts of Microsoft Windows.

If strange things are happening to your computer after a driver install, for example, you might find that restoring the system to a previous state *before* the driver install fixes the problem because System Restore will undo the installation. As another example, say you're restoring your computer to the state it was in a week ago. Any programs you've installed during that time will be uninstalled during the System Restore.

System Restore doesn't guarantee that the issue will be resolved.

System Restore *does not* affect your personal files like your photos, documents, email, etc. You can use System Restore without hesitation even if you've just imported a few dozen pictures to your computer - it doesn't "undo" the import. The same concept applies to downloading files, editing videos, etc. - all of it will stay on your computer.

**Note:** Even though System Restore may remove a program you've installed, it won't also delete the files you've made through the program. For example, even if System Restore deletes your Adobe Photoshop installation, the images you may have created or edited with it are not removed as well - those are still considered your personal files. Since System Restore doesn't restore personal files, it is not a fall-back solution if you've forgotten to make backups of your data or if you want to undo a change you made to a file. However, you may consider System Restore a "system backup" solution because it does, in fact, backup and restore crucial system files.

System Restore is also not a file recovery utility that lets you "undelete" your files. If you accidentally deleted a folder full of important documents, and you can't restore it from the Recycle Bin, System Restore is not what you want to use to get those things back.

#### How to Do a System Restore

The System Restore tool can be accessed from the *System Tools* program folder in Windows. Once started, this utility is designed as a step-by-step wizard, making it really easy to choose a point in the past, called a *restore point*, to return your important files and settings to.

If you can't access Windows normally, System Restore can also be started from Safe Mode in all versions of Windows. You can also start System Restore from the Command Prompt.

You can even run System Restore from outside Windows completely via Advanced Startup Options in Windows 10 and Windows 8, or System Recovery Options in Windows 7 and Windows Vista.

System Restore is available from within Microsoft Windows 10, Windows 8, Windows 7, Windows Vista, Windows XP, and Windows Me.

As mentioned above, System Restore is also available from the Advanced Startup Options or System Recovery Options menu, depending on the version of Windows, as well as from Safe Mode.

System Restore is not available on any Windows Server operating systems.

## Installation of Windows operating system

Each version of Microsoft Windows is installed on a computer using similar steps. While there are steps in the installation process that can differ between versions of Windows, the following general steps and guidelines will help you to install Windows on your computer.

If you have an OEM computer (e.g. Acer, Dell, Hewlett-Packard, etc.) the computer would not have a Windows CD, DVD, or USB thumb drive. Instead, you would re-install Windows and all the software using a hidden partition. The steps mentioned on this page would still work, but you'd need a copy of Windows.

The steps below are for all recent versions of Windows, including Windows 98, Windows ME, Windows 2000, Windows XP, Windows Vista, Windows 7, Windows 8, and Windows 10. These steps would even work for earlier versions (e.g. Windows 95) as long as you're using the disc version. The floppy diskette version is similar but would require additional steps.

## **Genuine Windows CD, DVD, or USB thumb drive**

First, you will need a genuine copy of the Microsoft Windows operating system installation CD, DVD, or USB thumb drive. A genuine Windows product key is included with the installation disc, which is required to activate Windows after installation. If you have an OEM computer, the product key for your version of Windows is also often on the back or side of the computer.

**Tip:** You can borrow a disc from a friend as long as you're installing the same version of Windows that came with the computer and you had the product key for that version of Windows.

**Note:** With early versions of Windows, you cannot download a copy of Windows to install on a computer. You must purchase a physical copy of Windows. If you are installing Windows 10, you can download the Windows 10 creation tool to create a bootable disc or USB thumb drive.

**Warning:** Microsoft only has Windows 10 available for download from their website. Any other site that claims to have copies of other versions of Windows should not be trusted. These copies of Windows are pirated software and could contain anything including spyware or malware.

## **Installing Windows**

To start the Windows installation process, you will need to configure your computer to boot from a CD or DVD before booting to the hard drive. Changing the boot process forces the computer to look for the Windows installation disc before trying to boot from the hard drive.

1. Access the computer's BIOS setup.
2. Change the computer's boot order, setting the CD, DVD or disc drive as the first boot device if you are trying to boot from a disc or a USB drive if you're trying to boot from a USB thumb drive.
3. Save the settings change and exit BIOS.

Once you have updated the boot order, you can begin the Windows installation process.

1. Place the Windows installation disc in the CD/DVD drive or USB thumb drive into the back of the computer.
2. Turn on or restart the computer. As the computer is starting up, it should see the installation disc or drive and show a message similar to **Press any key to boot from CD**. Press any key on the keyboard to have the computer boot from the installation disc or drive.
3. The Windows installation process will begin. There will be different prompts that you will need to answer. Select either **Yes** or the appropriate option to install Windows.

**Tip:** Make sure you select the full Windows installation option and not the Windows repair option.

4. You may be asked if you want to erase all contents on the hard drive, then install Windows. It is recommended that you choose this option, as it will also properly format the hard drive to allow the Windows operating system to be installed.
5. The computer may need to restart several times during the Windows installation process. The restarts are normal and if prompted to restart, select the **Yes** option.
6. When the installation process is nearly complete, the Windows configuration option screens is shown. On these screens, you may be asked to select the time zone you live in, your preferred language, and the name of the account you will use to access Windows. Select the appropriate options and enter the appropriate information on each configuration screen.

The Windows installation process will be complete when the computer prompts you to log in with the account you just created on the configuration screens or when it loads directly into Windows.

#### Final Windows and computer configuration

After Windows has been installed on the computer, you will need to install the drivers and related software for the hardware in the computer. You can use the installation discs that came with the hardware, or you can download the drivers from the hardware manufacturer's website.

**Tip:** If you cannot download drivers because your network card is not working after installing Windows you can download the drivers on another computer and then copy them to a USB thumb drive and move them over to your computer.

It is strongly recommended that you install the latest drivers for each piece of hardware.

To determine which hardware needs drivers to be installed, check the Device Manager and look for exclamation mark "!" next to hardware devices. The exclamation point means drivers are needed for that device.

After installing the necessary hardware device drivers, install any software programs on the computer that you want to use.

Finally, download and install any available Windows updates. Updating Windows can help improve the performance of the operating system, the hardware in the computer, and software programs you use. It can also improve security by fixing potential security holes and flaws in Windows.

#### **Long-term maintenance of Windows**

Microsoft frequently releases new updates for Windows, so it is recommended that you check for and install available updates. Doing so will help keep Windows running better and keep your computer protected.

Also, periodically check for updated hardware device drivers from manufacturers' websites. Keeping hardware drivers updated can help the hardware devices in the computer to run at peak performance and improve compatibility with other hardware and software in the computer.

## **Setup and installation of printer**

A computer printer does not work until you install the included drivers and software. If you have lost the CD for your printer, you can download the drivers for your printer and use the drivers to install your printer.

#### **Connecting the printer to the computer**

Connect the printer to the computer either using a USB cable, parallel port cable, or SCSI cable and then connect the power plug to a power outlet. Today, most all home computer printers are using a USB cable similar to the example picture.

**Tip:** If this is a network printer, connect the printer to a wireless network or the RJ-45 connection.

**Note:** A laptop computer works the same way as a desktop and can use any of the above connections if they are available.

**Note:** Smartphone and tablet users must have a printer that can connect to devices wirelessly or over the Internet to print.

#### **Setup printer and install software**

Every printer should come with the software used to install a printer in Windows or your operating system.

1. After everything has been plugged in turn the computer on.
2. Insert the CD that came with the printer. If the CD does not automatically start, open My Computer, double-click on the CD drive, and then click the Setup or Install file. If you have downloaded the drivers, run the downloaded setup file.
3. Follow the installation wizard and once completed your software is installed.
4. Test the printer to make sure it is working.

#### **Computer with no CD drive**

If your computer does not have a disc drive or you lost the CD you can download the software for your printer from the manufactures printers' driver page. Once the drivers have been downloaded you can run the file to install the drivers.

#### **Testing the printer**

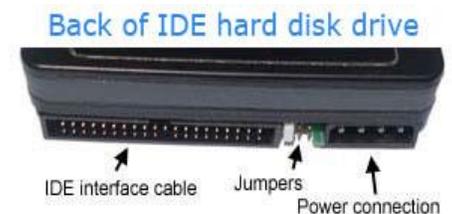
After the printer is installed, you can use Windows to print a self-test page to help verify the printer is working.

**Microsoft Windows users**

1. Click Start, Settings, and open Control Panel.
2. Double-click the Printers or Printers and Fax icon.
3. Right-click on the Printer you want to test and click Properties. If you do not see your printer, your printer is not installed.
4. In the Printers Properties window, click the **Print Test Page** button.
5. If the printer can print a test page, your printer is installed and setup properly. However, if you are unable to print in other programs the program you are attempting to print from has issues.

**Hard drive Installation****Before getting started**

1. If present, backup any important data on the hard drive currently within the computer.
2. Ensure you have a working bootable disk.
3. Write down important information from the top or bottom of the hard drive such as the Model Number, Serial Number, and specifications.
4. Ensure you are familiar with ESD and its potential dangers.
5. When physically installing the hard drive, ensure the computer is powered down and unplugged.

**Set the Jumpers**

Before installing the hard drive the jumpers must be properly set on the drive itself. On the back of the hard drive should be small pins with a small plastic piece known as a jumper block or shunt. This jumper must cover the appropriate pins to set the drive as a Single, Dual Master, Dual Slave, or Cable Select.

If this is going to be the only hard drive, set the drive as Master.

If this is going to be a second drive, set the jumper as Slave.

It is important to note that when installing a hard drive on an IDE/EIDE interface while other drives, such as a CD-ROM drive, are present they must be changed to the right setting. For example, if a CD-ROM is present on the same cable as a hard drive, it must be set to Slave.

**Drive Bays**

Once the jumpers have been set appropriately, open the computer and determine the drive bay present within the computer. Most computers have an option between a 5.25-inch Bay and a 3.5-inch Bay. Today, all IDE/EIDE and SATA hard drives are 3.5-inch. If your computer has an available 3.5-inch bay it is highly recommend that this drive bay be used to install the hard drive, as no additional brackets will be required. Most hard drive manufactures will include these brackets with the hard drive.

**Attach Cables**

Once the jumpers have been verified and the hard is attached and secured to the computer case, connect the cables to the computer hard drive. Start first with the IDE/EIDE interface cable (gray flat ribbon cable). This cable has a blue or red line or dotted line on one side of the cable, this indicates Pin 1. Almost always this side of the cable will point to the side where the power connects.

If the IDE/EIDE cable is not already connected to the interface card or motherboard, connect that cable now. If this is the only hard drive it is recommended that the drive be connected to PRIMARY 0, PRI 0, PRIMARY 1 or PRI 1. Once the IDE/EIDE cable has been connected to the computer hard drive, connect the power cable. This cable is almost always keyed and only goes in one direction. Look at the connection on the drive itself and then the cable to connect this cable in properly.

**CMOS Setup**

Once the hard drive has been installed, place the case back onto the computer and connect the keyboard, monitor, and power to the computer (we recommend that you do not connect all the cables yet, if problems are experienced you may have to disconnect all the cables again).

Once connected, turn on the computer and as the computer is booting, enter BIOS setup. Verify that the hard drive is being seen or that the hard drives are setup as Auto. Older computers may require that you enter the hard drive BIOS values, these values are sometimes found on the hard drive itself or with the included documentation.

## **Software Setup**

Once the hard drive has been setup in CMOS or appears to be detected in CMOS, the hard drive must be setup through the software. Using a bootable floppy diskette, boot from the diskette to prepare the setup:

If you plan on installing MS-DOS, Windows 3.x, Windows 95, Windows 98, or Windows ME, you need to setup the hard drive using the FDISK utility. If you plan on installing Windows NT or Windows 2000 you can utilize the Windows NT setup to create a NTFS partition or FAT32 partition if using Windows 2000.

If you plan on using another operating such as Linux or UNIX, disk partitioning will be performed during the installation process.

## **Understanding Hard Disk Partitions**

When a hard drive is installed in a computer, it must be partitioned before you can format and use it.

Partitioning a drive is when you divide the total storage of a drive into different pieces. These pieces are called partitions. Once a partition is created, it can then be formatted so that it can be used on a computer. When partitions are made, you specify the total amount of storage that you would like to allocate to that partition from the total size of the drive. For example, if you have an 80 GB drive, then it would be possible to make one partition consisting of the entire 80 GB of available storage. Alternatively, you could make two partitions consisting of a 20 GB partition that will be used for the operating system and programs and a 60 GB partition set aside for data, music, and images.

In the current IBM PC architecture, there is a partition table in the drive's Master Boot Record (section of the hard drive that contains the commands necessary to start the operating system), or MBR, that lists information about the partitions on the hard drive. This partition table is then further split into 4 partition table entries, with each entries corresponding to a partition. Due to this it is only possible to have four partitions. These 4 partitions are typically known as primary partitions. To overcome this restriction, system developers decided to add a new type of partition called the extended partition. By replacing one of the four primary partitions with an extended partition, you can then make an additional 24 logical partitions within the extended one. The table below illustrates this.

Partition Table

Primary Partition #1

Primary Partition #2

Primary Partition #3

Primary Partition #4 (Extended Partition)

    Logical Partition #1

    Logical Partition #1

As you can see, this partition table is broken up into 4 primary partitions. The fourth partition, though, has been flagged as an extended partition. This allows us to make more logical partitions under that extended partition and therefore bypassing the 4 partition limit.

Each hard drive also has one of its possible 4 partitions flagged as an active partition. The active partition is a special flag assigned to only one partition on a hard drive that the Master Boot Record (MBR) uses to boot your computer into an operating system. As only one partition may be set as the active partition, you may be wondering how people can have multiple operating systems installed on different partitions, and yet still be able

to use them all. This is accomplished by installing a boot loader in the active partition. When the computer starts, it will read the MBR and determine the partition that is flagged as active. This partition is the one that contains the boot loader. When the operating system boots off of this partition the boot loader will start and allow you to choose which operating systems you would like to boot from.

### **Why make partitions**

Now that you know what a partition is, you may be wondering why you would even need to make multiple partitions instead of just making one. Though there are quite a few reasons, we will touch on some of the more important ones below:

**Multiple Filesystems** - When you create a partition, you then need to format it before it can be used. When formatting a partition you tell the operating system what filesystem you would like that partition to be formatted in. Once you format a partition, and therefore assign the type of filesystem you want to use with it, you can not change that filesystem without formatting the partition again and losing all the data contained on it. If you require different filesystems on your computer, whether it be for security or for a specific application, you can then make multiple partition and assign one type of filesystem to one of the partitions and another to one of the other partitions.

**Partition Size** - On older operating systems the maximum size of a partition was limited. Therefore if you had more storage space on a hard drive than was usable in a single partition, you would need to create other partitions to utilize this unused space.

**Multiple Operating Systems** - Some operating systems use filesystems that are not compatible with other operating systems. If you want to use two operating systems on the same computer that are not compatible in this way, you could then make two partitions, one for each operating system. Then a boot loader could be used to switch between them when you start your computer.

**Wasted disk Space** - When a filesystems store data in a partition, the larger the partition, the greater the chance of wasted space. By having multiple partitions of smaller size, you reduce the amount of waste that filesystems may create.

**Seperate system files from users files** - Some components of an operating system require storage space to operate. For example, in Windows if you have no hard drive space available on the drive that Windows is installed on, you will not be able to print. By creating a partition solely devoted to the operating system and then another partition dedicated to your own data and programs, there is less of a chance of you using up the space on the operating system partition with your data, and thus not causing problems.

### **Creating and formatting a partition in Windows**

Before you can partition a hard drive in Windows, you must have installed a new unused hard disk, deleted an existing partition, or have some unpartitioned space available on an existing drive. In the example in this tutorial I will take the unused space from one of my hard drives and partition/format it. The steps shown here will work whether you are working with a brand new hard drive, deleting an existing partition and reusing it, or partitioning available space on an existing hard drive.

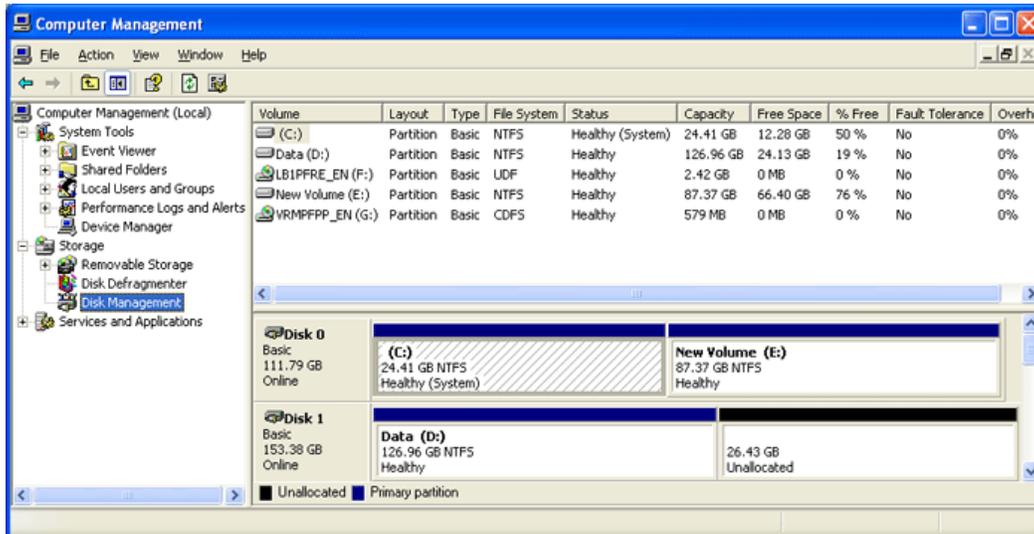
All hard disk management is done in the Disk Management Administrative Tool. Follow these steps to open this tool:

**1.** If you are using Windows 8, type Disk Management at the start screen, click on **Settings**, and then click on the **Create and format hard disk partitions** option. Then skip to step 3. Otherwise, click on the **Start** button and select the **Control Panel** option.

**2.** If in Classic control panel mode, double-click on the **Administrative Tools** icon and then double-click on **Computer Management** icon.

If your control panel is in the Category view, click on **Performance and Maintenance**, then click on **Administrative Tools**, and finally double-click on the **Computer Management** icon.

3. When the Computer Management screen opens, click on the **Disk Management** option under the **Storage** category. This will present you with a screen similar to the one below.



**The Disk Management Screen**

When you are in the disk management tool you will see a listing of your current hard drives and how they are partitioned. From the image above you can see that I have two hard disks installed. The first disk, Disc 0, has two partitions. One partition is a 24 GB NTFS partition that has been assigned the drive letter C:. The other partition on that drive is a 87 GB NTFS partition that has been assigned the drive letter E:. The other drive, has only one partition, the D: partition. The rest of the space, 26 GB, shows that it is unallocated and therefore can be used to make other partitions.

To make a partition from the unused space you would do the following.

1. Right click on the space listed as unallocated.
2. At the menu that comes up, click on the **New Partition** option.
3. You will now be presented with a wizard as to how you would like the partition to be created. At the first screen press **Next**.
4. At the following screen, determine if you need a primary or extended partition. For more information about these partitions you can read our partition tutorial listed above. Most people will be fine selecting **Primary Partition**. Select **Primary Partition** and press **Next**.
5. At the next screen you will be prompted to type in how much of the unallocated space you would like used for the new partition. In my example, my unallocated space is 26.43 GB, so I can choose to make a partition of

that entire amount of only use half and save the rest for another partition. Regardless, of what you decide, you need to enter a size in the **Partition size in MB:** field, or stick with the default size, and press the **Next** button.

**6.** At the next screen select the drive letter you would like assigned to it, or use the default one given. When done, press the **Next** button. The drive letter that you assign here will be how you access the partition later.

**7.** In this step you will determine how you would like the new partition to be formatted. For the most part you are advised to use the **NTFS** file system. If you need a file system that can be readable by older operating systems like DOS, Windows 95, Windows 98, or Windows ME, then you should instead choose the **FAT32** file system.

**8.** Type a name in the **Volume Label** field that will be associated with this partition or leave it blank.

**9.** Finally press the **Next** button and you will come to a summary screen. Review how the partition will be created, and if you are satisfied, press the **Finish** button to complete the creation and formatting of your new hard disk partition.

When the computer finishes creating and formatting the new partition you will be presented with the Disk Management screen again and will see that you have a new partition and drive letter on your computer. Now you can use that drive to start storing your data.

## **Deleting a partition in Windows**

If you have existing partitions on your computer that you would like to delete in order to use its space for other purposes, then you first need to delete this partition. **It is important to note that by deleting a partition you will lose all your data on that partition.** With that warning given, let me give some examples of why you would want to delete a partition. Lets say that you have a 60 GB hard drive in your computer that was originally partitioned into a 20 GB partition and a 40 GB partition. You would like to install another operating system on your computer, but feel that neither partition is big enough on its own, and would like to instead create one partition using the full storage of 60 GB. The only way to do that would be to delete both of the existing partitions and recreate a new one using all the available space.

To delete a partition please follow these steps:

**1.** Click on the **Start** button and select the **Control Panel** option.

**2.** If in Classic control panel mode, double-click on the **Administrative Tools** icon and then double-click on **Computer Management** icon.

If your control panel is in the Category view, click on **Performance and Maintenance**, then click on **Administrative Tools**, and finally double-click on the **Computer Management** icon.

**3.** When the Computer Management screen opens, click on the **Disk Management** option under the **Storage** category.

4. Right-click on the partition you would like to delete and choose the **Delete Partition** option.
5. A confirmation box will come up asking if you are sure you would like to continue. If you press the yes button, all data on this partition will be deleted. If you are sure about deleting this partition, press the **Yes** button.

The partition will now be deleted and you can either create a new partition or exit the program.

### **Uninterrupted Power Supply (UPS)**

No company can afford to leave its IT assets unprotected from power issues. Here are just a few of the reasons.

- **Even short outages can be trouble.** Losing power for as little as a quarter second can trigger events that may keep IT equipment unavailable for anywhere from 15 minutes to many hours. And downtime is costly
- **Utility power isn't clean.** By law, electrical power can vary widely enough to cause significant problems for IT equipment. According to current U.S. standards, for example, voltage can legally vary from 5.7 percent to 8.3 percent under absolute specifications.
- **Utility power isn't 100 percent reliable.**
- **The problems and risks are intensifying.** Today's storage systems, servers and network devices use components so miniaturized that they falter and fail under power conditions earlier-generation equipment easily withstood.
- **Generators aren't enough.** Generators can keep systems operational during a utility outage, but they take time to startup and provide no protection from power spikes and other electrical disturbances.
- **Availability is everything these days.** Once, IT played a supporting role in the enterprise. These days it's absolutely central to how most companies compete and win. When IT systems are down, core business processes quickly come to a standstill.

Definition: UPS is a device that provides backup power when utility power fails, either long enough for critical equipment to shut down gracefully so that no data is lost, or long enough to keep required loads operational until a generator comes online. Conditions incoming power so that all-too-common sags and surges don't damage sensitive electronic gear.

#### **Types**

UPSs come in three major varieties, which are also known as topologies:

#### **Single-conversion systems**

In normal operation, these feed incoming utility AC power to IT equipment. If the AC input supply falls out of predefined limits, the UPS utilizes its inverter to draw current from the battery, and also disconnects the AC input supply to prevent backfeed from the inverter to the utility. The UPS stays on battery power until the AC input returns to normal tolerances or the battery runs out of power, whichever happens first. Two of the most popular single-conversion designs are standby and line-interactive:

- *Standby UPSs* allow IT equipment to run off utility power until the UPS detects a problem, at which point it switches to battery power.
- *Line-interactive UPSs* regulate input utility voltage up or down as necessary before allowing it to pass through to protected equipment. However, like standby UPSs, they use their battery to guard against frequency abnormalities.

#### **Double-conversion systems**

As the name suggests, these devices convert power twice. First, an input rectifier converts AC power into DC and feeds it to an output inverter. The output inverter then processes the power back to AC before

sending it on to IT equipment. This double-conversion process isolates critical loads from raw utility power completely, ensuring that IT equipment receives only clean, reliable electricity.

In normal operation, a double-conversion UPS continually processes power twice. If the AC input supply falls out of predefined limits, however, the input rectifier shuts off and the output inverter begins drawing power from the battery instead. The UPS continues to utilize battery power until the AC input returns to normal tolerances or the battery runs out of power, whichever occurs sooner. In case of a severe overload of the inverter, or a failure of the rectifier or inverter, the static switch bypass path is turned on quickly, to support the output loads.