

Computer Hardware, Maintenance and Administration – 20CS32P

The computer cases are a visible part of our computers called PC towers and Computer towers. Its function is to serve as a **protective structure** for the rest of the internal components where they will be assembled.

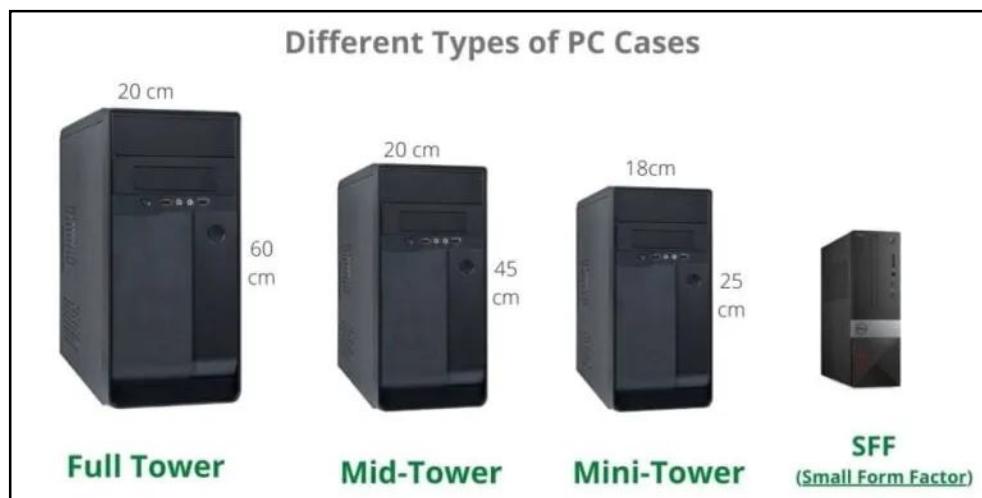
There are many different types of cases. The main feature of each of them is its form and size factor. This is due to the motherboard, whose form factor must be compatible with that of the tower to fit perfectly.

The **cooling system** is one of the main components of any PC case. There should be enough space inside for air circulation and large radiators that a powerful PC needs.

It must be understood that a PC case is an essential component for protecting the internal equipment from external influences.

Along with characteristics, it is necessary to highlight their size and type of execution, which can be either vertical or horizontal. The following are the **computer case sizes and models** available in the market.

4 Different Types of Computer Case



1. Full tower

Firstly, Full Tower is used to accommodate an **E-ATX or CEB motherboard**. This is very useful for high-performance servers that can use two processors and massive RAM and other storage units at once.

The full tower ranges between **55- 75 cm tall and 22 – 32 cm in width**. It can have from 4 to 9 5.25-inch bays (for additional optical drive). Allows you to install up to seven expansion cards, such as a sound card or a receiver.



This type of computer case comes with proper size and weight, which usually has better internal cooling. Of course, their prices are a little high. That's why enthusiasts, administrators have always used full Tower cases, and hardcore streaming gamers.

If you want to build your separate uncompromising, powerful gaming PC and wanted to use three monitors and play in 4K togetherly? Then such a case will provide your future computer with the necessary space.

Such a case provides better cooling for two top-end graphics cards and a processor like the **Intel Core i9-9900K** and allows you to create a custom cooling system with 230mm fans.

Buying a Full Tower is worth it, but only if you need space for a large number of components or need a lot of airflows to cool the powerful processors and cards.

Full Tower Gaming ↓ Chassis



One big **drawback** to having a Full Tower is that it takes up a lot of space and is difficult to hide. But if you have free space available, then it is not essential for you, then Full Tower can be the best choice for your PC.

2. Mid Tower

Mid-tower or ATX format is the most popular and widely used computer case that allows you to use many drives and almost all types of motherboards with acceptable overall dimensions in it.

The average full tower ranges between **35- 55 cm tall and 15 – 25 cm in width**.

Inside the mid-tower case, there is more enough space for installing full-size components, such as most extensive video cards over 300 mm long, and this case is capable of using **120, 140, or even 200 mm fans** for a positive effect on cooling the air.



If you want to build a regular gaming PC, not as hardcore gaming, then Mid Tower is most likely your right choice. This case is about 31 cm long, which is easy to install a full-size video card and two to three expansion slots thick.

Besides, the components inside the Mid Tower will receive adequate cold airflow. With proper use of fans (and regular cleaning from dust), the video card and processor temperatures will never exceed **70-80 degrees Celsius**, even in the most stressful conditions.

Using these types of computer cases, you can build a productive PC with a sound ventilation system. It is considered a **universal option for desktop users** because you can assemble a wide range of designs, a low-power office computer, a home media center, and a gaming computer.



This type of format includes both those developed for the mini ITX standard and those designed for the micro ATX standard. Therefore, you will find all the small computer cases in this segment, including many cube-shaped or oriented for HTPC.

- **Recommended:** Full Tower vs. Mid Tower – **Which is Suitable?** (Comparison)
- **Related:** 3 Pin vs. 4 Pin Fans for PC Case – **Which is Best?** (Comparison)

3. Mini Tower

These types of computer cases are designed to take up as little physical space and without installing decent-sized graphics cards. The average mini-tower length ranges between **30 – 45 cm tall and 15 – 25 cm in width** (they can sometimes be smaller).

Their thermal enclosures are not the best on the market, so it is more convenient for you to install low-consumption components rather than high-consumption ones.



The Mini Tower chassis is the smallest in size and not very popular among computer assemblers due to the limited volume, which does not allow assembly of a more or less productive computer and low airflow. A small body limits the choice of types of accessories too.

You can install only a microATX motherboard and a low power supply in these types of computer cases. Typically, Mini Tower computers are shipped in the most basic configuration for back-office machines or network terminals.



Mini Towers are an increasingly common choice for regular home PCs – both budget and enough for standard video games. Regarding their possible uses, given **their limited size and expansion capabilities, their benefits are quite limited.**

However, during assembly, only a specialist or experienced can beautifully arrange everything in its place as there is not much space inside.

4. HTPC and SFF

HTPC stands ‘**Home theatre PC**’ for and SFF stands for ‘**Small Form Factor**’. These types of cases were considered very niche, but in recent years they have gained popularity due to the miniaturization of powerful components that can fit in them.



HTPC is the perfect choice for the computer at your home **multimedia entertainment**. You can place it under the TV table, or even you can hang on the wall. And the computing power of this is more than enough to play music and video in any modern format.

Also, **such a PC will not make a sound – often, you can have passive cooling.**

SFF takes little space. Due to their small size and lightweight, they can be an excellent alternative to laptops. Some SFFs are handy to come with handles or unique bags to make them easier to transport. Also, the SFF has a significant advantage over a laptop since it has more power at less cost.



Many SFFs come with motherboards by offering cooling options that differ from the standard fans found in other types of computer cases.

This happens because the video and sound on such motherboards are built-in, leading to generating heat in a very tiny amount. As a result, they do not need powerful cooling. Also, this arrangement reduces the size.

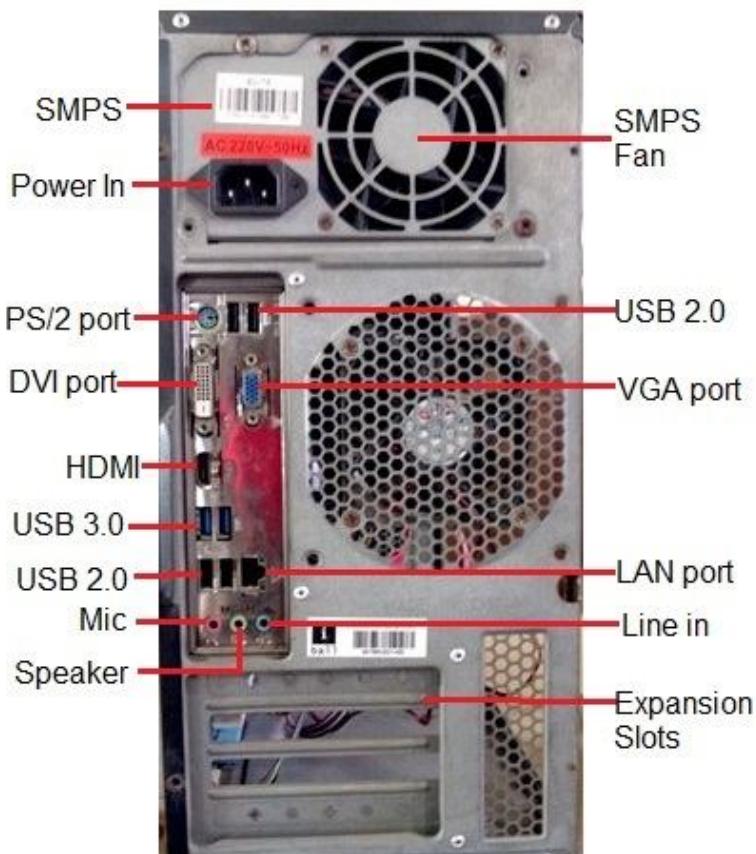


SFF cases with Mini-ITX motherboard suits perfectly the people who work or play in tight spaces. These are specially for **small living rooms and small offices**. It will also be much easier to repair and improve such a PC than a laptop with the feature of portability.

It has one drawback that they are most often limited to only one CD drive.

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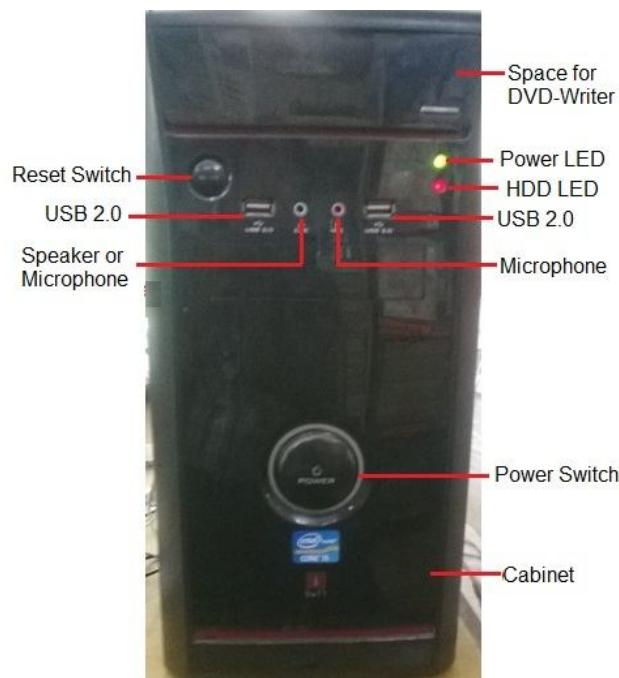
Back side connectors of PC



- **SMPS.** Switch Mode Power Supply uses electronics circuitry that converts the AC input voltage to different values of regulated DC supply which is fed into various color-coded wires fixed to connectors.
- **SMPS FAN.** The fan is fixed inside the SMPS and is used to radiate the internal heat of SMPS to outside.
- **Power In Socket.** This socket is used to input 220V AC to the PC from mains supply when the computer switch on the front side is pressed.
- **PS-2 Port.** You can see two different colored 6-pin round shaped connectors. These connectors are used to connect input devices, keyboard and mouse. Color Coding defines the connector type. The purple connector is dedicated to connect Keyboard and Green color is used for Mouse.
- **USB Port.** The full form is Universal Serial Bus and is used to connect various input and output devices like Mouse, Keyboard, Printers, Webcams etc. USB 3.0 is the latest version which offers high data transfer speed.

- **DVI Port.** Digital Video Interface is a high-speed serial link for connecting output display Devices.
- **HDMI Port.** HDMI stands for high definition multimedia interface. This is a latest interface that helps to get high definition video and multi channel sound. You can connect HDMI enabled blue ray devices, LED's etc.
- **15-pin Female VGA Port.** This is used to connect display devices like Monitor / LCD / LED Display.
- **LAN Port.** The LAN or network port is used to connect to other devices and computers in a network.
- **Audio Ports.** Generally there are 3 number of audio ports on the back side of a PC. These parts are either aligned vertically or in horizontal position. Green color port is dedicated for headphones or speakers, a blue colored port is marked as Line-in and Mic can be inserted in a pink port.
- **Expansion Slots:** These expansion slots are used to connect add-on cards to increase the capabilities of the motherboard.

Front Side buttons on PC



- **DVD-Writer.** Top slot of the cabinet is reserved to fix CD-ROM or DVD-writer.
- **Power-LED:** The LED glows and indicates that the Input Power is ON

- **HDD LED:** When we are working on the computer, the hard disk is in use , this LED glows and is the indication that the hard disk drive is in use.
- **Reset Switch:** This computer switch is quite handy when the computer is stuck-up and you are not able to work on the computer . Just press this switch, the computer will Re-Boot.
- **Front USB.** Cabinet provides a facility for you to connect USB devices from front-side as it is quite awkward to get to the back side of the computer again and again.
- **Front Audio Ports:** The ports for MIC and HeadPhone at the front are for user quite easy to approach.
- **Power Switch.** It is used to switch-ON the computer.

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Identify and understand different cables and connectors:

Video cables-

Mini-HDMI, Display port,

DVI;



VGA Cable for Computer and Projector

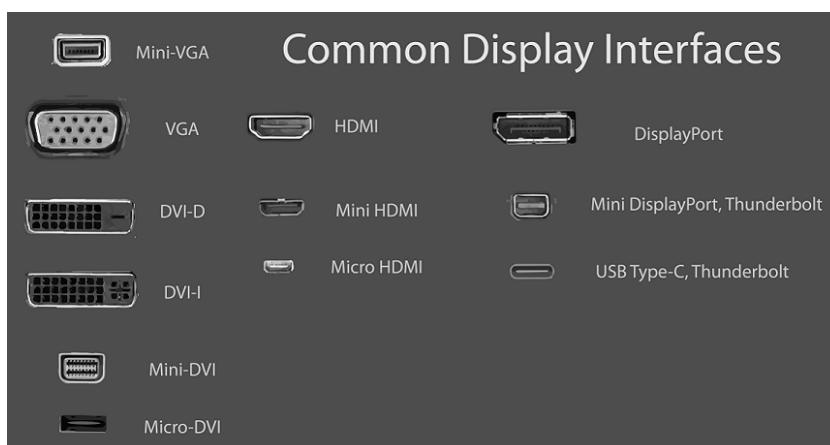


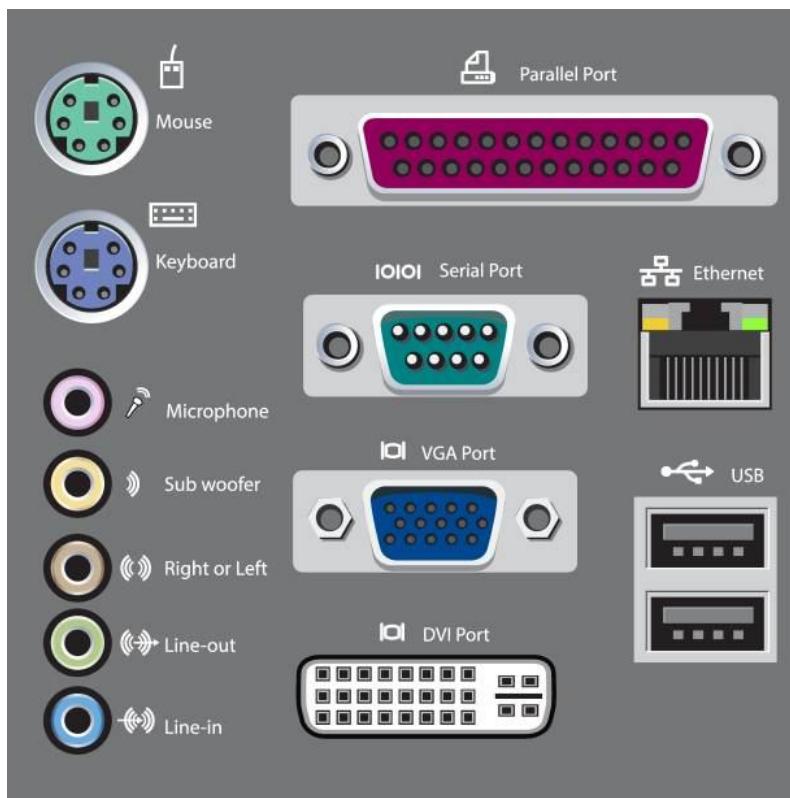
HDMI Cable



Mini HDMI

DVI Port





Peripheral cables:

Serial

Hard drive cables

There are three main types of cables: IDE/PATA, SATA and SCSI. IDE (Integrated Drive Electronics) drives, also known as PATA (Parallel AT Attachment) drives, are commonly found in personal computers.

There are several types of hard drives, and they all require different data cables. To connect a hard drive to a computer, one must have the proper cables and plug the cables into the appropriate places.

IDE/PATA Cable:



IDE/PATA data cable.

An IDE/PATA hard drive cable is a ribbon cable containing 40 pins. Either one or two devices may be connected to an IDE/PATA cable, and the devices need not be of the same type. For example, an IDE/PATA DVD-R drive may be connected along with an IDE/PATA hard drive on the same cable.

SATA Cable:



SATA data cable.

A SATA hard drive cable has seven conductors and is smaller than an IDE/PATA cable. A SATA cable connects a single hard drive to a single connector on the SATA controller, which is usually found on the computer's motherboard.

SCSI Cable:



SCSI 50-pin cable - by Smial on Wikimedia, Creative Commons Attribution ShareAlike 2.0 Germany.

SCSI cables look similar to IDE/PATA cables in that both drives use ribbon cables. However, SCSI cables have more pins than IDE cables. Depending on the SCSI interface, a SCSI cable may have 50 or 68 pins (IDE/PATA drives have 40). Like IDE, multiple SCSI devices can be connected to a single channel through "daisy chaining." Depending on the SCSI interface, as many as 7 or 15 devices may be connected to a single SCSI channel.

Adapters:

DVI to HDMI,



Usage: Computers and Laptops and Projectors

USB to ethernet,



Usage: Network Connection

DVI to VGA



Usage: Multimedia, DVD Player, Computer, Monitor, Game Player

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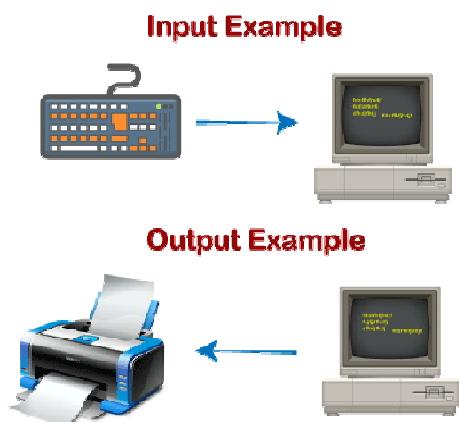
I/O devices and Interfaces

Input/Output Device:

Input Devices are devices which send information to a computer system for processing.

Example: keyboard, mouse, webcam, microphone, etc.

Output devices accept the output after processing of data from other devices. Example: Monitor, Printer, Speaker, etc.



Input devices:

An input device can receive instructions from users or forward information to another device. After receiving input, it translates these data into the electrical signals in binary code, which cannot be understandable by humans, and only a digital computer can understand it.

- **Keyboard and Mouse:** These are the input devices that are used by the users to give input to the computer. They send the received input (Data) from users to the system.
- **Microphone:** This accepts sound generated by an input source and allows users to send audio into their computers. In the microphone, the accepted signal may be converted into a digital signal or can be amplified as an analog signal.
- **Webcam:** A webcam is a video camera that connects to a computer and faces the user, which is used to capture pictures, make a video by a computer system. It takes images as input from where it is pointed and used for calling and taking selfies. However, most modern webcams have a microphone, which offers users a better sound quality while making videos. Webcams are attached to the monitor of a desktop computer and also built into laptops.

Output devices

Output devices that receives data from another device and produces output with the information. It functions to take data from input devices and translate the digitized signals into a form that can be understandable by users.

- **Monitor:** A monitor is a piece of computer hardware that accepts data from a computer (output) and displays it on the system screen through the computer's video card. Monitors have the ability to display information at a much higher resolution.
- **Speakers:** Speakers accept sound data from a computer and play the sounds for users to hear. Some speakers are manufactured in such a way that it cannot receive sound generated by users as well as refer that sound to another device. The main objective of the speakers is to produce sound or audio output for the listener.
- **Projector:** A projector is an output device that accepts data from a computer (output) and projects that data or information as a picture onto a wall or screen or any large surface. It does not have the ability to receive data from a user and also not capable of sending that data to another device. When you are showing video or images to a large group of people,

a projector is more beneficial to use instead of a monitor because it displays data on a large surface that can be visible to a large number of people clearly.

Input/output devices

An input/output device has the ability to accept data from users or another device (input), as well as forward data to another device (output). Some examples of input/output devices are discussed below:

- **CD-RW drive and DVD-RW drive:** These drives functions for accepting data from a computer as an input to copy onto a writable CD or DVD. And, this data contained on a CD or DVD is sent by the drive to the computer.
- **USB flash drive:** It is also referred to as a keychain drive, data stick, USB flash drive, thumb drive, memory unit, pen drive. It is a portable storage device that saves or accepts data from a computer (input). It connects to a computer via a USB port and forwards data to a computer or another device (output).

Difference between Input and Output devices.

The below table contains major key points of the difference between both Input and Output devices.

| Input device | Output device |
|--|---|
| The input device receives data from users. | An output device displays data on the screen for users. |
| It works for translating user-friendly instructions into a machine friendly. | It works for translating the machine's instructions to user intelligible. |
| An input device can be commanded by the user. | Processor commands output device. |
| It accepts data from the user as an input and forwards it to the processor for further processing. | The data, which is processed by the processor, is sent to the output device for sending it back to the user; it means that the output device takes the processed data from the processor. |
| Its design is more complex. | As compared to input devices, its design is less complex. |

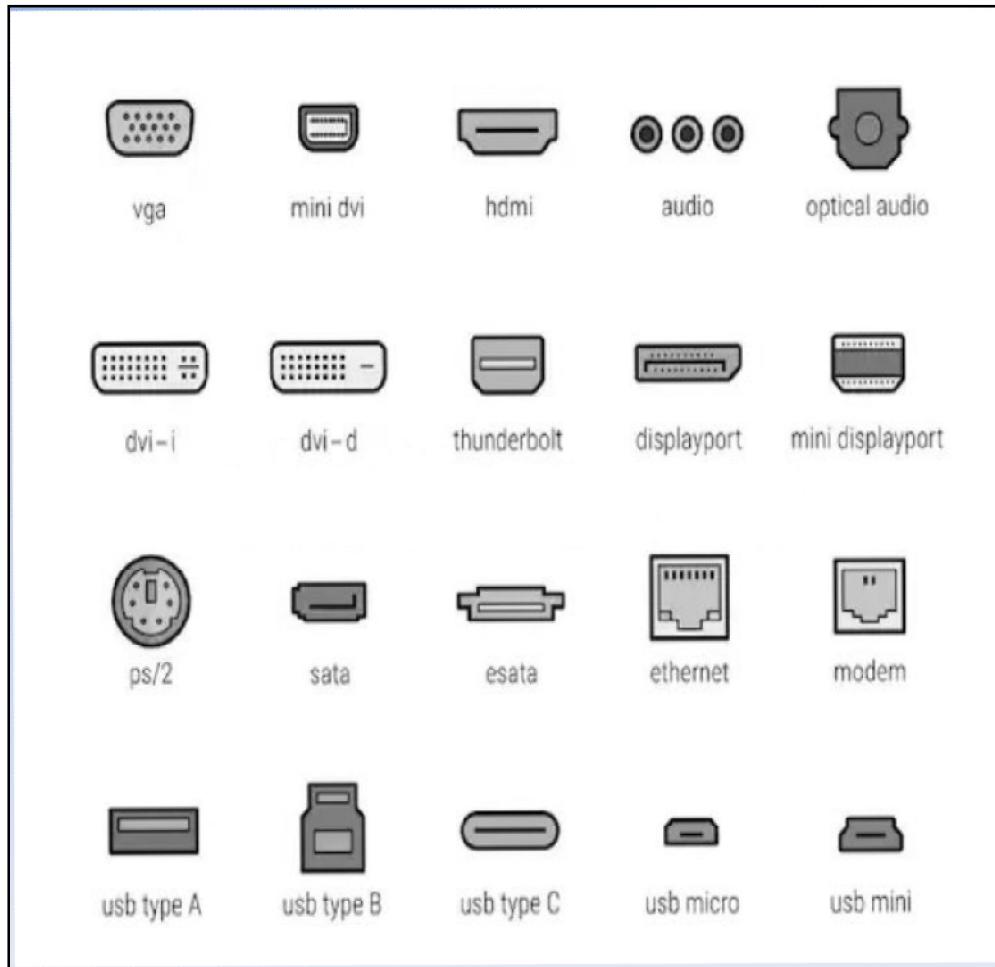
| | |
|---|---|
| Input device helps the computer to receive instructions from users. | The output device helps the computer to produce or display the information to the users. |
| There are various input devices available like Microphone, Joystick, Keyboard, Pointing device, Image Scanner, Graphics tablet, and more. | There are several output devices available such as Speakers, Printers, Plotters, Projector, Monitor and more. |

Ports :

It is the connection point which acts as an interface between the computer and the external devices like: Printer, Modem, Scanner, etc.

There are two types of ports :

1. **Internal Port:** It connects the system's motherboard to internal devices like hard-disk, CD drive, internal Bluetooth etc.
2. **External Port:** It connects the system's motherboard to external devices like mouse, printer, USB etc.



Some important types of ports are as per follows:

1. Serial Port:

- Used for external modems and older computer mouse
- Two versions-9pin,25pin
- Data travels at 115 kilobits per second

2. Parallel Port:

- Used for scanners and printers
- 25 pin model

3. Universal Serial Bus (or USB) Port:

- It can connect all kinds of external USB devices such as external hard disk, printer, scanner, mouse, keyboard, etc.
- Data travels at 12 megabits per seconds.

4. Firewire Port:

- Connects camcorders and video equipment to the computer.
- Transfers large amount of data at very fast speed.
- Data travels at 400 to 800 megabits per seconds.

5. Ethernet Port:

- Connects to a network and high speed Internet.
- Data travels at 10 megabits to 1000 megabits per seconds depending upon the network bandwidth.

Computer Ports

A port is a connection or a jack provided on a computer to connect external or peripheral devices to the computer, for example, a port needed to connect a keyboard, mouse, pen-drives, etc.

It acts as an interface or a point of attachment between computer and external devices.

It is also called a communication port, as it is the point where a peripheral device is plugged to allow data transfer or communication between the device and computer.

Generally, they are four to six in number and present on the back or sides of the computer.

Based on the type of protocol used for communication, computer ports can be of two types:
Serial Ports and Parallel Ports.

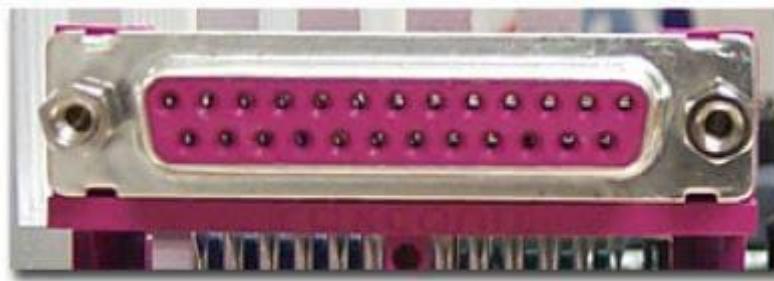
Serial Port:



In this port, the rate of transmission of data is one bit at a time through a single communication line.

For example, D-Subminiature or D-sub connector is a commonly used serial port, which carries RS-232 signals.

Parallel Port:

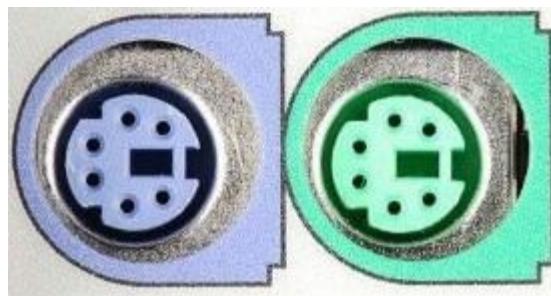


A parallel port is an interface that allows communication or data transfer between a computer and a device in a parallel manner through more than one communication line.

For example, a printer port is a parallel port.

Examples of Computer Ports:

1) PS/2:



As the name suggests, it was introduced with IBM's Personal Systems/2 series of computers. These connectors are colour coded, e.g., green was for mouse, and purple was for the keyboard. Besides this, it is a DIN connector with six pins. At present, it is superseded by USB ports.

2) VGA Port:



This port is commonly found in computers, projectors, and high definition TVs. It is a D-sub connector called DR-15 as it has 15 pins, which are arranged in 3 rows with five pins in each row. It was most often used to connect CPU with CRT monitors. Still, most of the LCD and LED monitors come with VGA ports.

As the demand and emphasis on video quality kept growing, the VGA ports were gradually replaced by more advanced ports that can assure high video quality such as HDMI and Display Ports.

3) Digital Video Interface (DVI):



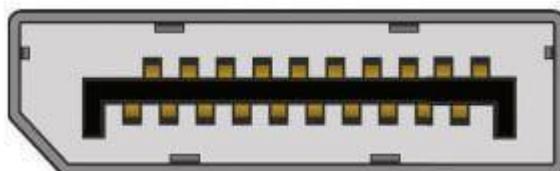
It is another interface between a CPU and a monitor.

It is a high-speed interface that is developed to transmit the lossless digital video signals and to replace analogue digital video signal transmission through VGA technology.

The DVI interface can be of three types based on the signals transmitted by it: DVI-I, DVI-D, and DVI-A. The DVI-I supports combined digital and analogue signals, whereas DVI-A supports only analogue signals, and DVI-D supports only digital signals.

Mini-DVI: As the name suggests, it is smaller than a commonly used DVI port. It is a 32 pin port developed by Apple as a substitute to Mini-VGA port. It can transmit various types of signals such as S-Video, VGA, and composite signals using respective adapters.

4) Display Port:



This interface allows transmitting a video and audio from a device to a display screen. It is an advanced display technology that is developed as a substitute for older interfaces such as DVI and VGA. A display port can be seen on laptops, desktops computers, tablets, monitors, etc. It has a 20-pin connector and offers a better resolution than DVI port.

5) RCA Connector:



It is designed to accept composite video and stereo signals transmitted by three cables called RCA cable. A RAC cable has three color-coded plugs that are connected to the three corresponding coloured jacks of an RCA connector. Each of the coloured jack is ringed with metal. The red jack supports the right stereo channel, and the white one supports the left stereo channel, while the yellow is used for composite video.

6) Component Video:



This interface allows splitting video signals into three channels. The component video generally has three color-coded slots; Red, Blue, and Green. Each slot receives and then transmits a particular component of the video signal. It offers high-quality videos than composite video and can carry both analogue and digital video signals.

7) HDMI port:



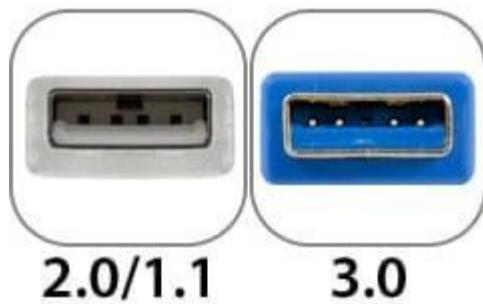
HDMI (High Definition Media Interface) is a digital interface developed to connect high definition devices such as digital cameras, gaming consoles, etc., to computers and TVs with HDMI ports. Besides this, it can carry uncompressed video and uncompressed or compressed audio signals. The advanced version of HDMI, such as 2.0, can transfer video signals of up to a resolution of 4096x2160.

8) USB:

USB (Universal Serial Bus) port is very versatile in use; It can be used for various purposes, such as to transfer data, to connect peripheral devices, and even as an interface for charging devices such as smartphones, digital cameras, etc. Today, it has replaced PS/2 connectors, game ports, serial and parallel ports, etc.

Types of USB ports:

USB Type A:



It is a four-pin connector and has many versions that include USB 1.1, USB 2.0 and USB 3.0, and USB 3.1. Version 3.0 is a common standard that supports a data transfer rate of upto 400 MBps. Version 3.1 allows a data rate of upto 10 Gbps.

USB Type C:



It is the latest design of the USB that comes with 24 pins and can handle a current of 3A. As it can handle high current, it is also used in devices for fast charging. This port was developed by

the USB Implementers Forum (USB-IF). One of the distinguishing features of this port is that it has no up or down orientation, which means you don't need to flip the male connector over to plug it in the USB port. For example, a USB-C plug is symmetrical, so that it can be inserted or plugged in either way.

9) RJ-45:



It is an Ethernet style network port found on the computer and other devices such as routers, switches, etc. This port allows your computer to interact or communicate with other computers and networking devices where Ethernet networking is required.

Its full form is Registered Jack 45. It is also known as Ethernet port, network jack, or RJ45 jack. It has eight pins; accordingly, the RJ45 cable comprises eight separate wires of different colours. Besides this, it looks like a telephone jack; however, it is slightly wider than that.

10) RJ11:



It is also a registered jack, which is often used as an interface for modem, ADSL, and telephone and for terminating the telephone wires. Although it looks like RJ45, it is different from that as it is smaller and has only six pins; it is a 6P4C connector that shows it has six pins with four contacts. This port is mainly used to connect to dial-up modems and is also known as a phone connector, modem port, phone jack, etc.

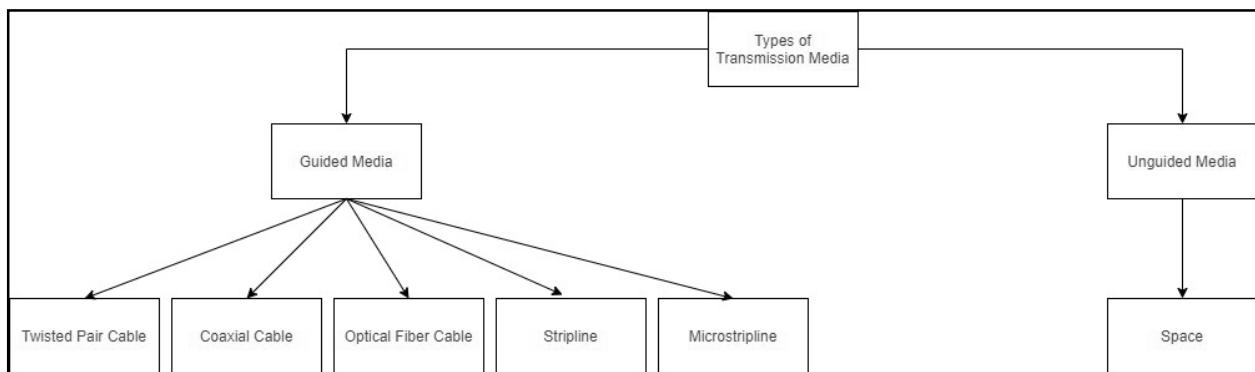
11) 3.5 mm Audio Jack:



It is a small round connector, port, or an audio jack commonly found on laptops, computers, phones, etc. It is designed to connect to wired headphones and speakers. In other words, it accepts a pin-shaped plug from a headphone, earphone, etc. The measurement "3.5 mm" denotes the diameter of the connector.

However, in older devices, there were two audio jacks, one for mic and another one for headphone. Besides this, they have a 2.5 mm jack or port for phone headphones.

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In data communication terminology, a ***Transmission Medium***

- is a *physical path* between the transmitter and the receiver OR
- it is the channel through which data is sent from one place to another.

Transmission Media is broadly classified into the following types:

1. Guided Media:

It is also referred to as Wired or Bounded transmission media. Signals being transmitted are directed and confined in a narrow pathway by using physical links.

Features:

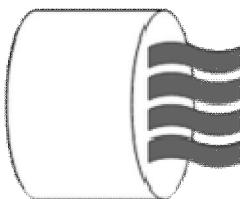
- High Speed
- Secure

- Used for comparatively shorter distances

There are 3 major types of Guided Media:

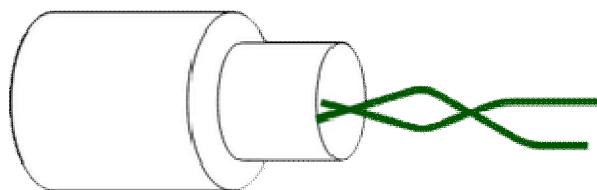
(i) Twisted Pair Cable: It consists of 2 separately insulated conductor wires wound about each other. Generally, several such pairs are bundled together in a protective sheath. They are the most widely used Transmission Media. Twisted Pair is of two types:

- **Unshielded Twisted Pair (UTP):** This type of cable has the ability to block interference and does not depend on a physical shield for this purpose. It is used for telephonic applications.



Advantages:

- Least expensive
 - Easy to install
 - High-speed capacity
 - Susceptible to external interference
 - Lower capacity and performance in comparison to STP
 - Short distance transmission due to attenuation
-
- **Shielded Twisted Pair (STP):** This type of cable consists of a special jacket to block external interference. It is used in fast-data-rate Ethernet and in voice and data channels of telephone lines.



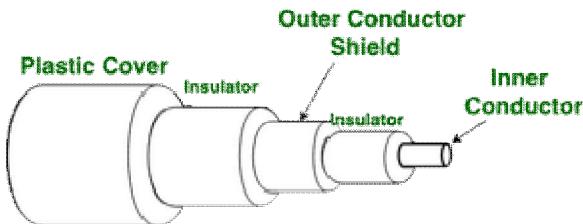
Advantages:

- Better performance at a higher data rate in comparison to UTP
- Eliminates crosstalk
- Comparatively faster

- Comparatively difficult to install and manufacture
- More expensive
- Bulky

(ii) **Coaxial Cable:** It has an outer plastic covering containing 2 parallel conductors each having a separate insulated protection cover.

- The coaxial cable transmits information in two modes:
 - Baseband mode(dedicated cable bandwidth)
 - Broadband mode(cable bandwidth is split into separate ranges).
- Cable TVs and analog television networks widely use Coaxial cables.



Advantages:

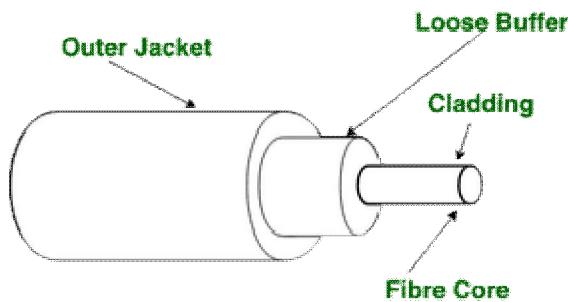
- High Bandwidth
- Better noise Immunity
- Easy to install and expand
- Inexpensive

Disadvantages:

- Single cable failure can disrupt the entire network

(iii) **Optical Fibre Cable:** It uses the concept of reflection of light through a core made up of glass or plastic. The core is surrounded by a less dense glass or plastic covering called the cladding. It is used for the transmission of large volumes of data.

The cable can be unidirectional or bidirectional. The WDM (Wavelength Division Multiplexer) supports two modes, namely unidirectional and bidirectional mode.



Advantages:

- Increased capacity and bandwidth
- Lightweight
- Less signal attenuation
- Immunity to electromagnetic interference
- Resistance to corrosive materials

Disadvantages:

- Difficult to install and maintain
- High cost
- Fragile

(iv) stripline:

- Stripline is a transverse electromagnetic (TEM) transmission line medium. Stripline is the earliest form of the planar transmission line.
- It uses a conducting material to transmit high-frequency waves; it is also called a waveguide.
- This conducting material is sandwiched between two layers of the ground plane which are usually shorted to provide EMI immunity.

(v) Microstripline

- Here the conducting material is separated from the ground plane by a layer of dielectric.

2. Unguided Media: It is also referred to as Wireless or Unbounded transmission media. No physical medium is required for the transmission of electromagnetic signals.

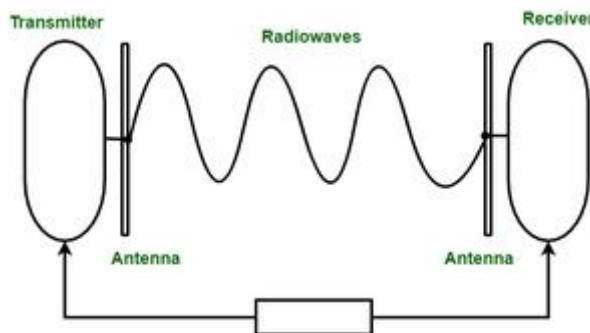
Features:

- The signal is broadcasted through air
- Less Secure
- Used for larger distances

There are 3 types of Signals transmitted through unguided media:

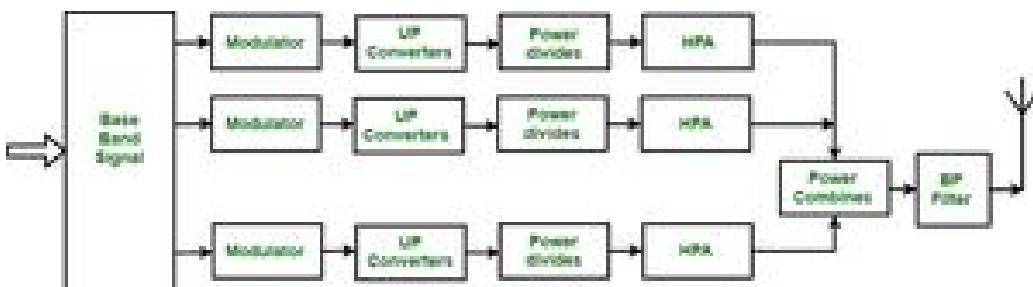
(i) Radiowaves:

- These are easy to generate and can penetrate through buildings. The sending and receiving antennas need not be aligned.
- Frequency Range: 3KHz – 1GHz. AM and FM radios and cordless phones use Radiowaves for transmission.
- Further Categorized as (i) Terrestrial and (ii) Satellite.



(ii) Microwaves:

- It is a line of sight transmission i.e. the sending and receiving antennas need to be properly aligned with each other.
- The distance covered by the signal is directly proportional to the height of the antenna.
- Frequency Range: 1GHz – 300GHz.
- These are majorly used for mobile phone communication and television distribution.



(iii) Infrared:

- Infrared waves are used for very short distance communication.
- They cannot penetrate through obstacles.
- This prevents interference between systems.
- Frequency Range: 300GHz – 400THz.
- It is used in TV remotes, wireless mouse, keyboard, printer, etc.



Television



Infrared Radiations



Remote

HDMI stands for **High Definition Multimedia Interface**:

- HDMI works as an interface between any multimedia devices to transfer audio and video signals.
- It is mainly a port in which cables (known as HDMI cables) are connected to transfer audio and video together.
- HDMI can transmit high-definition video and audio signals over up to 8-channels.
- HDMI standard was developed by multiple companies, such as Hitachi, Silicon Image, Thomson, Philips, Sony, Panasonic and Toshiba

Advantages

- HDMI support high resolution at high refresh rate.
- HDMI supports audio and video together with one port and one cable.
- Also HDMI supports HDCP and 3D transmission.
- HDMI has comes with nowadays TVs, monitor, laptops, in many devices.
- HDMI has Simple connection to connect devices.
- It has integrated audio, video and content protection.
- HDMI uses digital interface instead of an analog interface.
- In HDMI high definition signal is not compressed at all.

Disadvantages

- While using HDMI sometimes authentication delay can be happen which causes blanks screen, which is irritating thing.

- HDMI cables as well as HDMI supported devices are costlier than others.
- There are limitations to field terminations of HDMI cables
- CEC(Consumer Electronics Control) causes confusion when the devices themselves change their configuration as they might get undetected by the control systems.
- HDMI use DVI interfacing so its need a HDMI-DVI adapter to connect the audio, otherwise the audio cannot be connected.
- Multiple applications are difficult to run simultaneously via HDMI.

Universal Serial Bus (USB):

- It is used as a device for communication between connectors and cables.
- Data transfer and electricity supply between peripheral devices such like keyboard, mouse, printer, portable media players, disk drive etc was the main motive behind designing a USB.
- It is also used for connection and power supply between computers, laptops, and electronic devices.

Characteristics of USB:

- A maximum of 127 peripherals can be connected to a single USB host controller.
- USB device has a maximum speed up to 480 Mbps (for USB 2.0).
- Length of the individual USB cable can reach up to 5 meters without a hub and 40 meters with hub.
- USB acts as a “plug and play” device.
- USB can draw power by its own supply or from a computer.
- If a computer turns into power-saving mode, some USB devices will automatically convert themselves into “sleep” mode.

Advantages:

- Ease of use
- Acceptable data rate for many applications
- Robust connector system
- Variety of connector types/sizes available
- Low cost

Disadvantages:

- USB cables are limited in length.
- Some very high-speed peripheral devices require sustained speeds not available in the USB standard.
- Use of the USB logos on the product require annual fees and membership in the organization.

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Speaker:



Speakers are used to connect to a computer to generate sound. With the computer speaker, the computer's sound card creates a signal that is used to produce sound. The primary objective of speakers is to offer audio output for the listener. The electromagnetic waves are converted into sound waves through the speaker as they are transducers. The devices, like an audio receiver or computer, give audio input to speakers, which may be in the form of analog or digital. The function of the analog speaker is simply to magnify the analog electromagnetic waves into sound waves.

The sound waves are produced in analog form, but first, the digital input is converted into an analog signal by digital speakers then the sound waves are generated. The amplitude and frequency define the sound produced by speakers. The frequency determines the pitch of the sound of how high or low it is. The sound quality, how clear it will be, depends upon the speaker system's ability; if it is able to accurately reproduce sound frequencies, it can be the best indicator to determine audio quality.

There are numerous speakers that consist of different speaker cones, which make them capable of offering more accurate sounds for different ranges. The three-way speakers generally contain a subwoofer, mid-range speaker, and a tweeter, whereas the two-way speakers have a mid-range speaker and a tweeter. The air pressure created by the speakers' sound waves determines the loudness or amplitude.

Speakers that have the ability to increase the sound input are commonly known as active speakers. If a speaker can be plugged into an electrical outlet or consists of volume control, you can easily determine if the speaker is active. The passive speakers are those that do not have any internal amplification; these speakers need a high level of audio input as they do not increase the audio signal.

Usually, speakers come in pairs that lead to producing stereo sound. It means, on two separate channels, the left and right speakers produce audio. Music sounds much more natural when you use two speakers, as in this condition, our ears hear sounds from the left and right at one time, which makes sounds much more natural. Furthermore, surround systems can produce more realistic sound as they may include four to seven speakers, including a subwoofer.

Rating a Speaker:

Speakers are rated in distortion, watts, frequency response, and total harmonic.

- **Frequency response:** It is produced by speakers, which is the rate of the lows and highs of the sound.
- **Watts:** For the speakers, it is the amount of amplification.
- **Total harmonic distortion (THD):** It is the amount of distortion created with the help of amplifying the signal.

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Keyboard

A keyboard is an input device that allows users to input text into a computer or any other electronic machinery. It consists of multiple buttons, which create numbers, symbols, and letters, and special keys like the Windows and Alt key, including performing other functions. The design of the keyboard comes from the typewriter keyboards, and numbers and letters are arranged on the keyboard in that way, which helps to type quickly.



The above keyboard design is called QWERTY design because of its first six letters across in the upper-left-hand corner of the keyboard. Keyboards have function keys (F1 to F12 or F16) at the

top of the keyboard and arranged arrow keys in the downside used to perform numerous functions.

Types of keyboards

Most computer users use the standard keyboard, which connects to the computer. Although there are many types of a computer keyboard, such are as follows:

1. Flexible keyboard: It is a type of keyboard that is made of soft silicone with highly portable. It is water and dust-resistant and does not require constant cleaning. It acts the same as a standard keyboard and connects to the computer via a USB connection serial port.

The flexible keyboard is made of soft silicone that saves it from a number of different substances. It does not make a sound when being used; that's why it is also called a silent keyboard. These keyboards are useful for traveling time because they can be rolled up into a bag and flexible in outdoorsy situations.



2. Ergonomic Keyboard: This type of keyboard is beneficial for your body posture. Instead of adjusting yourself to fit the keyboard, it is designed to fit you easily, ease of use, and reduce strain. It is designed in that way; instead of bending their hands, it allows users to straight their hands. Generally, the space-bar is bigger as compared to a regular keyboard, which allows for fast typing.



3. Wireless Keyboard: It is a computer keyboard that is connected to computers, laptops, or tablets without any cables. It uses radio frequency (RF), infrared (IR), or Bluetooth technology to connect with devices. Users can move the wireless keyboard around without having to put it on a desk as it provides portability and flexibility to the users. It is designed by stainless steel material that increases its life for a long time. It can set up very easily by plugging the USB receiver into the computer.

It utilizes light waves to transmit signals to other infrared-enabled devices as it is based on infrared technology. Some wireless keyboards use radio frequency technology, which communicates via signals with a range from 27 MHz to up to 2.4 GHz.



4. Mechanical Keyboard: It is made with high quality that commonly used in both home and office. It is designed for long life with high durability and responsiveness. It provides crisp click sound, medium resistance, and better feedback for gaming performance and ultimate typing. It offers framing, switches, type print methods, functionality, PCB board, key construction, LED lighting, or more other better features as compared to traditional rubber dome keyboards.



5. Virtual Keyboard: It is a software-based keyboard that enables users to type without the need for physical keys. It is an alternative for a physical keyboard or a digital representation of a QWERTY keyboard. These types of keyboards commonly have many pages of characters, including numbers, letters, punctuation, and symbols. Some virtual keyboards also include options to insert emojis, stickers, or animated GIFs on the basis of the device's operating system.

Examples of virtual keyboards



6. Projection Keyboard: It is a form of computer input device that can be connected via Bluetooth to the mini PC, tablet computer, or even smartphone. In projection keyboard, the image of a virtual keyboard is projected onto a surface. The device records the corresponding keystroke when a user touches any key from the shown keyboard on the surface. Some devices are connected via Bluetooth devices such as tablets, smartphones, mini-PC with Android, Windows operating system or iOS, etc.



7. Gaming Keyboard: A keyboard that contains a few specific keys used for gamers is known as a gaming keyboard. The W, S, D, A, and arrow keys are widely used for games on the standard QWERTY keyboard. Gaming keyboards (mostly mechanical keyboard), the key switches needless depression that provides faster action for games.



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Monitor:



A monitor is an electronic output device that is also known as a **video display terminal** (VDT) or a **video display unit** (VDU). It is used to display images, text, video, and graphics information generated by a connected computer via a computer's video card.

Older monitors were built by using a fluorescent screen and Cathode Ray Tube (CRT), which made them heavy and large in size and thus causing them to cover more space on the desk. Nowadays, all monitors are made up by using flat-panel display technology, commonly backlit with LEDs. These modern monitors take less space on the desk as compared to older CRT displays.

Types of Monitors

There are several types of monitors; some are as follows:

1. Cathode Ray Tube (CRT) Monitors

It is a technology used in early monitors. It uses a beam of electrons to create an image on the screen. It comprises the guns that fire a beam of electrons inside the screen. The electron beams repeatedly hit the surface of the screen. These guns are responsible for generating RGB (Red, Green, Blue) colors, and more other colors can be generated with the help of combining these three colors.



2. Flat Panel Monitors

These types of monitors are lightweight and take less space. They consume less power as compared to CRT monitors. These monitors are more effective as they do not provide harmful radiation. These monitors are more expensive than CRTs. The flat-panel monitors are used in PDA, notebook computers, and cellular phones. These monitors are available in various sizes like 15", 17", 18" & 19" and more. The display of a flat-panel monitor is made with the help of two plates of glass. These plates contain a substance, which is activated in many ways.



Flat-panel monitor screens use two types of technologies, which are given below:

- **Liquid Crystal Display:** LCD (Liquid crystal display) screen contains a substance known as liquid crystal. The particles of this substance are aligned in a way that the light located backside on the screens, which allow to generate an image or block. Liquid crystal display offers a clear picture as compared to CRT display and emits less radiation. Furthermore, it consumes less power and takes less space than a CRT display.
- **Gas Plasma Display:** This display uses gas plasma technology, which uses a layer of gas between 2 plates of glass. When voltage is applied, the gas releases ultraviolet light. By this ultraviolet light, the pixels on the screen glow and form an image. These displays are available in different sizes of up to 150 inches. Although it offers effective colors as compared to the LCD monitor, it is more expensive. That's why it is less used.

3. Touch Screen Monitors

These monitors are also known as an input device. It enables users to interact with the computer by using a finger or stylus instead of using a mouse or keyboard. When users touch the screen by their finger, it occurs an event and forward it to the controller for processing. These types of screens include pictures or words that help users to interact with the computer. It takes input from the users by touching menus or icons presented on the screen.



There are different types of touch screen monitors; three common types are given below:

- **Resistive Touch Screen:** Generally, this screen includes a thin electrically conductive and resistive layer of metal. When the touch is pressed, a change in the electrical current occurs that is sent to the controller. These screens are widely in use. These monitors are more reliable as they cannot be affected by liquids or dust.
- **Surface Wave Touch Screens:** These monitors process the input through ultrasonic waves. When a user touches the screen, the wave is processed and absorbed by the computer. It is less reliable as they can be damaged by water or dust.
- **Capacitive Touch Screen:** This screen includes a cover with an electrically-charged material. This material continuously flows the current over the screen. It is mainly used by the finger rather than a stylus. These monitors contain better clarity and do not damage by dust. Nowadays, capacitive touch screen is mostly used in smartphones.

4. LED Monitors

It is a flat screen computer monitor, which stands for light-emitting diode display. It is lightweight in terms of weight and has a short depth. As the source of light, it uses a panel of LEDs. Nowadays, a wide number of electronic devices, both large and small devices such as laptop screens, mobile phones, TVs, computer monitors, tablets, and more, use LED displays.



Advantages of LED Monitor:

- It includes a broader dimming range.
- It is a more reliable monitor.
- It is often less expensive.
- It consumes less power (20 watts), and run on a lower temperature.
- It has a more dynamic contrast ratio.

Comparison between LCD and LED monitors:

| Resolution 1920 x 1080 | LCD Monitors | Led Monitors |
|------------------------------|-------------------------|-------------------------|
| Brightness | 250 cd / m ² | 250 cd / m ² |
| Energy Star Certified | No | Yes |
| Weight | 2.4 kg | 2.4 kg |
| Contrast Ratio | 12,000,000: 1 | 100,000,000: 1 |

5. OLED Monitors

It is a new flat light-emitting display technology, which is more efficient, brighter, thinner, and better refresh rates feature and contrast as compared to the LCD display. It is made up of locating a series of organic thin films between two conductors. These displays do not need a backlight as they are emissive displays. Furthermore, it provides better image quality ever and used in tablets and high-end smartphones.



Nowadays, it is widely used in laptops, TVs, mobile phones, digital cameras, tablets, VR headsets. The Samsung, Apple, iPhone X uses AMOLED display.

6. DLP Monitors

DLP stands for **Digital Light Processing**, developed by Texas Instruments. It is a technology, which is used for presentations by projecting images from a monitor onto a big screen. Before developing the DLP, most of the computer projection systems produced faded and blurry images as they were based on LCD technology. DLP technology utilizes a digital micromirror device, which is a tiny mirror housed on a special kind of microchip. Furthermore, it offers better quality pictures that can also be visible in a lit room normally.



7. TFT Monitors

It is a type of LCD flat panel display, which stands for a thin-film transistor. In TFT monitors, all pixels are controlled with the help of one to four transistors. The high-quality flat-panel LCDs use these transistors. Although the TFT-based monitors provide better resolution of all the flat-panel techniques, these are highly expensive. The LCDs, which use thin-film transistor (TFT) technology, are known as active-matrix displays. The active-matrix displays offer higher quality as compared to older passive-matrix displays.



8. Plasma Screen Monitors

A plasma screen is a thin, flat-panel, and capable of hanging on a wall like LCD and LED televisions. It is a brighter screen as compared to LCD displays and thinner than CRT displays. It can be used to either display modes of digital computer input or analog video signals, and sometimes, it is marketed as 'thin-panel' displays. Plasma displays have wide viewing angles, high contrast ratios, and high refresh rates, which is used to reduce a blur video. Additionally, it provides better quality pictures as it supports high resolutions of up to 1920 x 1080.

The plasma screen also includes some disadvantages such as the **chance of screen burn-in, consumes more power, loss of brightness with time, can be heavier in weight.**



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Installation of a Local printer:

Steps:

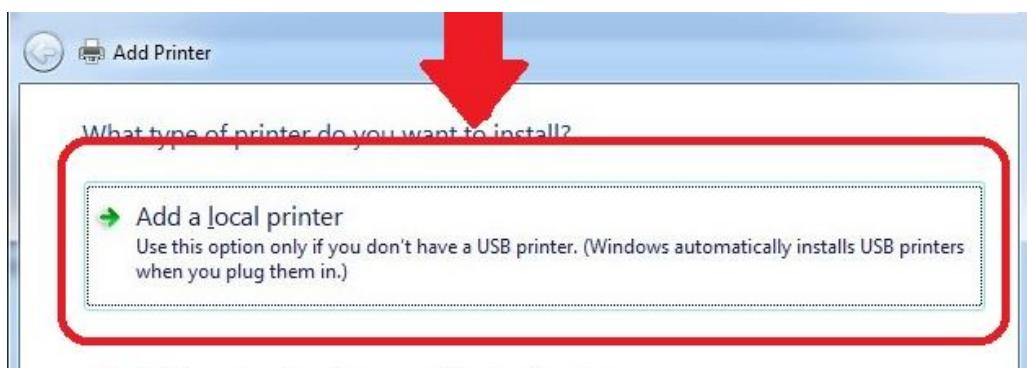
- If you DO NOT have the installation CD that came with your printer: proceed to Manual Installation and follow remaining directions (as mentioned in Manual Installation).
- If you DO have the installation disk that came with your printer: Insert the CD into your computer, and follow the installation wizard using all defaults.

Installing Manually

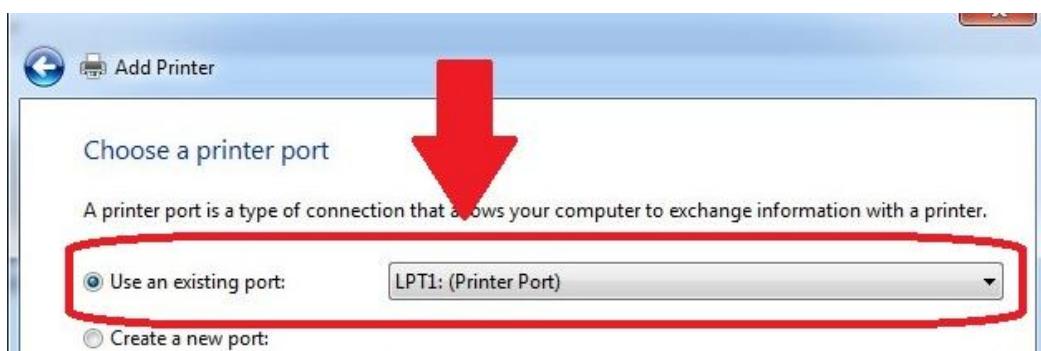
- Click the START button and select DEVICES AND PRINTERS.



- Select "Add a Printer"



- Select "Add a Local Printer"

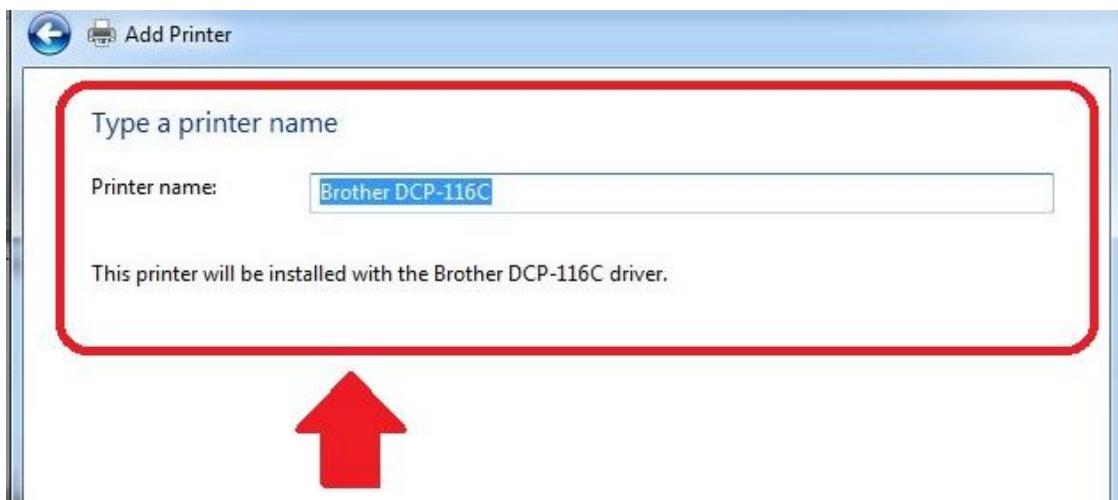


- Choose to "Use an Existing Port", and leave as default "LPT1: (Printer Port)" If you already have another printer connected to this PC, you may need to change to LPT2

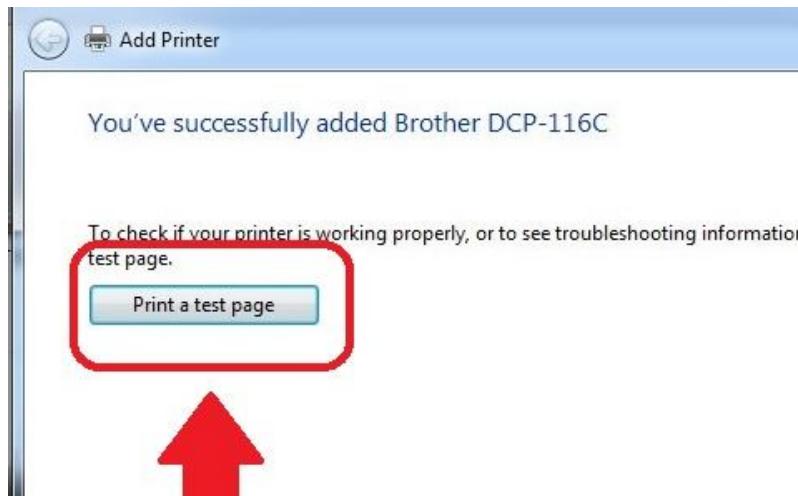


- Select "Windows Update" to populate the list of known printers. This may take several minutes.

Then choose your printer from the list. If multiple drivers are listed for your printer, select the one that say PCL. For instance: Dell 5130PCL



- Choose a name for your printer. The default name is fine, unless you have multiples of the same printer.



- If you wish to test your printer to make sure it was installed correctly, select "Print a test page"
- When you're all done, press "Finish"

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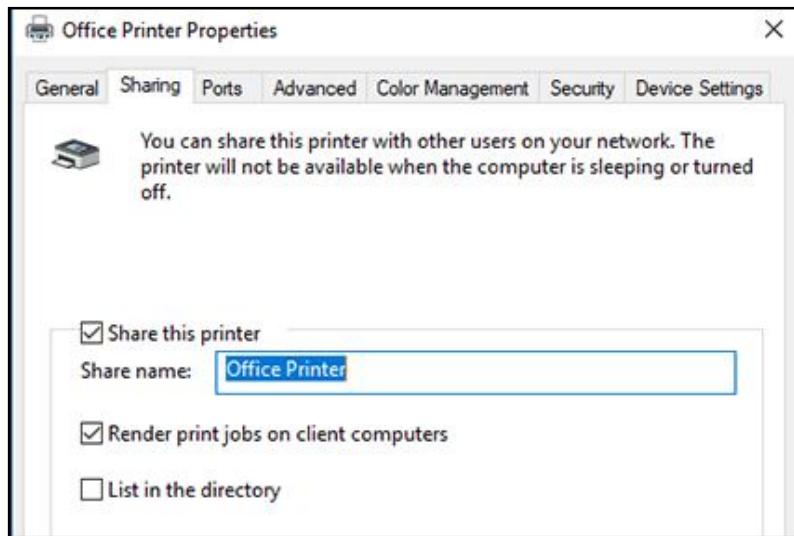
Installation of Shared Printer through Wired and Wireless Means

Share the printer on the primary PC

There are two ways to share your printer: using Settings or Control Panel.

Share your printer using Settings

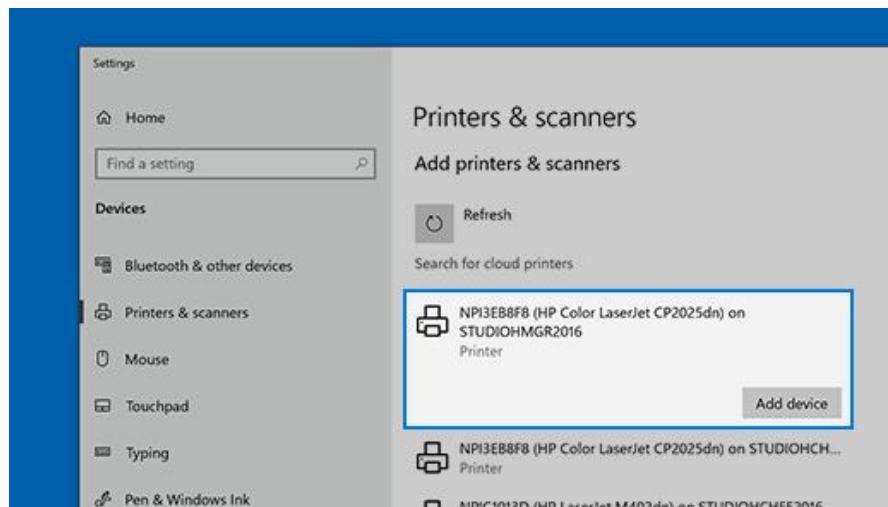
1. Select the **Start** button, then select **Settings > Devices > Printers & scanners**.
2. Choose the printer you want to share, then select **Manage**.
3. Select **Printer Properties**, then choose the **Sharing** tab.
4. On the Sharing tab, select **Share this printer**.
5. If you want, edit the share name of the printer. You'll use this name to connect to the printer from a secondary PC.



Connect the shared printer to another PC

There are two ways to connect a shared printer to another PC: using Settings or Control Panel.

1. Select the **Start** button, then select **Settings > Devices > Printers & scanners**.
2. Under **Add printers & scanners**, select **Add a printer or scanner**.
3. Choose the printer you want, and then select **Add Device**.



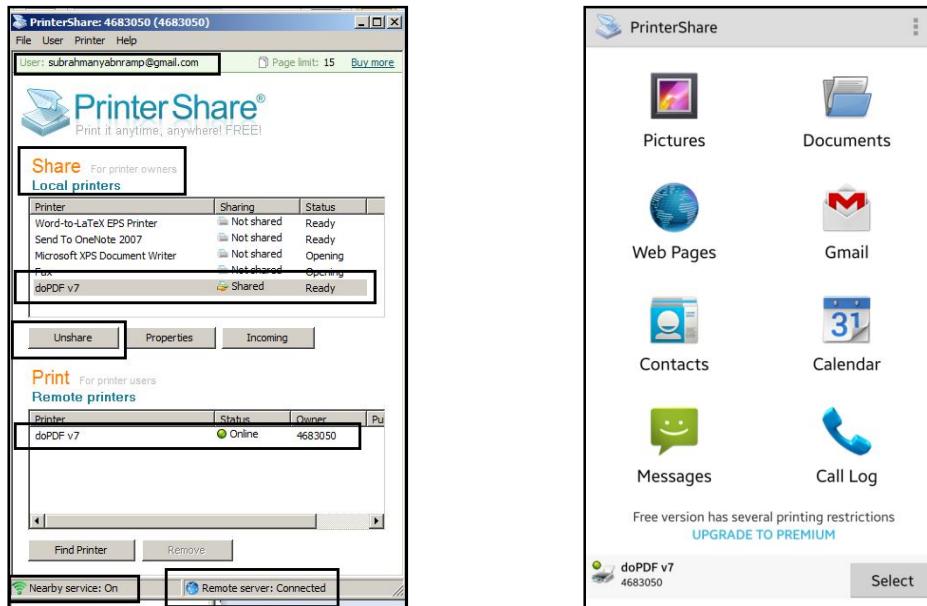
4. If you don't see the printer you want, select **The printer that I want isn't listed**.
5. In the Add printer dialog box, select **Select a shared printer by name**, and then enter the computer or device name of the primary PC and the share name of the printer using one of these formats:
 - o **\computername\printername**
6. When prompted to install the printer driver, select **Next** to complete the installation.

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Installing Cloud Printer:

- Download PrinterShare Software (full Version) from
<http://download.printershare.com/files/PrinterShare2308.exe>
- Install PrinterShare in Personal Computer (Windows OS)
- Launch the PriterShare Software at the end of Installation
- Login to PrinterShare Software with valid Gmail Account by Clicking icon at Taskbar (or Search for PrinterShare Console) at TaskBar. Provide password of your own choice.
- Select the Printer which is to be shared (From Share **Local Printer** Lists)
- Click **Share** (Which will appear in Remote Printers List after Success)

- Download and Install "PrinterShare" Software Application in Mobile (Another Device) using Google Play Store.
- In Mobile, Login PrinterShare App with Username and Password (Which is available in message sent to gmail account, in case of Forgot Password)
- Select the File to be printed remotely From Mobile Gallery and Click on Print, Select the Shared Printer Name which is Shared in Personal Computer.
- And Click Print.
- Go to Personal Computer, the New Printing job is now available at Personal Computer PrinterShare Application and automatically Prints the file which is sent remotely (through Mobile).



PrinterShare Software GUI at Desktop and Android Mobile.

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Power Supply

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Inside a computer, a PSU is the device that converts alternate electricity (the electricity from your outlet, normally 220V) to direct current to the components inside the case. Looking from the outside, it's the three-prong plug that plugs into your socket. Laptops' are much the same, except they're external: A block and cord that attaches to the back and plugs into the wall.



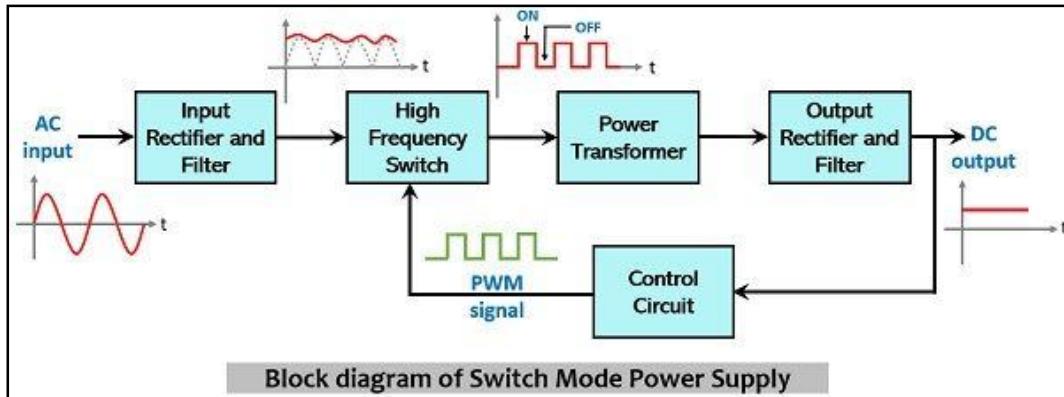
Every power supply is different. Some (typically for laptops) may have a low output of 65 watts, while others might output 1,000 watts or more. Some may only have 10 amps, while others output 65 amps.

Computer power supplies (PSU) convert AC to low-voltage regulated DC power. Most modern desktop computers conform to the ATX standard, which supplies three positive rails: +3.3V, +5V and +12V.

Wires coming out of an ATX PSU are color-coded as follows:

- Yellow: +12V
- Red: +5V
- Orange: +3.3V
- Black: Ground
- Purple: 5V SB (standby voltage)
- Green: /PS_ON (it can be shorted to ground to start PSU)
- Grey: PWR_OK (status signal generated by PSU to indicate voltages are OK)
- White: -5V (optional on newer ATX-2 PSUs)
- Blue: -12V

Working of Switch Mode Power Supply



Initially, the unregulated AC input signal from the source is provided to the input rectifier and filter circuit. Here the ac input signal is rectified to generate a DC signal and further smoothed to remove high-frequency noise component from it. The DC output (still in unregulated form) is fed to the power transistor that acts as a high-frequency switch.

According to the switching action of the power transistor (**High Frequency Switch**) DC voltage will be obtained at its output side. **The chopping frequency plays a crucial role in maintaining the desired DC voltage level.**

The obtained DC signal at the output of the chopper circuit is then fed to the primary winding of the high-frequency **power transformer**. Here the **step-down transformer** converts the high voltage signal into a **low voltage** level which is further provided as input to the **output rectifier and filter** unit. This simply filters out the unwanted residuals from the signal in order to provide a regulated DC signal as the output.

The **control circuitry** present here acts as the **feedback circuit** for the complete unit. This involves a **comparator** along with a **pulse width modulator** (PWM). The DC output from the rectifier and filter is fed to the control circuit where the **error amplifier** which acts as a **comparator**, compares the obtained DC voltage with the **reference value**.

If the DC output is greater than the reference value then the chopping frequency is to be decreased. The decrease in chopping frequency will reduce the output power and so the dc output voltage. However, if the DC output is less than the reference value then the chopping frequency is increased. When chopping frequency is raised then the DC output voltage will get increased.

Applications of SMPS found in various power amplifiers, personal computers, security and railway systems, television sets, motor drives, etc.

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- **+5 Volts:** This voltage is **used to drive motors** present in drives of form factors 2.5 inch and 3.5 inches. Also a 5 Volts green wiring is used to connect the power button to the rest of the circuitry.
- **+12 Volts:** This voltage is **used by the cooling systems and cooling fans** of the computer. Also, this supply may be used to drive motors which can't run on a +5V DC Supply.
- **-12 Volts:** This voltage is **used in the ISA bus slots**. Now mostly the work which was carried out earlier by a -12 volts supply, is being taken care of by the +/- 5 Volt supply.
- **+ 3.3 Volts:** The +3.3 Volts orange line is the most basic supply line. Most of the **CPUs and RAM use 3.3 volts**. The PCI Bus is powered with this supply voltage and hence any components attached to it use this voltage line. In addition, a 3.3 Volts line powers up the motherboard and is used to compensate any line losses since every device needs a constant supply voltage.
- The Power-Good signal prevents the computer from attempting to operate on improper voltages and damaging itself.

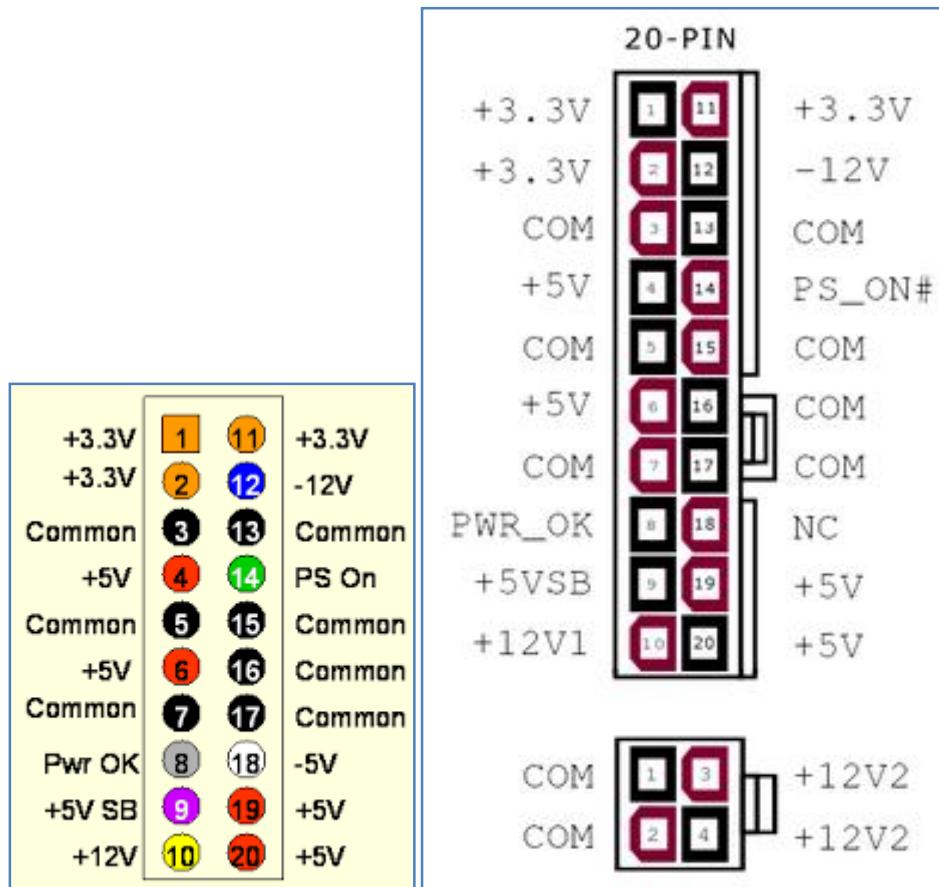
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Experiment Conducted on SMPS Voltage Checking:

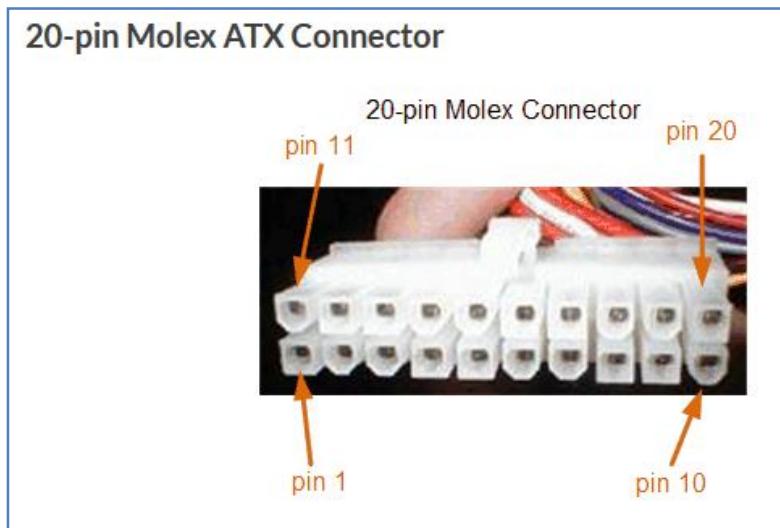
| Wire Color with Theoretical Voltage Value | Voltage Reading in Lab |
|--|------------------------|
| • Yellow: +12V | |
| • Red: +5V | |
| • Orange: +3.3V | |
| • Black: Ground | |
| • Purple: 5V SB (standby voltage) | |
| • Green: /PS_ON (it can be shorted to ground to start PSU) | |
| • Grey: PWR_OK (status signal generated by PSU to indicate voltages are OK) – Power Good Signal | |
| • White: -5V (optional on newer ATX-2 PSUs) | |
| • Blue: -12V | |

Department of Computer Science

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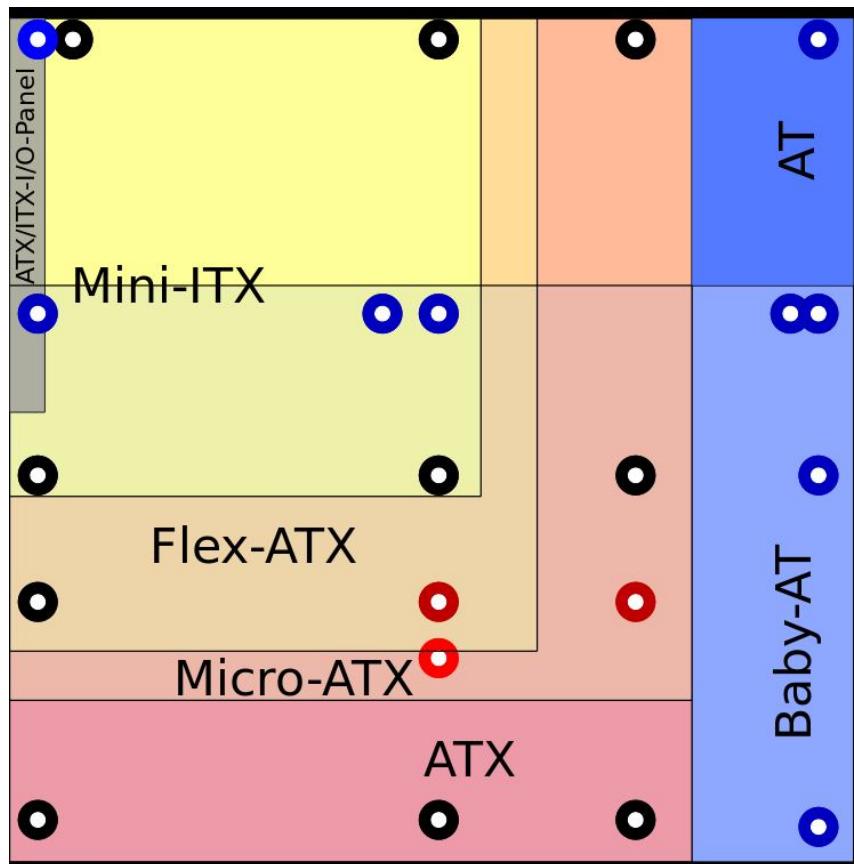
ATX (Advanced Technology eXtended) Power Supply



ATX (Advanced Technology eXtended) is a motherboard and power supply configuration specification developed by Intel

ATX is the most common motherboard design.^[1] Other standards for smaller boards (including microATX, FlexATX, nano-ITX, and mini-ITX)

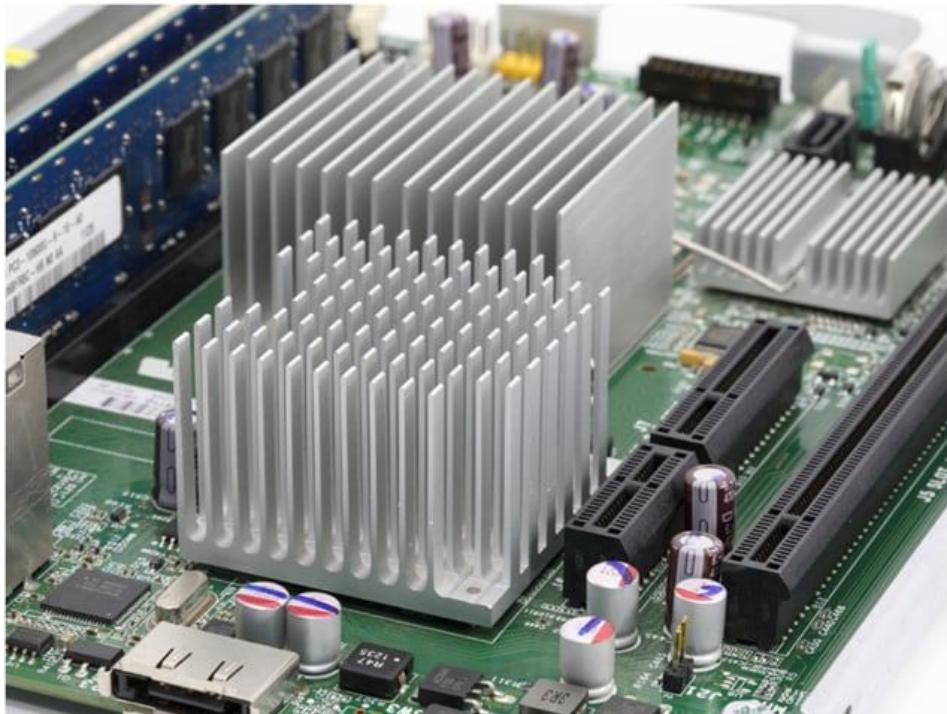
Dimensions of a full-size ATX board are 12×9.6 in (305×244 mm), which allows many ATX chassis to accept microATX boards.



Heat Sink

A heat sink is a component that increases the heat flow away from a hot device. It accomplishes this task by increasing the device's working surface area and the amount of low-temperature fluid that moves across its enlarged surface area. Based on each device's configuration, we find a multitude of heat sink aesthetics, design, and ultimate capabilities.

A heat sink works by moving heat away from a critical component.



Active Heat Sinks and Passive Heat Sinks

Heat sinks are most commonly utilized in Active, Passive or hybrid configurations.

- Passive heat sinks

- rely on natural convection, meaning the buoyancy of hot air alone causes the airflow generated across the heat sink system.
- These systems are advantageous as they do not require secondary power or control systems to remove heat from the system.
- passive heat sinks are less effective at transferring heat from a system than active heat sinks.

- Active heat sinks

utilize forced air to increase fluid flow across the hot area.

Forced air is most commonly generated by a fan, blower, or even movement of the entire object

One example of a fan producing forced air across a heat sink is the fan in your personal computer turning on after your computer gets warm.

- **Hybrid heat sinks** combine some aspects of passive and active heat sinks. These configurations are less common

How to test your PSU to see if it is dead or alive

Testing for a faulty power supply is a process of elimination. The process isn't exhaustive, but should give you a good idea of whether your PSU is working properly or not.

If you have performed software troubleshooting and think the issue may be hardware, follow these steps. Retest after each step.

1. Make sure any external switch on the rear of the power supply hasn't accidentally been turned off.
2. Check the power cable is secure in the wall socket and rear of the computer.
3. Try a different power cable and wall socket to make sure neither is dead.
4. Check all internal connections inside your PC, especially power connectors to peripherals.
5. Remove all peripherals and hardware from your computer except your boot drive and graphics card if you don't have onboard graphics. If your CPU does have built-in graphics, remove the graphics card also.

Symptoms of a Failing Power Supply

- System failures during the boot-up process.
- The PC doesn't power on at all
- Spontaneous restarts or lockouts when trying to use the machine
- Case fans and hard drives that do not spin
- An overheating system due to heatsink and fan failure
- Errors related to system memory
- Recurring Blue Screen of Death (BSOD)



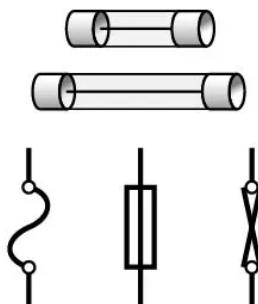
==== * ===

Active and Passive Components on Motherboard:

As a computer professional, you should be familiar with the more common types of electronic components within a power supply.

Fuse

Before the advent of the circuit breaker, fuses were common in the home and office. A fuse serves one purpose-to fail-and thus cut the flow of power in the event of a current load that has exceeded the safe capacity of the system components to absorb.

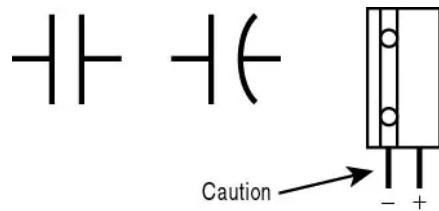


Capacitors

A capacitor is an electrical component used to hold an electrical charge.

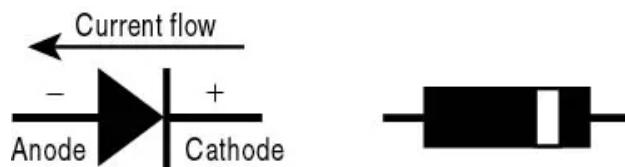
In PCs, they are often used to regulate the flow of current to areas of the system circuits for a short period of time. Some are fixed-capacity models, whereas others can absorb or hold variable

amounts of power. The amount of electrical current a capacitor can control is called capacitance, measured in microfarads



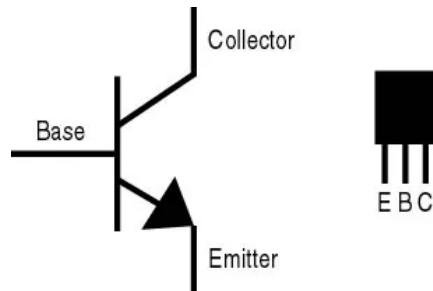
Rectifiers and Diodes

Rectifiers are devices that convert AC power into a DC form (rectification). A diode is a device that lets current flow in only one direction (see Figure 13.12). Two or more diodes connected to an AC supply will convert the AC voltage to DC voltage.



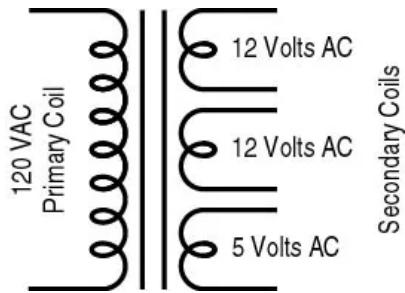
Transistors

Transistors are basically a pair of diodes connected in series with an "on-off" switch. Varying the voltage sent to a transistor turns the switch on or off.



Transformers

The most common forms of electrical transformers are step-down or step-up devices. A step-down transformer decreases the transformer's voltage on the output side; a step-up model increases it.



Inductors (Coils)

Inductors, commonly called coils because of their shape, are loops of conductive wire (see Figure 13.16). Current passing through the inductor sets up a magnetic field. This field reduces any rapid change in current intensity. Inductors can also be used to distinguish between rapidly and slowly changing signals in a circuit.



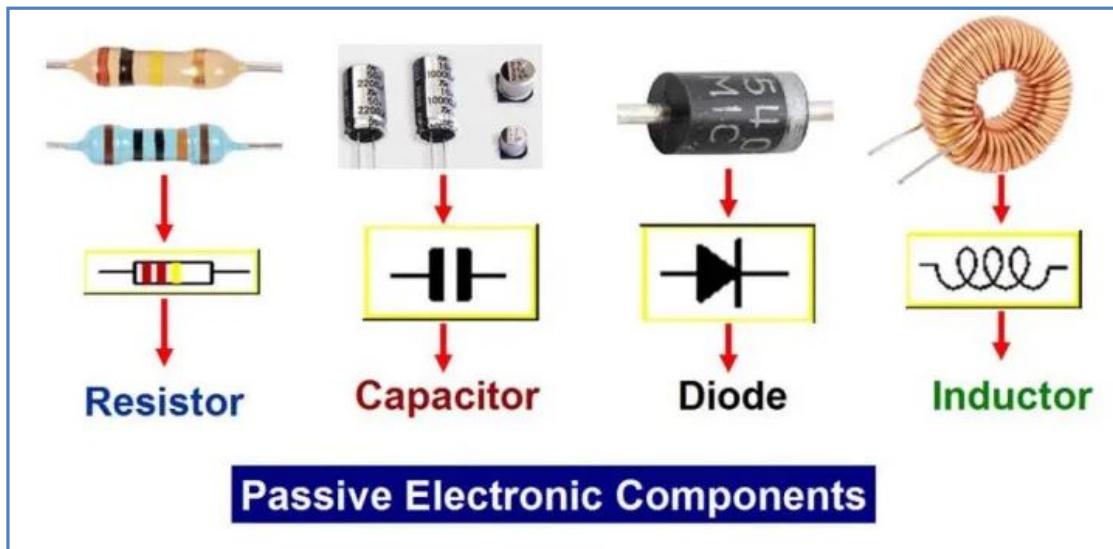
Types of Electronic Components

These are of 2 types: Passive and Active Components. Both these types of components can be either Through-Hole or SMD.

1. Passive Components

These components are those that do not have gain or directionality. They are also called Electrical elements or electrical components.

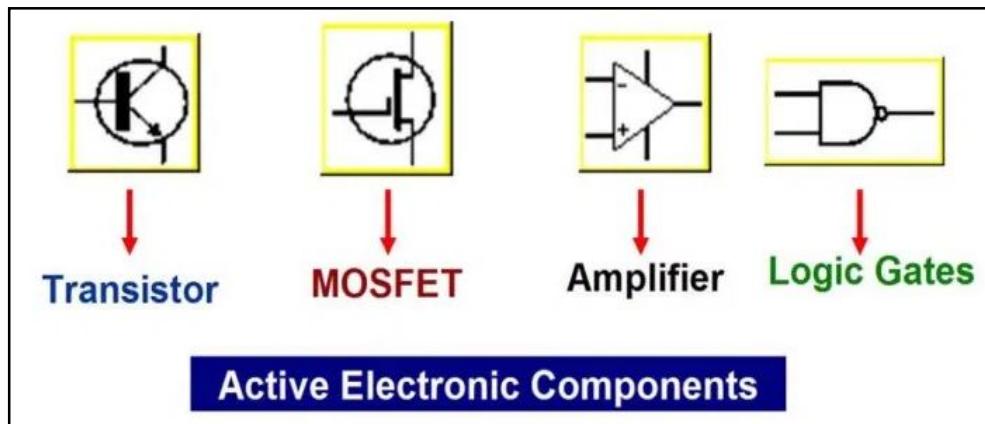
Example: Resistors, Capacitors, Diodes, Inductors.



2. Active Components

These components are those that have gain or directionality.

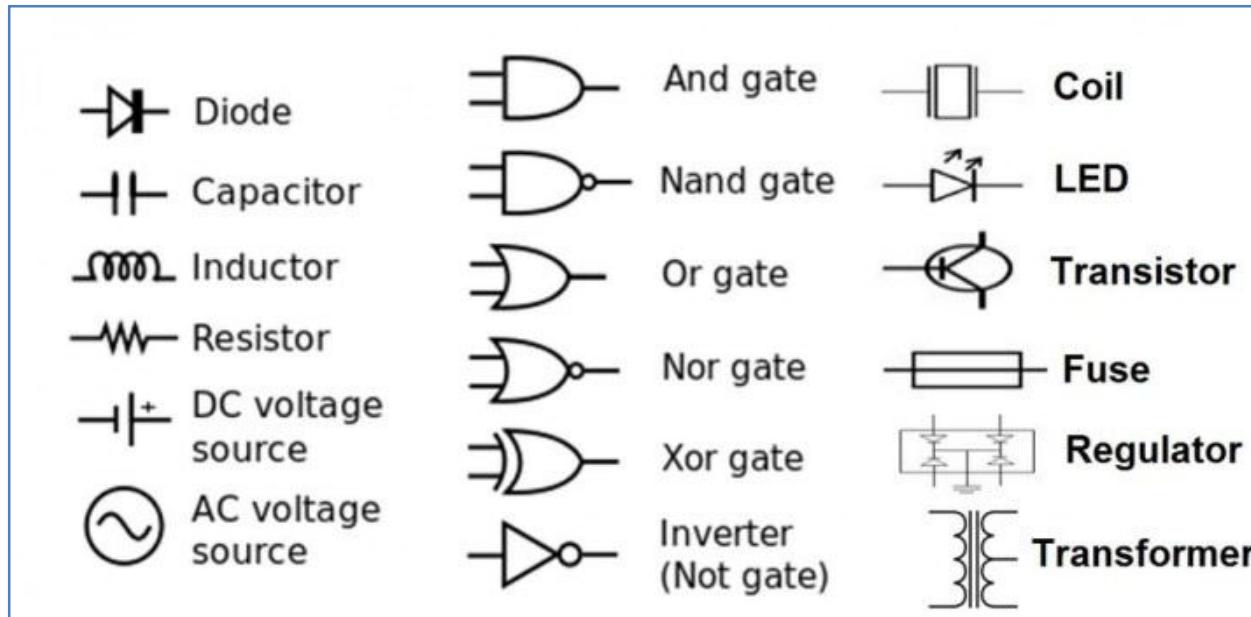
Example: Transistors, Integrated Circuits or ICs, Logic Gates.



Function of Basic Electronic Components

1. **Terminals and Connectors:** Components to make electrical connection.
2. **Resistors:** Components used to resist current.
3. **Switches:** Components that may be made to either conduct (closed) or not (open).
4. **Capacitors:** Components that store electrical charge in an electrical field.
5. **Magnetic or Inductive Components:** These are Electrical components that use magnetism.
6. **Network Components:** Components that use more than 1 type of Passive Component.
7. **Piezoelectric devices, crystals, resonators:** Passive components that use piezoelectric effect.
8. **Semiconductors:** Electronic control parts with no moving parts.
9. **Diodes:** Components that conduct electricity in only one direction.
10. **Transistors:** A semiconductor device capable of amplification.
11. **Integrated Circuits or ICs:** A microelectronic computer circuit incorporated into a chip or semiconductor; a whole system rather than a single component.

Circuit Symbols of Electronic Components



| Components | Output Values Measured Or Status of the Device Observed | Components | Output Values Measured Or Status of the Device Observed |
|------------|---|------------|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

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Motherboard:

The motherboard is generally a thin circuit board that holds together almost all parts of a computer except input and output devices. All crucial hardware like CPU, memory, hard drive,

and ports for input and output devices are located on the motherboard. It is the biggest circuit board in a computer chassis.

It allocates power to all hardware located on it and enables them to communicate with each other. It is meant to hold the computer's microprocessor chip and let other components connect to it. Each component that runs the computer or improves its performance is a part of the motherboard or connected to it through a slot or port.

There can be different types of motherboards based on the type and size of the computers. So, a specific motherboard can work only with specific types of processors and memory.

Components of a Motherboard:

- **CPU Slot:** It is provided to install the CPU. It is a link between a microprocessor and a motherboard. It facilitates the use of CPU and prevents the damage when it is installed or removed. Furthermore, it is provided with a lock to prevent CPU movement and a heat sink to dissipate the extra heat.
- **RAM Slot:** It is a memory slot or socket provided in the motherboard to insert or install the RAM (Random Access Memory). There can be two or more memory slots in a computer.
- **Expansion Slot:** It is also called the bus slot or expansion port. It is a connection or port on the motherboard, which provides an installation point to connect a hardware expansion card, for example, you can purchase a video expansion card and install it into the expansion slot and then can install a new video card in the computer. Some of the common expansion slots in a computer are AGP, AMR, CNR, PCI, etc.
- **Capacitor:** It is made of two conductive plates, and a thin insulator sandwiched between them. These parts are wrapped in a plastic container.
- **Inductor (Coil):** It is an electromagnetic coil made of a conducting wire wrapped around an iron core. It acts as an inductor or electromagnet to store magnetic energy.
- **Northbridge:** It is an integrated circuit that allows communications between the CPU interface, AGP, and memory. Furthermore, it also allows the southbridge chip to communicate with the RAM, CPU, and graphics controller.
- **USB Port:** It allows you to connect hardware devices like mouse, keyboard to your computer.
- **PCI Slot:** It stands for Peripheral Component Interconnect slot. It allows you to connect the PCI devices like modems, network hardware, sound, and video cards.

- **AGP Slot:** It stands for Accelerated Graphics Port. It provides the slot to connect graphics cards.
- **Heat Sink:** It absorbs and disperses the heat generated in the computer processor.
- **Power Connector:** It is designed to supply power to the motherboard.
- **CMOS battery:** It stands for complementary metal-oxide-semiconductor. It is a memory that stores the BIOS settings such as time, date, and hardware settings.

Motherboard form factors

A motherboard form factor is a specification for its general shape and size. It helps to prevent incompatibilities between many hardware manufactures. It also determines the types of power supply, supported case, the physical layout and organization of the board, and the placement of mounting holes. Furthermore, if you construct your own computer system, a form factor is much important as it specifies the correct case and components of the computer system. Nowadays, ATX is the most common form factor for desktop computers. There are different types of form factors of the motherboard, which are as follows:

1. **AT & Baby AT:** The size of AT is 12" wide x 13.8" deep, which is rarely used, and its replaced by ATX and Baby AT.

Baby AT motherboard was introduced by IBM that is a replacement for the AT motherboard, which is also known as BAT. The width of Baby AT is 8.57" and 13.04" deep, which is more similar to the original IBM XT motherboard. It was mainly designed for peripheral devices such as a keyboard and mouse.

2. **ATX:** It stands for **Advanced Technology eXtended**, which was first released by Intel. The size of Standard ATX or Full-ATX is 12" wide x 9.6" deep. There were some improvements in the ATX form factor as well as a single 20-pin connector for power supply, less overlap between the drive bays and motherboard, and integrated I/O Port connectors soldered directly onto the motherboard.

3. **BTX (Balanced Technology Extended):** The BTX includes features such as a more efficient layout to facilitate cooling, low profile, support for high-mass motherboard components, and a scalable board to accommodate several system sizes. BTX was developed to offer advantages like PCI Express, ATA, and USB 2.0. Furthermore, it uses in-line airflow and allows to switch the places of memory slots and expansion slots. Its main components, such as chipset, graphics controller, and processor,

use the same airflow, which decrease the required fans in the system; that's why unnecessary noise reduces. The industry considers the ATX form factor in terms of standard, although legacy AT systems are mainly still used today. The BTX form factor is incompatible with the design of ATX. Thus, it is not a standard for the industry.

4. **DTX:** In telecommunications, it stands for **discontinuous transmission**. It is a method that is used to improve the efficiency of two-way wireless voice communication.

In the computer, it is a form factor for motherboards, which is a variation of ATX specification. It was designed for small form factor computers such as home theater PCs with dimensions of 8×9.6 inches. It is an open standard declared by AMD and is lower compatible with ATX form factor cases. Furthermore, the Mini-DTX, a smaller version, was also developed that had 8.0-inches by 6.7-inches dimensions. It uses fewer layers of printed circuit board wiring through which it offers a lower cost of manufacturing.

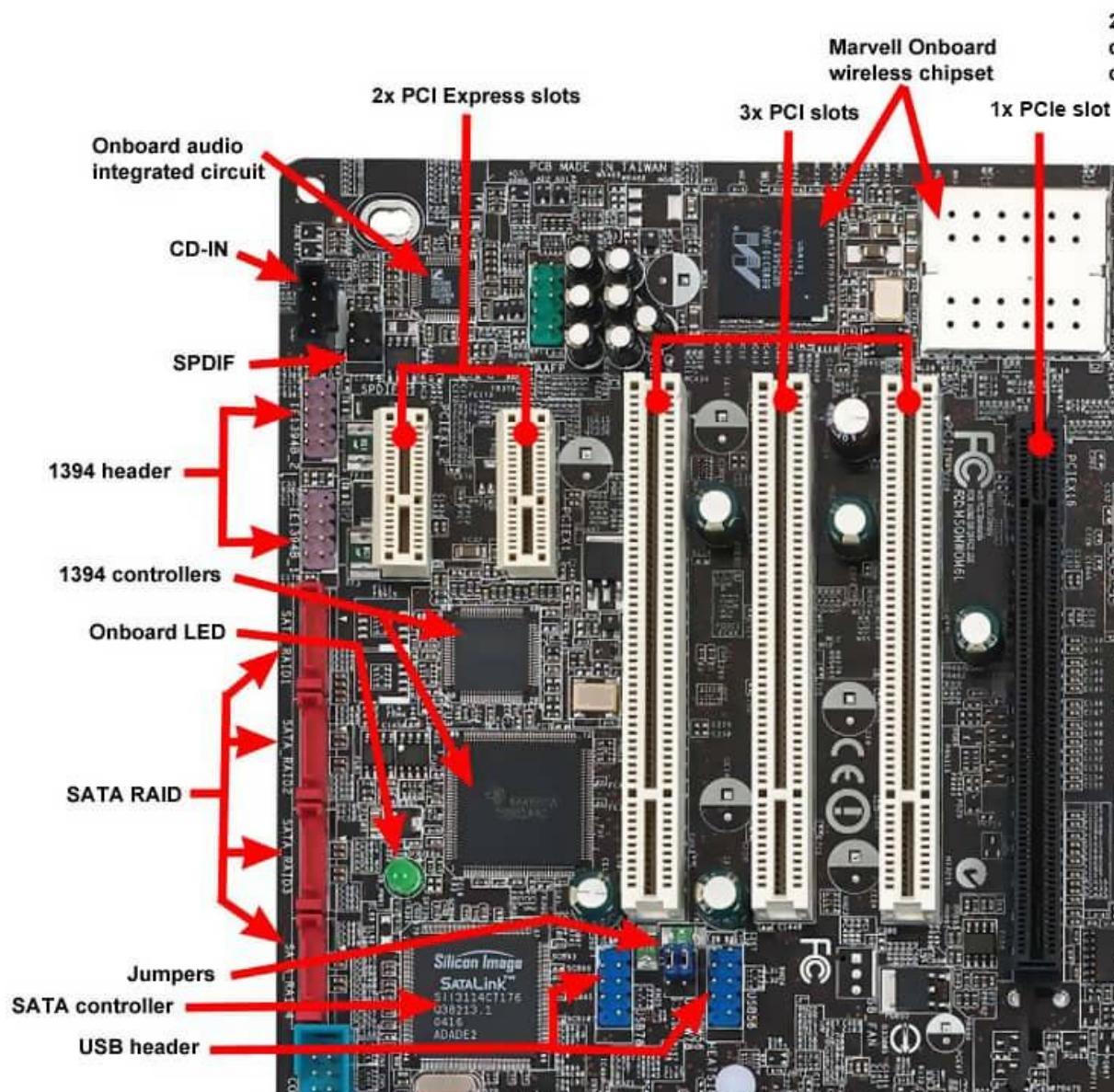
5. **LPX (Low Profile eXtension):** The size of an LPX motherboard is 9" wide and 13" deep. As compared to other motherboards, it has several placements of the video, serial, parallel, and PS/2 ports. It is known as low profile as it contains a big slot for a riser card that gives the permission to the expansion cards to be installed parallel to the motherboard. The computers using low profile motherboards are much slimmer as compared to use a Baby-AT motherboard computer.
6. **microATX:** It is a smaller motherboard that is designed by following the ATX form factor, having the same benefits. But it improved the overall design cost by reducing the physical size of the motherboard. Intel developed the first mATX motherboard. The size of mATX is 9.6" wide x 9.6" deep, which can be reduced to size as 6.75" wide x 6.75" deep. It provides more I/O space at the rear, and with the help of integrated Input/Output, connectors help to reduce the emissions.
7. **NLX:** It is based on the boards, stands for **New Low Profile Extended**. These motherboards can be removed easily, and it was developed to replace the nonstandard LPX design. The size of the NLX motherboard is 9" wide x 13.6" deep maximum to 8" x 10" deep minimum. It includes various features such as provide support for AGP, DIMM, USB, Pentium II, larger memory modules, lower cases, and can reduce cable length. Additionally, it is an actual standard (unlike NLX form factor) that has more component options for repairing and upgrading.

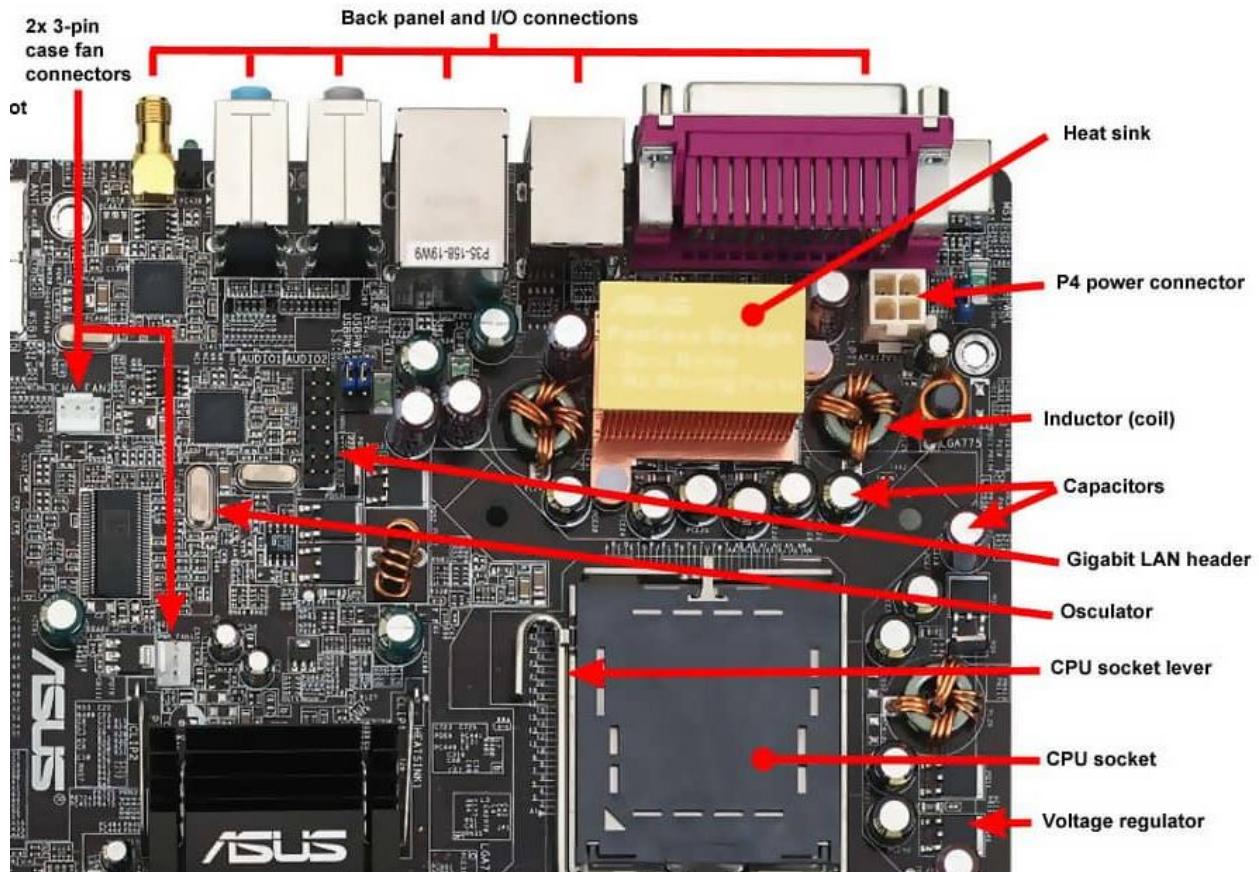
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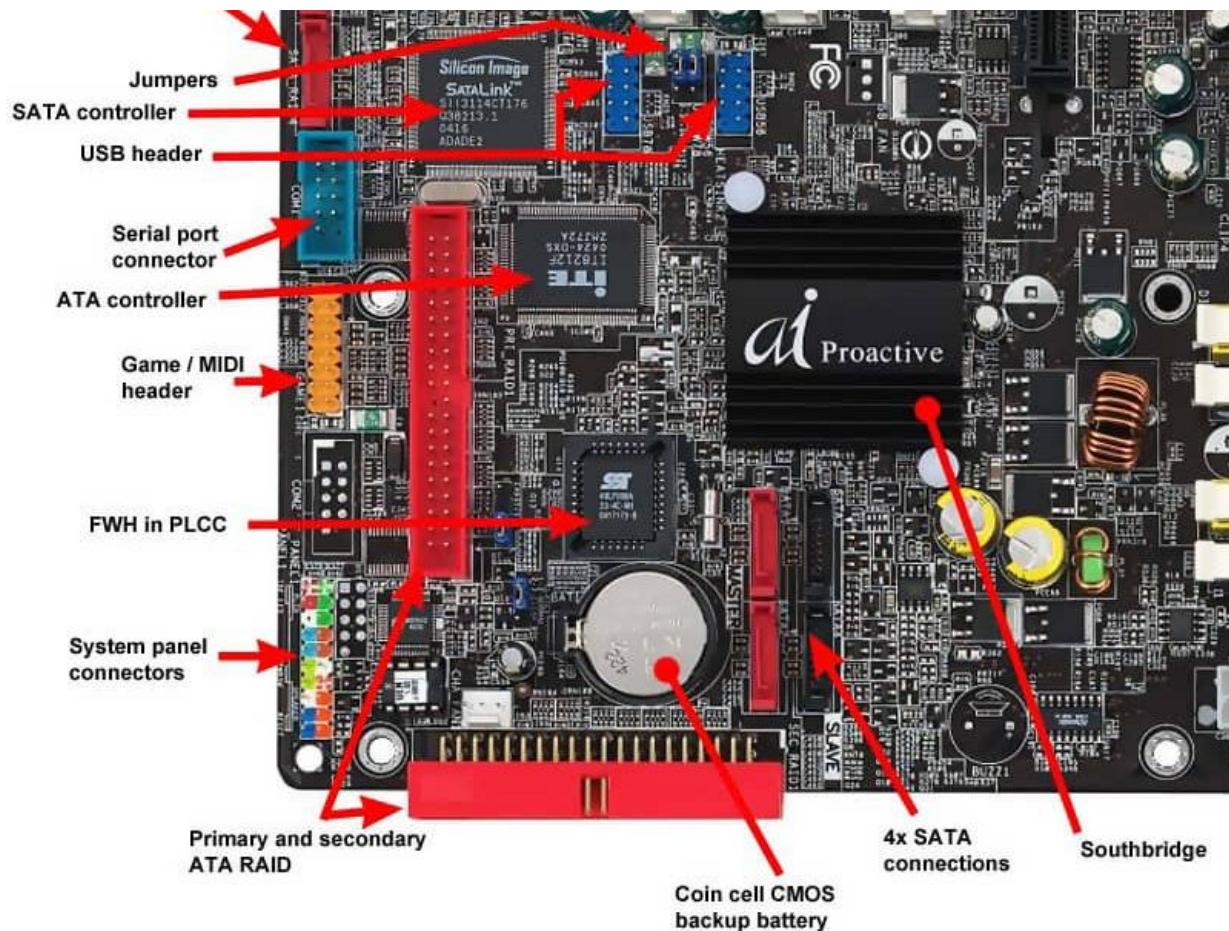
Mother Board Example: **ASUS P5AD2-E motherboard LGA 775 (Socket T) ATX**

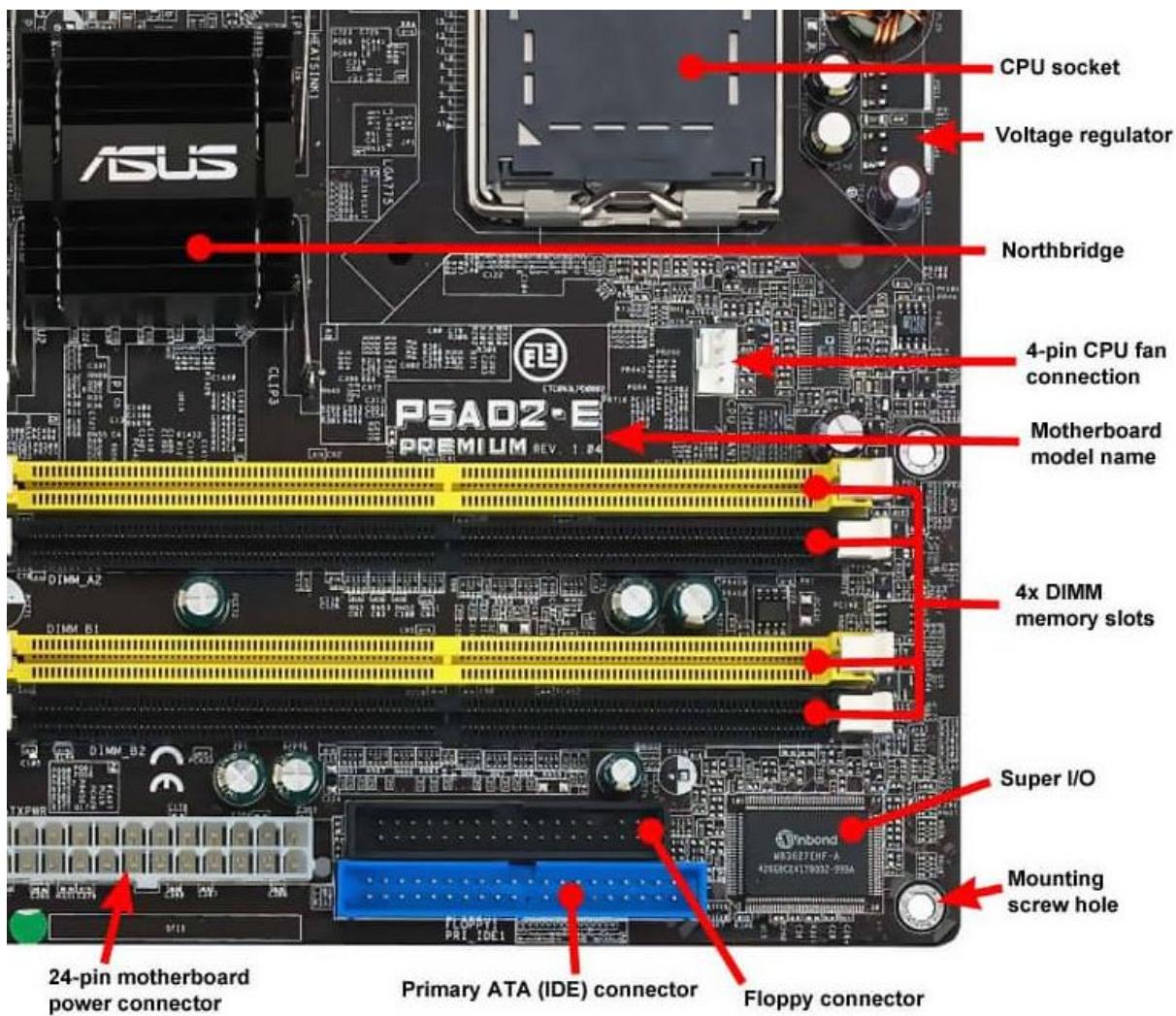
| Processor | |
|-----------------------------------|--------------------|
| Processor manufacturer * | Intel |
| Processor socket * | LGA 775 (Socket T) |
| Memory | |
| Number of memory slots * | 4 |
| Maximum internal memory * | 4 GB |
| Internal I/O | |
| USB 2.0 connectors * | 4 |
| Number of SATA connectors | 4 |
| Number of Parallel ATA connectors | 1 |
| S/PDIF out connector | ✓ |
| Front panel audio connector | ✓ |
| CD/AUX audio in | ✓ |
| ATX Power connector (24-pin) | ✓ |
| CPU fan connector | ✓ |
| Number of chassis fan connectors | 2 |
| Chassis intrusion connector | ✓ |
| Number of COM connectors | 1 |
| Rear panel I/O ports | |
| USB 2.0 ports quantity * | 4 |

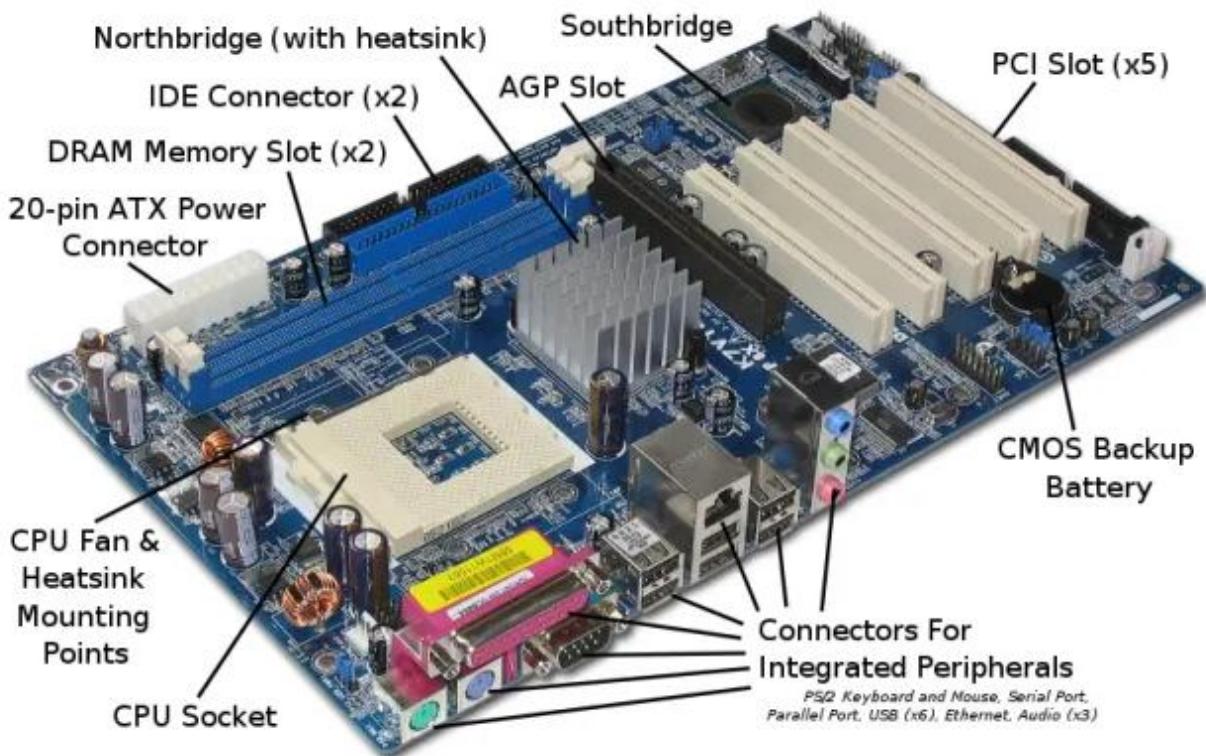
| Rear panel I/O ports | |
|--------------------------------|--|
| Ethernet LAN (RJ-45) ports * | 2 |
| PS/2 ports quantity | 2 |
| Headphone outputs | 1 |
| Microphone in | ✓ |
| S/PDIF out port | ✓ |
| Parallel ports quantity | 1 |
| Serial ports quantity | 1 |
| Network | |
| Networking features | Marvell PCIe 88E8053 Gigabit LAN |
| Features | |
| Motherboard form factor * | ATX |
| Power source type | ATX |
| Expansion slots | |
| Expansion slots | 1 x PCI Express x16 2 x PCI Express x1 3 x PCI |
| Weight & dimensions | |
| Width | 305 mm |
| Depth | 245 mm |
| Other features | |
| Audio output | C-Media High Definition Audio 8-ch CODEC |
| GAME/MIDI connector | ✓ |











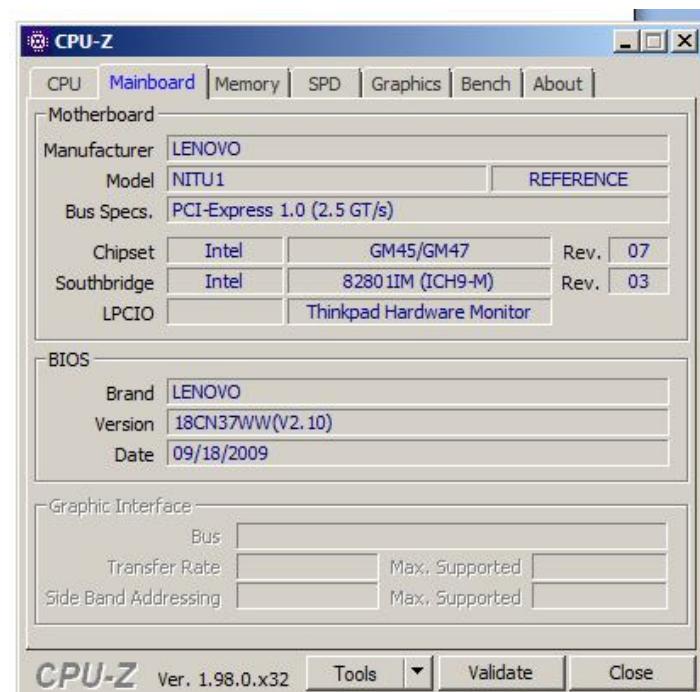
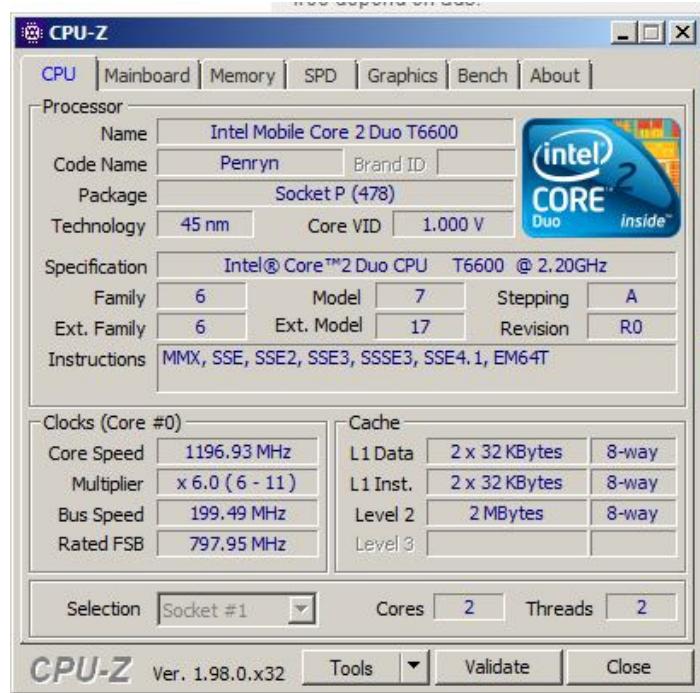
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CPID CPU-Z Tool

The CPU-Z utility displays detailed information about the memory modules installed in a computer using a feature called Serial Presence Detect. The "SPD" tab in CPU-Z displays this information, helping you learn more about the computer's configuration and confirm that memory module makes and models are as expected.

Information Displayed in CPU-Z

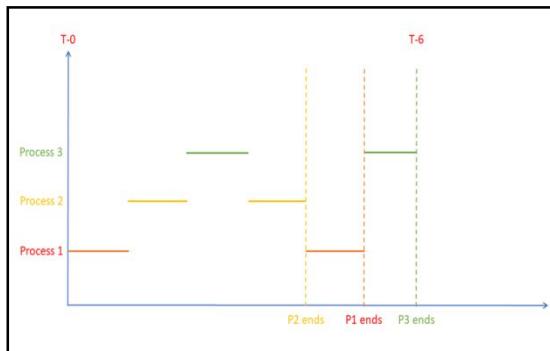
- Size, Maximum Speed, Manufacturer, Model Number and Production Date of each memory module in the computer.
- CPU-Z detects whether a module is Registered, Buffered or Error-Correcting.
- CPU-Z displays the Latency Timings that a memory module is compatible with at all supported speeds.
- CPU-Z displays an overview of the Hardware Installed in a computer.
- CPU-Z displays the Brand, Model and Speed of the Processor, the Manufacturer, Model and Chipset of the Motherboard and the Manufacturer and Model of the Video Adapter.



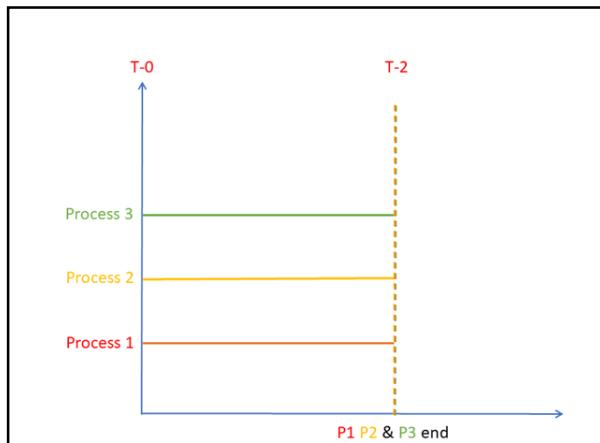
| Output Observed in CPU-Z Tool for CPU | |
|--|--|
| Processor Name | |
| Core Speed | |
| Number of Cores | |
| Bus Speed | |
| Cache L1 Data | |
| Cache L1 Inst. | |
| Level-2 Cache | |
| | |

Few Terms Found in CPU-Z Report:

- **Concurrency or Single Core:** In Operating Systems, concurrency is defined as the ability of a system to run two or more programs in overlapping time phases.



- **Parallel Execution or (Multi-Core):** In parallel execution, the tasks to be performed by a process are broken down into sub-parts, and multiple CPUs (or multiple cores) process each sub-task at precisely the same time.



- **Thread:**
 - A thread is a unit of execution on concurrent programming. Multithreading is a technique which allows a CPU to execute many tasks of one process at the same time.
- **CPU Core:**
 - A CPU core is the part of something central to its existence or character. In the same way in the computer system, the CPU is also referred to as the core.
 - The number of threads you have depends on the number of cores in your CPU. Each CPU core can have two threads. So a processor with two cores will have four threads. A processor with eight cores will have 16 threads.
- **MMX:** The MMX instructions enable **x86 processors to perform single-instruction**, multiple-data(SIMD) operations on packed byte, word, doubleword, or quadword integer operands contained in memory, in MMX registers, or in general-purpose registers.
- **Streaming SIMD Extensions (SSE).** Older processors only process a single data element per instruction. SSE enables the **instruction to handle multiple data elements**.
- A **cache** is a reserved storage location that collects temporary data to help websites, browsers, and apps load faster.
- Recently used Instructions or upcoming instructions will be made available in **Instruction Cache**
- Recently used Data or upcoming data will be made available in **Data Cache**

- **VID/FID** – Voltage Identification / Frequency Identification
- The **Unified Extensible Firmware Interface (UEFI)** is a publicly available specification that defines a software interface between an operating system and platform firmware.
- The **RAS to CAS** delay determines the time between memory accessing RAS (Row Address Strobe) and CAS (Column Address Strobe). The lower the number, the better
- **Serial Presence Detect (SPD)** is a standardized way to automatically access information about a memory module.
- **EHCI PCI:** The **Enhanced Host Controller Interface (EHCI)** is a register-level interface that enables a host controller for USB or FireWire hardware to communicate with a host controller driver in software.
- **eXtensible Host Controller Interface (xHCI)** is a computer interface specification that defines a register-level description of a host controller for Universal Serial Bus (USB), which is capable of interfacing with USB 1.x, 2.0, and 3.x compatible devices.
- **Universal Host Controller Interface (UHCI)** was created by Intel as an implementation of the USB 1.0 host controller interface. The UHCI specification defines a set of I/O mapped registers that allow communication between the controller and the operating system.
- **High Definition Audio (HDA):** *High Definition Audio Specification* includes architecture, register and electrical interface, programming model, link protocol, and codec features.
- The **DMI** (Desktop Management Interface) is **an abstraction layer provided by your system management BIOS** that provides information about your computer's hardware to your operating system.
- **Desktop Management Interface (DMI)** is an industry framework for managing and keeping track of hardware and software components in a system of personal computers from a central location.

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Windows Resource Monitor:

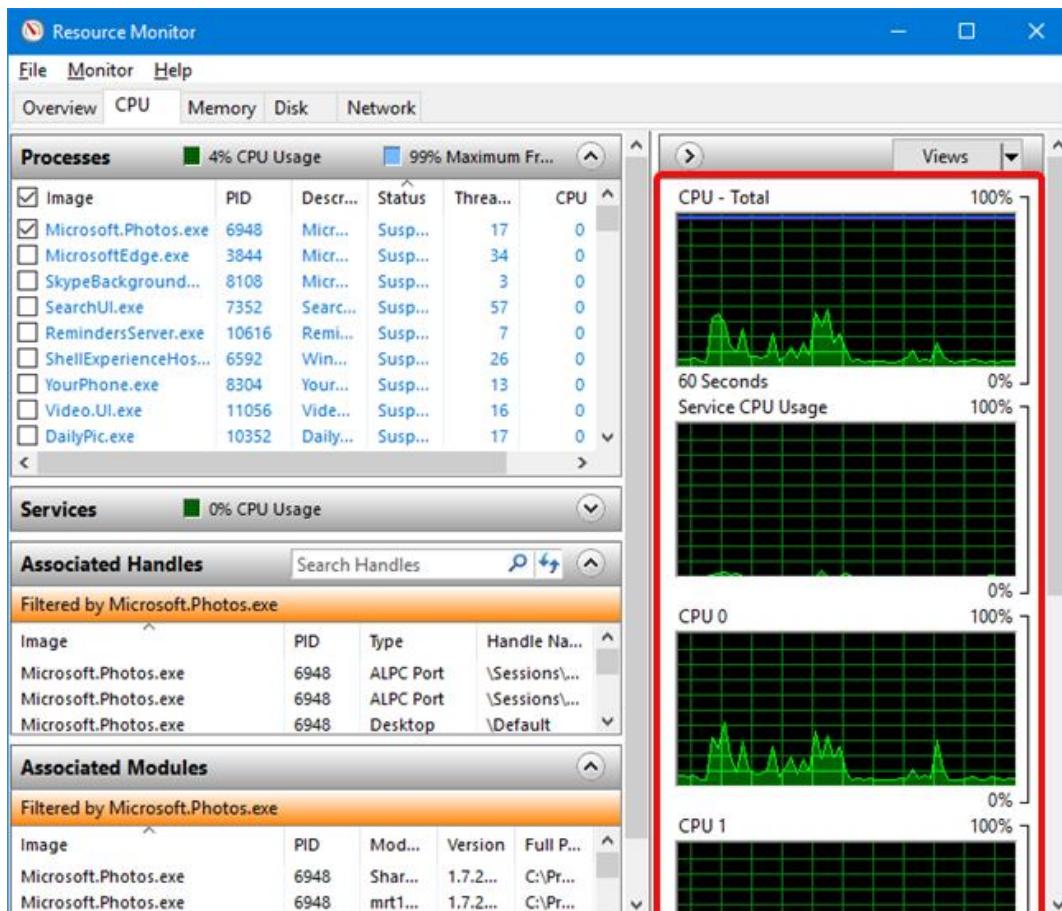
- When Windows slows down or freezes, we usually turn to the Task Manager to figure out what is going on. If you need a better understanding of the way Windows and its apps use

the resources of your computer, **Resource Monitor** (resmon.exe) is the right tool for the task.

- The information is concise and real-time with graphs and grouping by resources.
- You can monitor the use of the CPU, memory, disk, and network. This tutorial shows what you need to know about Resource Monitor and how to use it:

How to start the Resource Monitor in Windows

- An easy way to start Resource Monitor that works in all Windows versions is to search for the name of its executable file **resmon** or for Resource Monitor, and click or tap the search result with the same name.



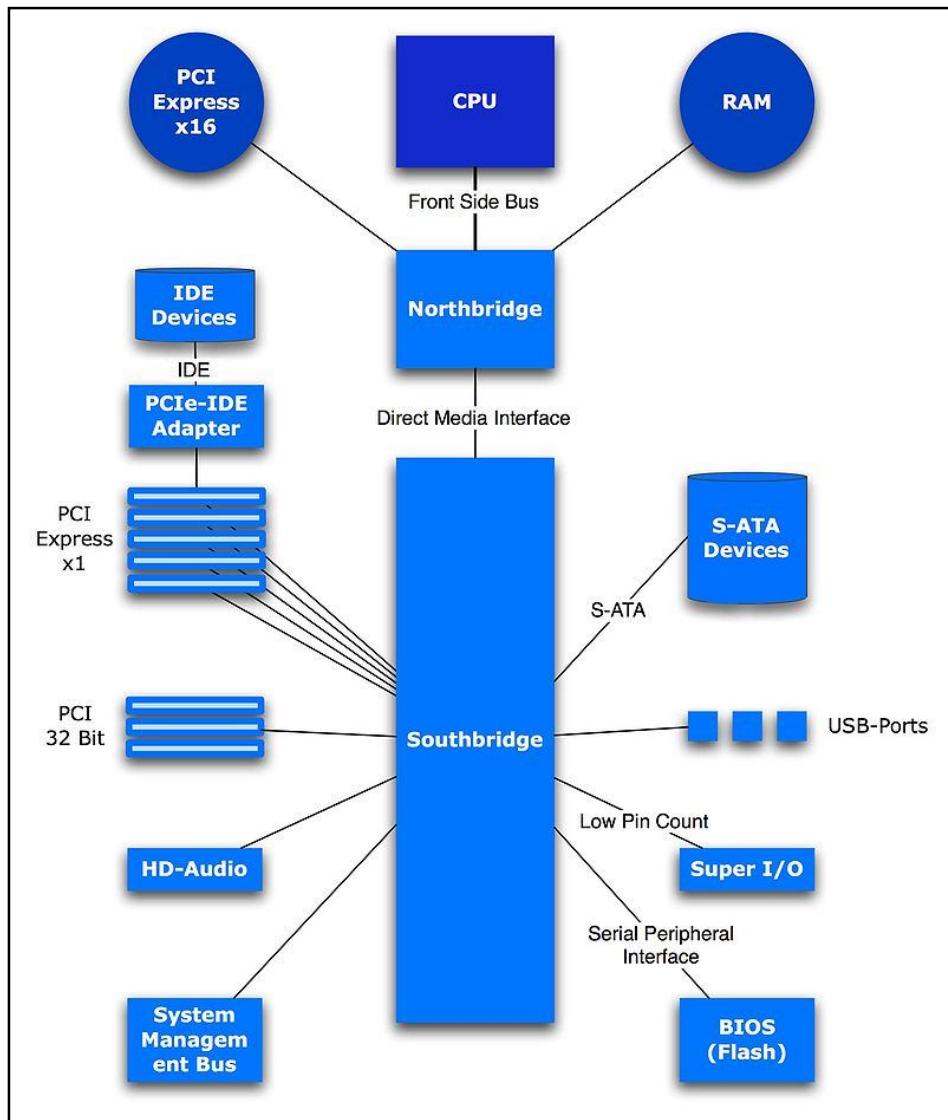
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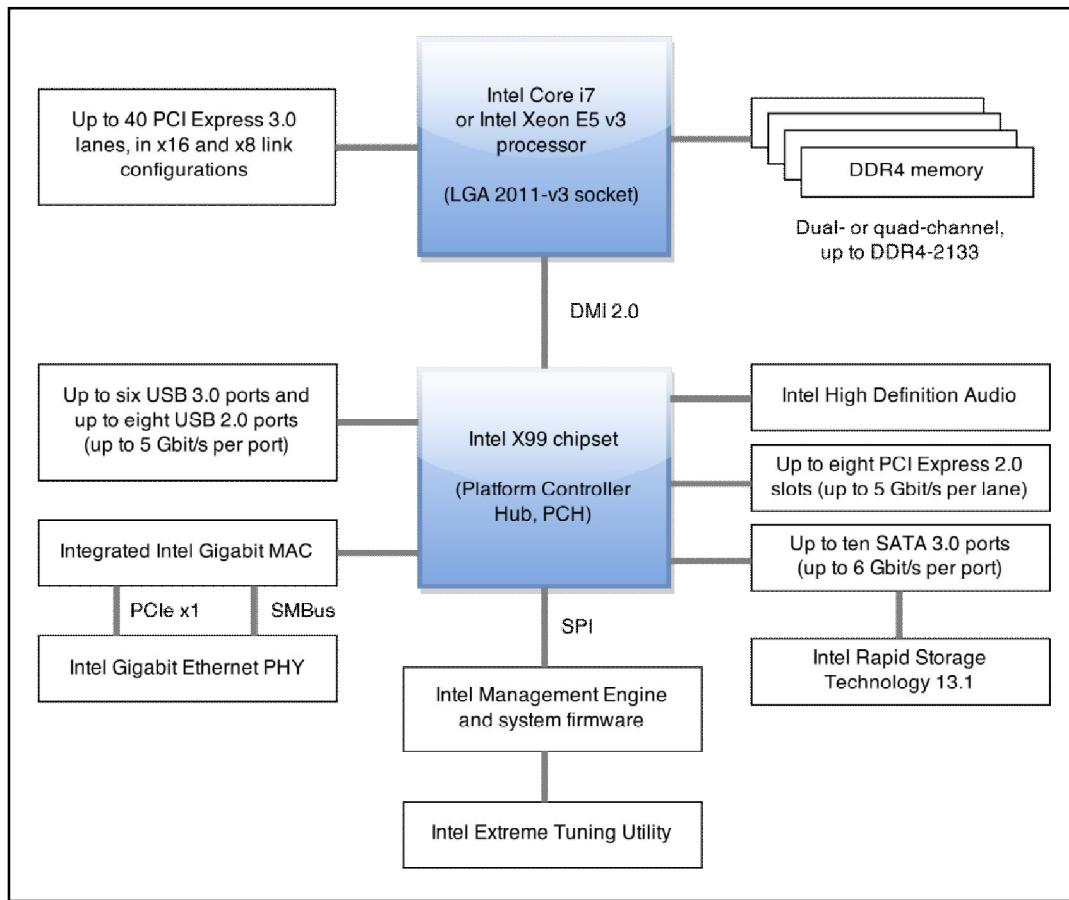
Chipset:

In a computer system, a **chipset** is a set of electronic components in an integrated circuit known as a “Data Flow Management System” that manages the data flow between the processor, memory and peripherals. It is usually found on the motherboard. Chipsets are usually designed to

work with a specific family of microprocessors. Because it controls communications between the processor and external devices.

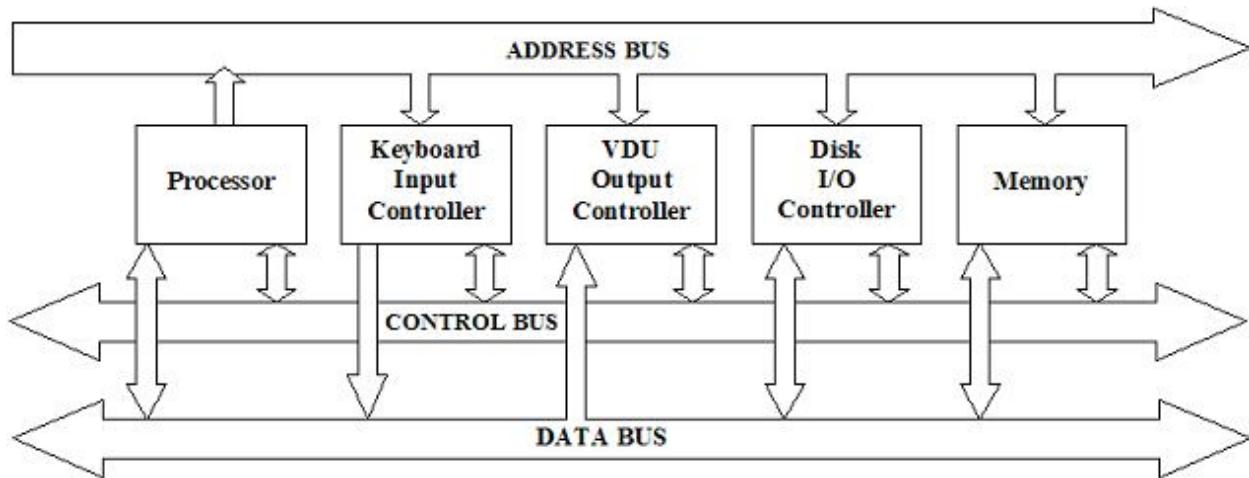
The term *chipset* often refers to a specific pair of chips on the motherboard: the *northbridge* and the *southbridge*. The northbridge links the CPU to very high-speed devices, especially RAM and graphics controllers, and the southbridge connects to lower-speed peripheral buses (such as PCI or ISA).





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System Bus Architecture:



System bus contains 3 categories of lines used to provide the communication between the CPU, memory and IO named as:

1. Address lines (AL)
2. Data lines (DL)

3. Control lines (CL)

1. Address Lines:

- Used to carry the address to memory and IO.
- Unidirectional.
- Based on width of a address bus we can determine the capacity of a main memory

2. Data Lines:

- Used to carry the binary data between the CPU, memory and IO.
- Bidirectional.
- Based on the width of a data bus we can determine the word length of a CPU.
- Based on the word length we can determine the performance of a CPU.

3. Control Lines:

- Used to carry the control signals and timing signals
- Control signals indicates type of operation.

Timing Signals used to synchronize the memory and IO operations with a CPU clock.

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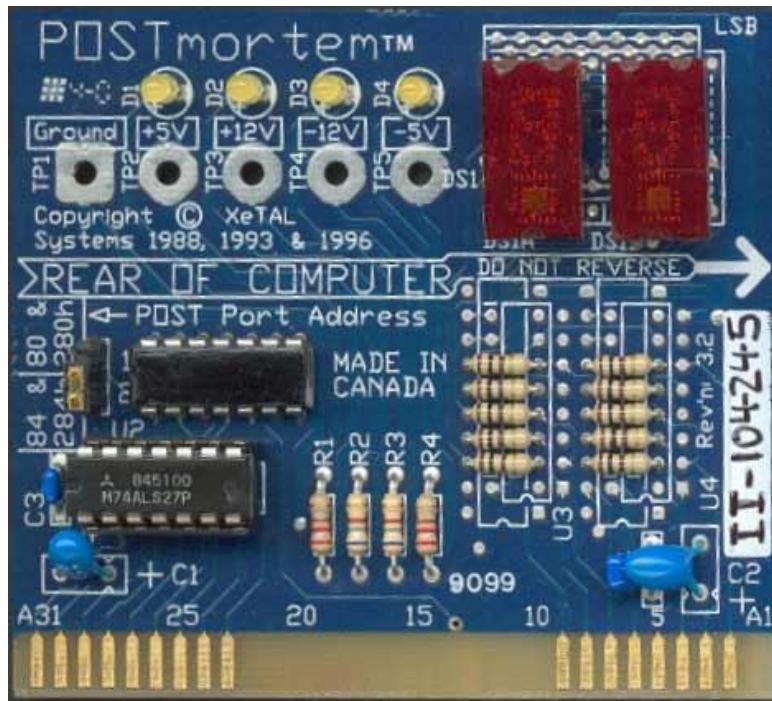
Identify system faults using POST diagnostics card.

- Whenever you power on your computer, the ROM BIOS runs a diagnostic test of the hardware, called the Power On Self Test (POST).
- Each stage of testing generates a two-digit hex code. By tracking these codes, you can view a progress report of the boot-up process and diagnose computer problems.
- By monitoring POST codes using a POST diagnostic card, which plugs into a machine's ISA or PCI port, one can troubleshoot a computer right on the bench, without needing to hook up a monitor, keyboard, or even a disk drive.
- These cards allow you to make quick work of fixing components and avoid the usual time-consuming method of swapping them out one at a time and retesting.

POST codes vs. BIOS beep codes

- Beep codes use audible signals to alert users to computer problems—an especially useful feature if a hardware failure occurs before the video card is initialized.
- While some sets of beep codes, such as those generated by the latest Phoenix BIOSs, can provide extensive troubleshooting information, others are less revealing.

- There may be only 10 beep codes—a tiny subset of the up to 255 two-digit POST codes that can be displayed right on a POST diagnostic card, via digital readouts (**Figure A**).



- This POST diagnostic card, called POSTmortem, plugs into an ISA port. In addition to digital readouts, the POSTmortem also includes four LEDs to diagnose power-supply voltage problems.

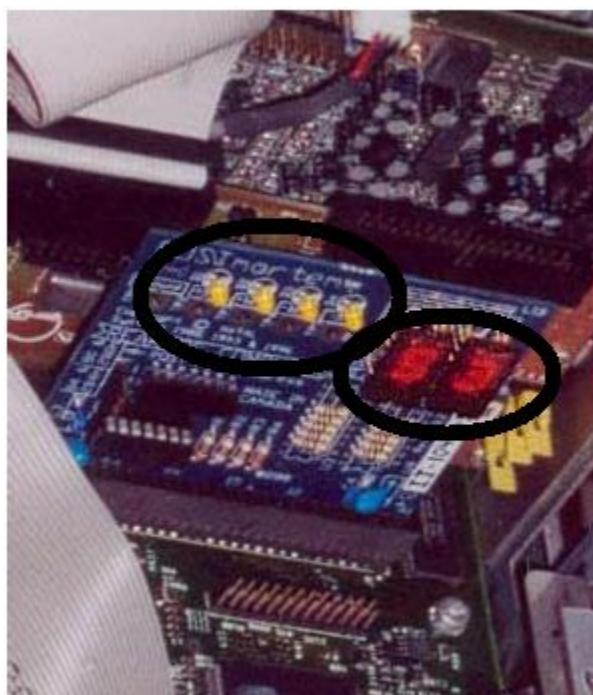
POST card quick facts

- POST codes are most often sent to port 80h (although some manufacturers use different ports, Compaq, for example, uses port 84h.) POST cards either automatically detect the port or contain jumpers for setting it manually.
- In addition to providing digital readouts of POST codes, these cards typically include LEDs for troubleshooting power-supply voltages. For example, the POSTmortem ISA card pictured above contains four LEDs for testing +5V, +12V, -12V, and -5V power supplies, as well as five contacts for testing these voltages with a probe.
- For a more complete troubleshooting solution, get an ISA card if possible. (Your motherboard will likely have an ISA legacy port.)
- Sometimes PCI ports do not show all the available codes, for two reasons.
 - 1. ISA busses are initialized before PCIs—the PCI bus will only receive the codes that are generated after it is initialized.

- 2. ISA busses connect to the South Bridge chip; motherboards with damaged North Bridge chips may not be able to send codes to the PCI bus at all.
- Before using a POST diagnostic card, you'll need a code manual.

POST card usage

- As simple as POST cards are to use, they do require some care. Not all models, the POSTmortem included, have protection circuits built in. Therefore, be careful not to install these cards in reverse or upside down. Doing so could burn out the card. A marker shows which way to orient the card. After you plug in the card, power up the machine and follow the progress of the POST test.



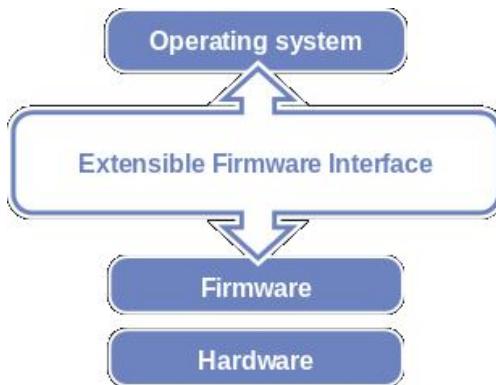
- The code you'll see is sent to the card just prior to the start of each test.
- In above Figure, the code displayed (53) indicates the start of a video display ROM test. The four lit LEDs indicate normal power from the power supply.
- Should the computer fail during the POST, the failing test number will be the last one displayed. Consider the failed test as only a possible indicator of the real problem at hand—another component may, in fact, be the culprit. For example, a failed memory test could indicate a badly seated chip or a motherboard problem.

POST Codes:

| Code | Description |
|------|--|
| E6h | Enabling floppy drive controller, timer IRQs and internal cache memory |
| Edh | Initializing floppy drive |
| Efh | Read error—floppy drive in A: |
| 07h | Initializing CPU |
| 08h | Calculating CMOS checksum |
| 14h | Timer test |
| 30h | Display memory read/write test passed |
| 49h | Verified memory below 1MB |
| 4Eh | Running memory test |
| 50h | Memory below 1MB passed test, initialized |
| 62h | DMA page register test passed |
| 80h | Start keyboard test |
| 81h | Keyboard reset error or stuck key |
| 82h | Keyboard controller test passed |
| 84h | Checking for memory size mismatch |
| 85h | Memory test passed |
| 8Dh | Resetting hard disk controller |
| 8Fh | Passed; configuring floppy disk controller |
| 9Dh | Coprocessor initialized |
| Abh | Performing DMI POST test |

Table A: AMIBIOS POST codes (sample selection)

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Unified Extensible Firmware Interface (UEFI)

- The **Unified Extensible Firmware Interface (UEFI)** is a publicly available specification that defines a software interface between an operating system and platform firmware.

- UEFI replaces the legacy Basic Input/Output System (BIOS) firmware interface originally present in all IBM PC-compatible personal computers, with most UEFI firmware implementations providing support for legacy BIOS services.
- UEFI can support remote diagnostics and repair of computers, even with no operating system installed.
- Intel developed the original **Extensible Firmware Interface (EFI)** specifications. Some of the EFI's practices and data formats mirror those of Microsoft Windows.
- The Unified EFI Forum is the industry body that manages the UEFI specifications throughout.

EFI Services:

EFI defines two types of services: *boot services* and *runtime services*.

- **Boot services** are available only while the firmware owns the platform (i.e., before the ExitBootServices() call), and they include text and graphical consoles on various devices, and bus, block and file services.
- **Runtime services** are still accessible while the operating system is running; they include services such as date, time and NVRAM access.

UEFI booting

- Unlike the legacy PC BIOS, UEFI does not rely on boot sectors, defining instead a boot manager as part of the UEFI specification.
- When a computer is powered on, the boot manager checks the boot configuration and based on its settings, then executes the specified OS boot loader or operating system kernel (usually boot loader).
- The boot configuration is defined by variables stored in NVRAM, including variables that indicate the file system paths to OS loaders or OS kernels.
- OS boot loaders can be automatically detected by UEFI, which enables easy booting from removable devices such as USB flash drives.

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BIOS Settings:

- BIOS, or Basic Input/Output System, is the built-in core processor software responsible for booting up your system.

- Typically embedded into your computer as a motherboard chip.
- Programmed on an erasable, programmable, read-only memory (EPROM) chip, BIOS is stored on this memory chip which retains data when the power source is switched off.
- The BIOS system is also responsible for managing data flow between your computer's operating system and any attached devices including a hard drive, keyboard, video adapter, printer, or mouse.
- Each time you power your PC on, BIOS runs through a process called **Power-On Self Test**, or POST, that determines whether your attached devices are operating correctly and are in their proper place.
- Once all attachments are allocated and given the OK, your computer startup continues as usual and takes you to your load screen in a matter of seconds.
- If BIOS detects any problems, an error screen will appear or a series of beep codes will sound, effectively indicating to you that something has gone wrong.
- In order to access BIOS on a Windows PC, you must press your BIOS key set by your manufacturer which could be F10, F2, F12, F1, or DEL.

Basic functions of BIOS:

BIOS's functionality can be broken down into four key responsibilities.

1. POST

- POST (Power-On Self Test) that your PC runs through the moment you turn it on. POST tests the hardware of your PC and ensures that there is nothing out of order and no errors present with your operating system.
- If No Problem found, POST will continue as usual and allow your PC to boot normally.
- If there is a detected error, BIOS will issue an error message that may come in the form of displayed text or a series of error-indicating beeps.

2. CMOS setup

- Your PC stores all low-level settings like system time and hardware configuration within its CMOS. This means that every change you make to your BIOS structure is saved on this special memory chip called the Complementary Metal-Oxide Semiconductor, or CMOS. The CMOS setup is responsible for setting your password, time, and date.

3. Bootstrap loader

- The program that lives within your computer's EPROM or ROM, the bootstrap loader is tasked with reading your PC's hard drive boot sector to move along the complete operating system load.
- When you restart your PC, the bootstrap loader activates the POST, then loads Windows-10 into memory.
- Newer PCs have replaced the bootstrap loader with an EFI, or Extensible Firmware Interface.

4. BIOS drivers

- BIOS drivers are the many programs stored in your computer's many memory chips.
- These low-level drivers are used to boot your system and prompt basic operational controls on your PC.

Working with Settings:

- Change the boot order
- Create a BIOS password
- Change your date and time
- Change Keyboard Typing Speed

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When to replace CMOS battery?

- Computer is losing its time or date settings.
- An error or alert message, like the following, is displayed when the computer boots.
- **CMOS Read Error**
- **CMOS Checksum Error**
- **CMOS Battery Failure**
- **System battery voltage is low**



Steps:

Locate CMOS battery

- Open the computer case and find the battery on the motherboard.
- Verify it is accessible and can be removed. Today, most computers use a coin cell CMOS battery (like the CR2032 battery shown in the picture).

Note:

- Some CMOS batteries may be held down by a metal clip or bar. The battery can be removed by sliding it out from under the clip. Do not bend this clip to get the battery out, as a bent clip can result in the new battery not staying in the socket.
- With some computers, you may need to disconnect cables, remove drives, or remove other parts of the computer to get full access to the CMOS battery.

Obtain battery information

- Once the battery is located, it is recommended writing down its specifications (voltage, chemistry, wiring). If possible, remove the battery and take it to a retail location.

Removing the battery

- If a computer uses a coin cell battery, removing the battery is relatively simple. Use fingers to grab the edge of the battery and pull it up and out of the socket holding it in place.
 - Some motherboards have a clip holding the battery down. If computer's motherboard has this clip, it is necessary to use one hand to move the clip up and the other hand to pull the battery out.
 - Unfortunately, not all CMOS batteries are removable. Some manufacturers only allow a replacement battery to be added.

- If computer's motherboard does not have a removable battery, you need to set a jumper on the motherboard to install the new battery.

Insert the new battery

- After purchasing a new battery, remove the old battery and replace it with the new battery.
 - Some computers may not have a removable battery, for these computers insert the new battery into the secondary battery socket on the motherboard.

Enter CMOS values

- Once the battery has been replaced, turn on the computer and reset the CMOS values to the defaults.
- After the values have all been entered, make sure to save the settings before exiting. Many CMOS setups allow you to press a key, such as F10, to save values and exit with one action.

Bad hardware

- If you continue to receive the error after following all the steps above, this is a sign of a more serious issue. The most likely causes are a bad power supply or bad motherboard.

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Nonvolatile BIOS memory refers to a small memory on PC motherboards that is used to store BIOS settings.

- It is traditionally called **CMOS** RAM because it uses a volatile, low-power complementary metal-oxide-semiconductor (CMOS) SRAM powered by a small "CMOS" battery when system and standby power is off.
 - It is referred to as non-volatile memory or NVRAM because, after the system loses power, it does retain state by virtue of the CMOS battery.
 - The typical NVRAM capacity is 256 bytes.
- The CMOS RAM and the real-time clock have been integrated as a part of the southbridge chipset and it may not be a standalone chip on modern motherboards.
- In turn, the southbridge have been integrated into a single Platform Controller Hub

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CMOS battery



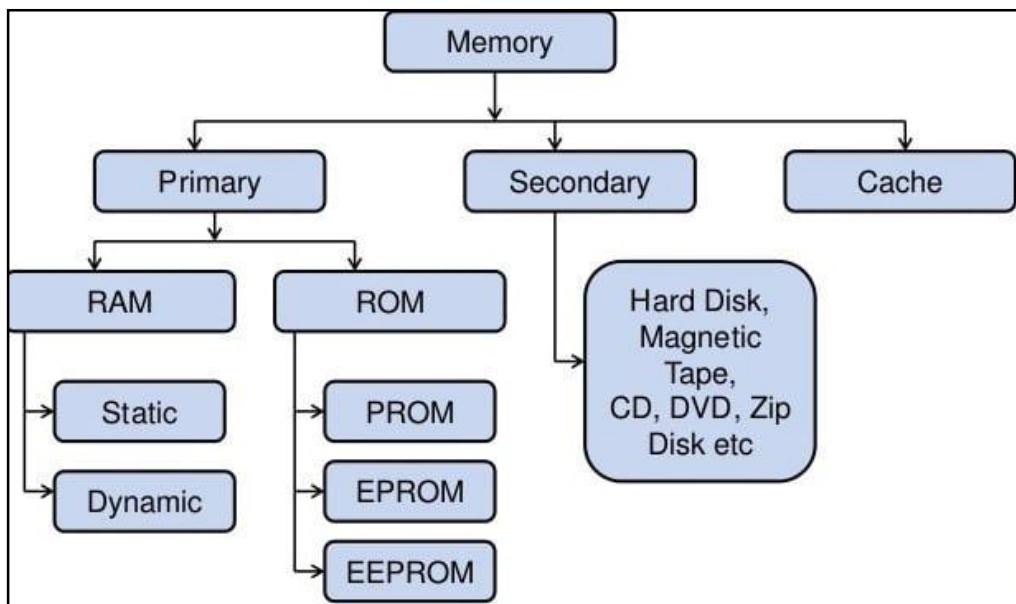
- Type CR2032 button cell, the most common CMOS battery.
- The memory battery (CMOS, real-time clock (RTC), clock battery) is generally a CR2032 lithium coin cell.
- This cell battery has an estimated life of 3 years when power supply unit (PSU) is unplugged or when the PSU power switch is turned off. This battery type, unlike the Lithium-ion battery, is not rechargeable and trying to do so may result in an explosion.
- Motherboards have circuitry preventing batteries from being charged and discharged when a motherboard is powered on. Other common battery cell types can last significantly longer or shorter periods, such as the smaller CR2016 which will generally last about 40% less time than CR2032.
- Higher temperatures and longer power-off time will shorten battery cell life. When replacing the battery cell, the system time and CMOS BIOS settings may revert to default values.

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Memory

Computer memory is any physical device capable of storing information temporarily like RAM (random access memory), or permanently, like ROM (read-only memory). Memory devices utilize integrated circuits and are used by operating systems, software, and hardware.

Types of Memory



Primary Memory

RAM (Random access memory) – Random Access Memory (RAM) is a type of data storage used in computers that is generally located on the motherboard. This type of memory is volatile and all information that was stored in RAM is lost when the computer is turned off

There are two types of Random access memory

- **Dynamic RAM** – dynamic indicates that the memory must be constantly refreshed (reenergized) or it will lose its contents.
- **Static Memory** – A computer memory that contains fixed information and retains its programmed state as long as the power is on.

Virtual memory is a feature of an operating system (OS) that allows a computer to compensate for shortages of physical memory by temporarily transferring pages of data from random access memory(RAM) to disk storage.

ROM (Read only memory) – Once data has been written onto a ROM chip, it cannot be removed and can only be read. Unlike main memory (RAM), ROM retains its contents even when the computer is turned off. ROM is referred to as being nonvolatile.

There are three types of Read only memory (ROM)

- **PROM** – PROM stands for Programmable Read Only Memory. This form of ROM is initially blank. The user or manufacturer can write data/program on it by using special devices. However, once the program or data is written in PROM chip, it cannot be

changed. If there is an error in writing instructions or data in PROM, the error cannot be erased. PROM chip becomes unusable.

- **EPROM** – EPROM stands for Erasable Programmable Read Only Memory. This form of ROM is also initially blank. The user or manufacturer can write program or data on it by using special devices. Unlike PROM, the data written in EPROM chip can be erased by using special devices and ultraviolet rays. So program or data written in EPROM chip can be changed and new data can also be added. When EPROM is in use, its contents can only be read.
- **EEPROM** – EEPROM stands for Electrically Erasable Programmable Read Only Memory. This kind of ROM can be written or changed with the help of electrical devices. So data stored in this type of ROM chip can be easily modified.

Cache:

| RANDOM ACCESS MEMORY | READ ONLY MEMORY |
|---|--|
| It is possible to both read data from memory and write data into memory. | Only reading of data from memory is possible. |
| RAM is volatile (if the power supply is interrupted then the data is lost). | ROM is non-volatile (the data is maintained even if the power supply is lost). |
| It is mainly of two types Dynamic-RAM and Static RAM (Cache memory). | It is mainly of the following types: Programmable ROM, Erasable PROM and Electrically Erasable PROM. |
| It is used for temporary data storage as it is volatile. | It is used for permanent data storage as it is non-volatile. |

A cache is a place to store something temporarily in a computing environment. Cache memory, also called CPU memory, is random access memory (RAM).

Secondary memory

Secondary memory – Secondary memory is a computer memory that is not directly accessed by the central processing unit (CPU) of a computer and is usually available as non-volatile memory. One of the most common forms of this memory is the hard drive of a computer, which is used to store the operating system (OS) and other programs. Example: DVD, CDs, Floppy Disk etc.

- **Hard Drive** – a rigid non-removable magnetic disk with a large data storage capacity.
- **Floppy disk** – A floppy disk, also called a diskette or just disk, is a type of disk storage composed of a disk of thin and flexible magnetic storage medium, sealed in a rectangular

plastic carrier lined with fabric that removes dust particles. Floppy disks are read and written by a floppy disk drive (FDD).

- **Magnetic Tape** – Magnetic tape used in recording sound, pictures, or computer data.
- **Flash memory** – a kind of memory that retains data in the absence of a power supply.
- **Optical disk** – an electronic data storage medium that can be written to and read using a low-powered laser beam.

CD-ROM: “Read Only” (used for distribution of commercial software, for example) Standard storage capacity is 640MB.

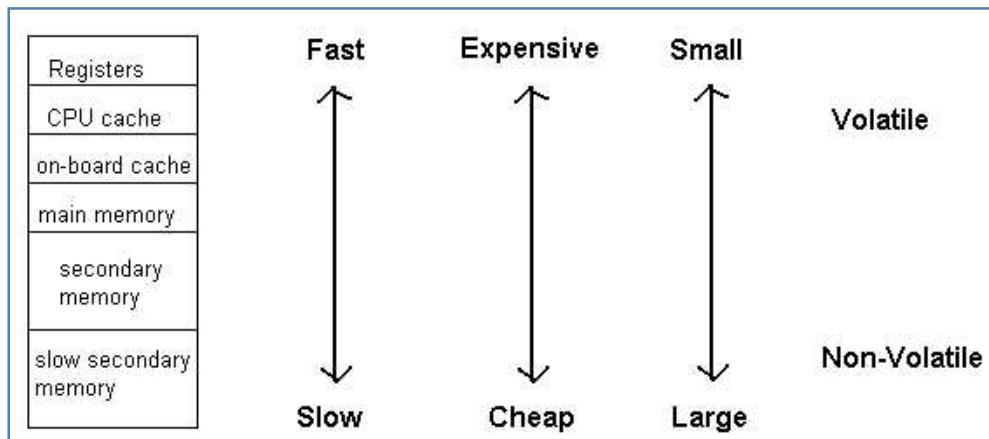
CD-R (or CD-WORM): “Write Once, Read Many” times

CD-RW: rewritable multiple times

DVD: similar to CD, but with significantly larger storage capacity (4.7GB)

Mother board – A motherboard is the main circuit board inside a computer that connects the different parts of a computer together. It has sockets for the CPU, RAM and expansion cards (e.g. discrete graphics cards, sound cards, network cards, storage cards etc)... and it also hooks up to hard drives, disc drives and front panel ports with cables and wires. Also Called as mainboard, system board.

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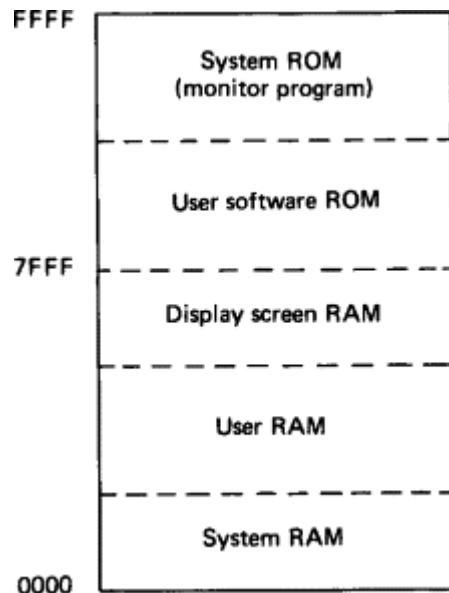
Memory Units

Memory units are used to measure and represent data. Some of the commonly used memory units are:

- **Bit:** The computer memory units start from bit. A bit is the smallest memory unit to measure data stored in main memory and storage devices. A bit can have only one binary value out of 0 and 1.

- **Byte:** It is the fundamental unit to measure data. It contains 8 bits or is equal to 8 bits. Thus a byte can represent 2^8 or 256 values.
- **Kilobyte:** A kilobyte contains 1024 bytes.
- **Megabyte:** A megabyte contains 1024 kilobytes.
- **Gigabyte:** A gigabyte contains 1024 megabytes.
- **Terabyte:** A terabyte contains 1024 gigabytes.
- **Peta Byte:** A Petabyte contains 1024 Terabytes
- **Exa Byte:** A Exabyte contains 1024 Petabytes
- **Zetta Byte:** A Zettabyte contains 1024 Exabytes
- **Yotta Byte:** A Yottabyte contains 1024 Zettabytes

Memory Locations:



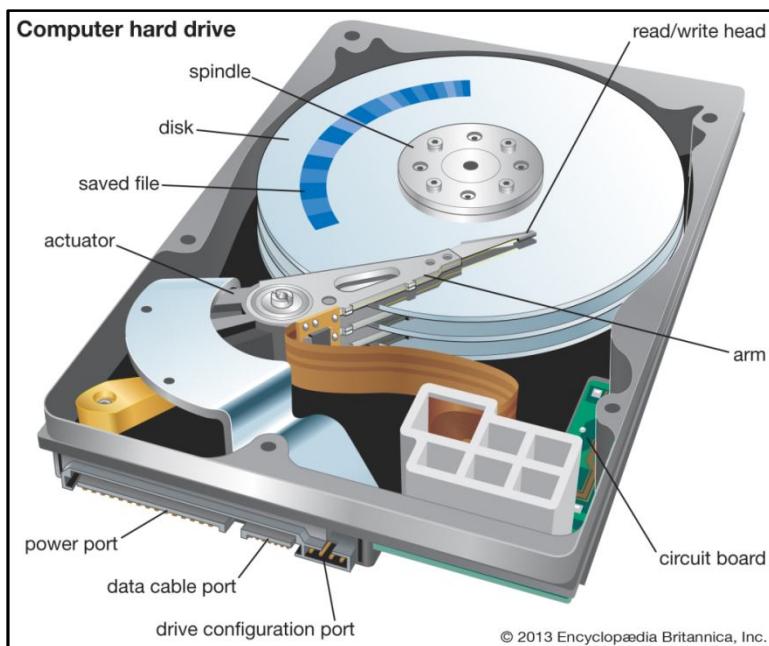
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HDD (Hard Disk Drive):

The hard drive is the component that stores your data. Several reasons to buy HDD:

- Shortage of space on your current HDD and need a bigger one
- Takes a long time to open documents or export large files like videos
- Setting up a new PC from scratch

SATA (or Serial Advanced Technology Attachment) Drives



- SATA (or Serial Advanced Technology Attachment) is the default interface for most desktop and laptop hard drives.
- They are referred to as SATA hard drives, but they are actually rotary hard drives with spinning platters and a moving needle that writes data to consecutive sectors on each platter.
- SATA hard drives are incredibly fast compared to their predecessor, the PATA hard drive, and can write to the disk with an interface rate of 6 Gb/s with a throughput of 600 MB/s.
- A single drive can range from 500 GB to 16 TB and are available at a lower cost than any of the other drive types discussed here.
- Since data is physically written to a disk, it can also become fragmented, meaning that different sectors can be spread across different areas of the disk, slowing down the drive.

- They also are vulnerable to shock and sudden movement since there are moving parts in each drive, which makes them a poor choice for laptops.

Pros:

- Low cost
 - High disk sizes

Cons:

- Not good for laptops
 - Requires regular de-fragmentation

SSD hard drives



- SSD stands for Solid State Drive.
- These disks don't have any moving parts.
- That means that there isn't a needle that has to move to read or write data and that they are significantly faster than SATA drives.
- It's difficult to find an exact speed because it varies by manufacturer and form factor, but even the lower-performing drives are comparable to SATA drives.
- Data is stored on a series of NAND chips, which can retain their charge without a power source.
- The downside is that these drives are significantly more expensive and don't come in as many sizes.
- SSD drives range from about 120 GB to 2 TB, and are about 2-4 times the price of a SATA hard drive of the same size.
- Since there are no moving parts, these drives are also a lot more durable, and there are form factors built specifically for laptops, making them ideal for storage on the go.

Pros:

- Fast
- More durable, especially for laptops

Cons:

- More expensive than SATA drives
- Lower disk sizes

NVMe





- Non-Volatile Memory Express, or NVMe, is a type of SSD that's attached to a PCI Express (PCIe) slot on a main board.
- These slots were originally designed for graphics cards, so they are incredibly fast.
- Speeds on NVMe drives can reach an interface rate of 32 Gb/s with a throughput of 3.9 GB/s.
- That can be very useful if you are doing something that needs a lot of disk throughput, like gaming or high-resolution video editing.
- For starters, they are only available on desktop PCs and are very expensive.
- Most BIOS don't support booting from NVMe at this time.
- It's still possible to get one that does, but it might mean replacing your entire main board.

Pros:

- Fastest disk type on the market

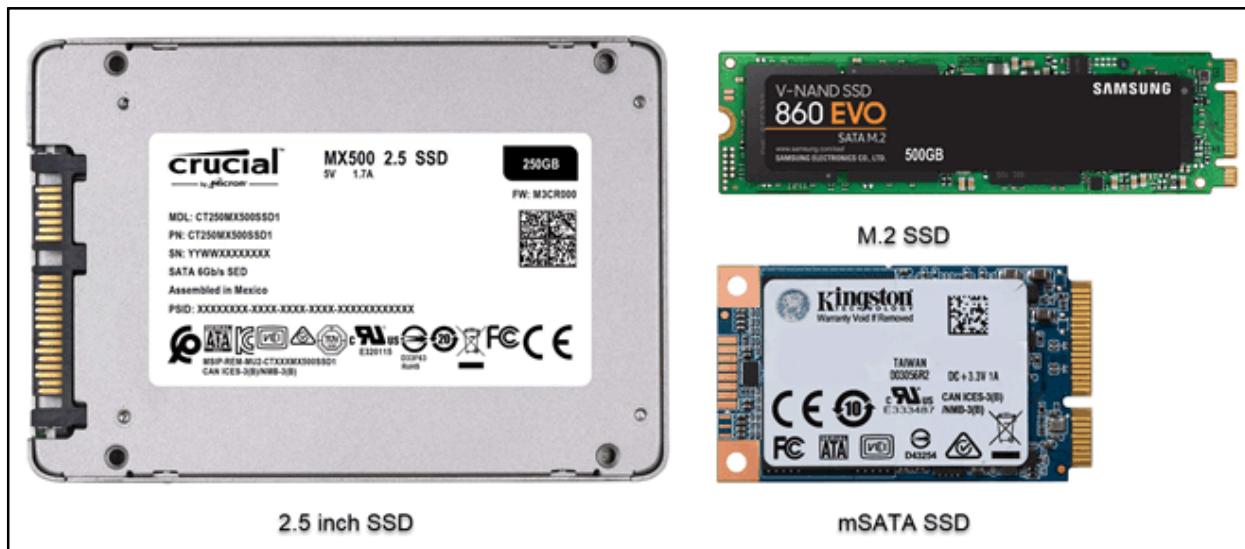
Cons:

- Extremely expensive
- Available for desktop PCs only
- May require replacing main board to get full benefit

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| Attribute | HDD | SSD |
|----------------------------|-------------------------------------|---------------------------------|
| Full-Form | Hard Disk Drive | Solid State Drive |
| Components | Moving Mechanical Parts, e.g., arm. | Electrical Parts, e.g., ICs. |
| Cost | Cheap | Expensive |
| Battery Consumption | High | Low |
| Speed | Lower than SSD | High |
| Capacity | Higher | Lower |
| Weight | Heavy | Light-weight |
| Size | Large | Compact |
| Data Transfer | Sequential | Random |
| Reliability | Less, due to mechanical parts. | More reliable than HDD. |
| R/W Time | Higher number of R/W time | Shorter R/W time |
| Fragmentation Issue | Yes | No |
| Magnetism Effect | Susceptible to strong magnets. | No effect, safe from magnetism. |
| Latency | Higher | Shorter |
| Noise | Yes, due to spinning | No Noise |
| Vibration | Little vibration | No vibration |

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Optical Disc Drive

An optical drive is a piece of computer hardware about the size of a thick softcover book. The front has a small Open/Close button that ejects and retracts the drive bay door. This is how media like CDs, DVDs, and BDs are inserted into and removed from the drive.

Most optical drives also have jumper settings on the back end that define how the motherboard is to recognize the drive when more than one is present. Alternatively, an external optical drive may be a self-contained unit that connects to a computer via a USB cable.



Optical Disc Drive Media Formats

Most optical drives can play and/or record a large number of different disc formats.

Popular formats include CD-ROM, CD-R, CD-RW, DVD, DVD-RAM, DVD-R, DVD+R, DVD-RW, DVD+RW, DVD-R DL, DVD+R DL, BD-R, BD-R DL & TL, BD-RE, BD-RE DL & TL, and BDXL.

Recordable and Rewritable Discs

The "R" in these formats means "recordable" and the "RW" means "rewritable." For example, DVD-R discs can be written to just once, after which the data on them cannot be changed, only read. DVD-RW is similar but since it's a rewritable format, one can erase the contents and write new information to it at a later time.

Recordable discs are ideal if someone is borrowing a CD of photos and don't want them to accidentally delete the files. A rewritable disc may be handy if data in the storage required to be deleted and make a room for newer backups.

CD and Blu-Ray Discs

Discs that have the "CD" prefix can store around 700 MB of data, while DVDs can keep around 4.7 GB (nearly seven times as much). Blu-ray discs hold 25 GB per layer, dual-layer BD discs can store 50 GB, and triple and quadruple layers in the BDXL format can store 100 GB and 128 GB, respectively.

Logical BlockAddressing (LBA)

A disc or disk is divided into blocks. Each block with a unique address. There are however different addressing methods. The Logical address does not necessary match with the Physical address. A block is also referred to as a frame or sector.

Logical block addressing (LBA) is a common scheme used for specifying the location of blocks of data stored on computer storage devices, generally secondary storage systems such as hard disk drives. LBA is a particularly simple linear addressing scheme; blocks are located by an integer index, with the first block being LBA 0, the second LBA 1, and so on.

A 28 -bit LBA address allows addressing of 2^{28} blocks and each block of size 512 bytes (2^9), which is equal to the 128 GB (2^{37}). As an extension of a 48 -bit address allows addressing of 2^{48} blocks and each block of size 512 bytes (2^9), which is equal to the 128 PB (2^{57}).

Memory Capacity:

The total memory (RAM) that can be added to a computer depends on the address registers built into the CPU. For example, most 32-bit CPUs can address only up to 4 GigaBytes (GB) of memory.

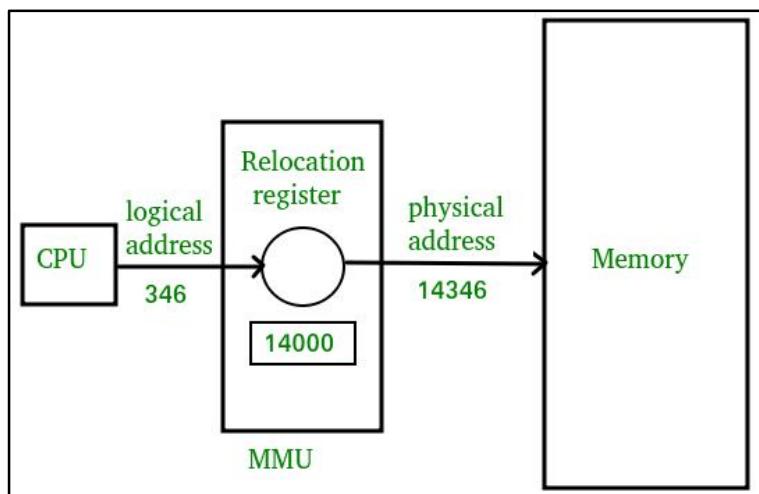
The reason the maximum capacity in a 64-bit computer is limitless for all intents and purposes is that 64-bit hardware manipulates (calculates, compares and copies) 64 bits, or 8 bytes, of data at a time. However, the actual memory is addressed with far fewer bits. A 64 bit register could address 16 exabytes (EB) of memory (which is 16 million Terabytes).

Physical and Logical Addressing

Logical Address is generated by CPU while a program is running. The logical address is virtual address as it does not exist physically, therefore, it is also known as Virtual Address. This address is used as a reference to access the physical memory location by CPU. The term Logical Address Space is used for the set of all logical addresses generated by a program's perspective.

The hardware device called Memory-Management Unit is used for mapping logical address to its corresponding physical address.

Physical Address identifies a physical location of required data in a memory. The user never directly deals with the physical address but can access by its corresponding logical address. The user program generates the logical address and thinks that the program is running in this logical address but the program needs physical memory for its execution, therefore, the logical address must be mapped to the physical address by MMU before they are used. The term Physical Address Space is used for all physical addresses corresponding to the logical addresses in a Logical address space.



| Basis for Comparison | Logical Address | Physical Address |
|----------------------|---|--|
| Basic | It is the virtual address generated by CPU | The physical address is a location in a memory unit. |
| Address Space | Set of all logical addresses generated by CPU in reference to a program is referred as Logical Address Space. | Set of all physical addresses mapped to the corresponding logical addresses is referred as Physical Address. |
| Visibility | The user can view the logical address of a program. | The user can never view physical address of program |
| Access | The user uses the logical address to access the physical address. | The user can not directly access physical address. |
| Generation | The Logical Address is generated by | Physical Address is Computed by MMU |

| Basis for Comparison | Logical Address | Physical Address |
|----------------------|-----------------|------------------|
| | the CPU | |

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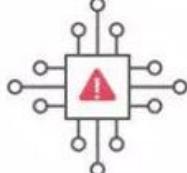
Causes of Hard drive failure:

1 FIRMWARE OR MANUFACTURER FAULTS



| REASONS | SYMPTOMS | SOLUTIONS |
|---|---|---|
| <ul style="list-style-type: none"> - Improper voltage - Interruption during firmware upgrade. - Manufacturing faults | <ul style="list-style-type: none"> - Unrecognizable hard disk - System hangs or fails to boot | <ul style="list-style-type: none"> - Contact manufacturer for Return Authorization (RA). |

2 ELECTRONIC FAILURE OR POWER SURGE



| REASONS | SYMPTOMS | SOLUTIONS |
|---|--|---|
| <ul style="list-style-type: none"> - Unreliable power source - Improper power supply by UPS | <ul style="list-style-type: none"> - Sudden startup failure - BIOS not detecting the hard drive - Hard drive not spinning | <ul style="list-style-type: none"> - Use UPS of a well-known brand - Switch off system when not in use. |

3 OVERHEATING



REASONS

- Due to faulty CPU fan
- Improper ventilation

SYMPTOMS

- Fans moving too slow or not at all
- Clicking sounds from System hardware.
- Heating of PC/Laptop soon after starting

SOLUTIONS

- Check for sufficient cooling to the processor
- Use thermal paste between heat sinks

4 MECHANICAL OR INTERNAL FAILURE



REASONS

- Moving parts, degrading over time
- Malware attack
- Bad sectors & blocks
- Spindle motor stops functioning

SYMPTOMS

- Total system freeze
- Grinding or clicking sounds
- Invisible/corrupt files & folders
- Appearance of Black screen on booting

SOLUTIONS

- Keep your system updated
- Update antivirus
- Replace hard drive every 3-4 years

5 CORRUPT FILE



REASONS

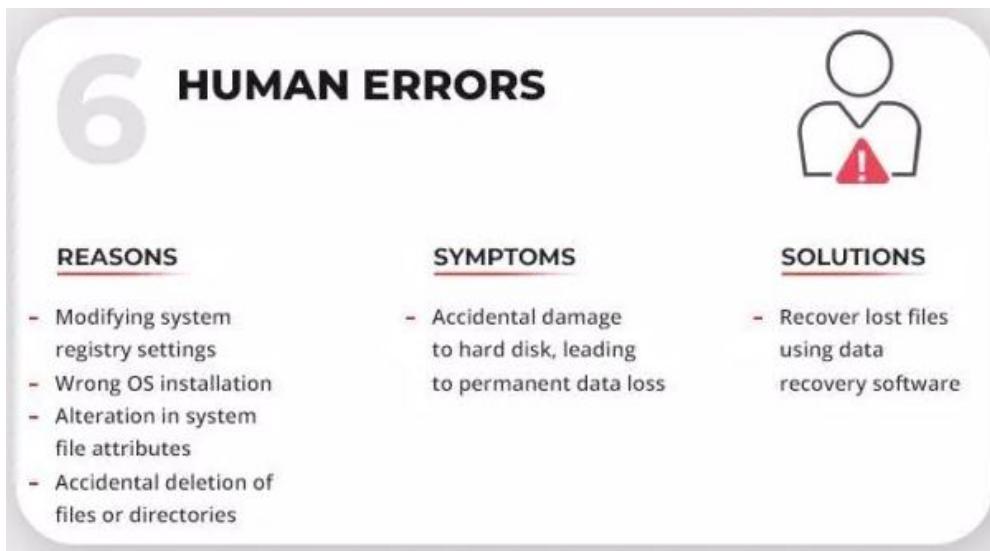
- Use of malicious/faulty apps.
- Accidental closure of programs
- Unethical shut down

SYMPTOMS

- Corrupt or damaged files.
- Sudden system shut down
- Force restart

SOLUTIONS

- Always shut down PC properly
- Close all programs before shutting down PC.
- Avoid installation of faulty/malicious app & software.



Signs of Hard Disk Failure:

- **Computer Crashes Or Blue Screen Of Death**
- **Error Messages While Copying Or Moving Files –**
- **Hard Drive Doesn't Boot**
- **Hard Drive Is Making A Beeping Sound:** When a hard drive makes a beeping sound, this is usually because the platters may be physically blocked by something. The beeping noises are made by the spindle motor inside the drive as it attempts to get the platters spinning. This generally happens when the read/write headstack clamps down on the platter surfaces instead of floating above them.
- **Hard Drive Is Not Spinning –** A hard drive will fail to spin up if there is no electricity that flows through its PCB (or Printed Control Board). This generally happens when the circuit board experiences a short or it has worn out over time.
- **Hard Drive Is Smoking –** It is a warning sign that the PCB of the hard drive has burned. This is mainly due to an electrical surge which may cause the PCB to short or burn.
- **Hard Drive Is Clicking Or Buzzing -**When the hard drive makes a clicking or other strange sounds, this is mainly due to the read write heads being unable to perform their key functions. This may be what's known as a head crash. Also referred to as the “click of death”, this happens when the hard drive has been severely damaged or has failed completely. It is never a good idea to keep running a hard drive that's making some kind of physical sound.
- **Losing Files Without Notice –** This can sometimes mean that drive is having issues.

- **File Access Takes A Long Time**
- **Noise** – Most recently manufactured hard drives are whisper quiet. Any noise at all, particularly a clicking hard drive noise, can mean the drive may be on its last legs.
Try the best to backup the contents, or shut down the system and call an expert.

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SSD Common Specifications:

The common specs include

- Form Factor
- The Interface
- Read Speed
- Write Speed
- Endurance Rating TBW - Overall Lifespan
- IOPS
- Storage Capacity
- Memory Cell Type - SLC, MLC, TLC, QLC, PLC

1. Form Factors

Common Form factors include:

- 2.5" SSD Drive (or 7mm SSD Drive)
- M.2 Drive (half the size of a single RAM stick)
- Portable SSD

2. SSD Interface

Uses the traditional **SATA connection**, which is also used by hard drives.

To give you a better understanding of how these transport interfaces perform, following are the speeds:

- **SATA II** - Maximum bandwidth of 3Gb/s or 384 MB per second.
- **SATA III** - Maximum bandwidth of 6Gb/s or 768 MB per second.
- **PCI-E Gen 3** - Maximum bandwidth of 8GT/s or 8 GB per second.

3. Read Speed - Sequential and Random

- **Up to 560 MB per second** which is three times the performance of a traditional hard drive (HDD 80-160MB per Second).
- **M.2 drives**, its sequential read speed could vary between **2.4 GB per second up to 3.4 GB per second**.

4. Write Speed - Sequential and Random

- Up to 530MB per Second ((HDD 80-160MB per Second).

5. Endurance Rating (TBW - Terabytes Written)

- While SSDs are more durable compared to hard drives, they can still break down in time.
- In this case, you should look out for solid-state drives with a decent TBW (Total Bytes Written) rating. TBW indicates how much data you can write on an SSD over its lifespan.
- A good SSD like the Western Digital Blue has a 600 TWB rating for the 4 terabyte model.
- For better understanding, a **250 GB SSD** would usually have a **70 TWB rating** which you can max out for a year if you store 190 GB of new data every day, which is impossible for a typical user.
- In this case, it is safe to say that most SSDs would have a lifespan of double or even triple compared to an ordinary hard drive in normal usage.

5. IOPS

- IOPS or **Input/Output Operations Per Second** determines how fast an SSD can read and write random packets of data like browser files, cookies, saved game data, and documents.
- For example, the Western Digital Blue SSD has a **4KB sequential read speed of 97,000 IOPS**.
- In order to convert these to MB per second, we would use the formula:
- **MBps = (IOPS * 4)/1024**
- So, our Western Digital Blue solid-state drive would have **378.90 MB per second 4KB sequential read speed**.

6. Capacity

- Most SSD manufacturers offer solid-state drives with a capacity of **80 GB up to 4 TB** or even higher. However, SSDs get even more expensive as you increase its capacity.
- A **500 GB** variant of Western Digital Blue SSD is priced around **\$60** while its **4 TB model** would cost you over **\$500** on Amazon. For that price, you can already build a decent desktop PC.

7. Memory Cell Type - SLC, MLC, TLC, QLC

- Solid-state drives use NAND flash memory that consists of cells that can hold bits of memory.
- These bits are controlled by an electric charge that either turns it off or on.

7.1 Single Level Cell (SLC)

- Typically found on server-grade drives, single-level cell flash is known to be the most accurate when it comes to reading and writing data.

7.2 Multi-Level Cell (MLC/eMLC)

- Based on its name, multi-level cell memory stores multiple bits of data in one cell, which makes manufacturing cost a lot cheaper compared to SLC drives.

7.3 Triple Level Cell (TLC)

- TLC solid-state drives can **write three bits to each of its cells**, which allows it to have higher storage capacities compared to MLC and SLC memories.
- However, packing three bits on one cell has a few drawbacks like **slower performance, decreased reliability, and endurance**.

7.4 Quad and Penta Level Cell (QLC/PLC)

- Similar to how TLC flash memory works, Quad and Penta level cell NAND flash can store multiple bits in a single cell (four bits for QLC and five bits for PLC) but with a few compromises.

7.5 3D NAND Flash

- Compared to traditional 2D planar NAND memory, **3D NAND stacks cells on top of each other**, utilizing both vertical and horizontal space that resulted in better performance and increased reliability without needing to shrink single cells to its limits.

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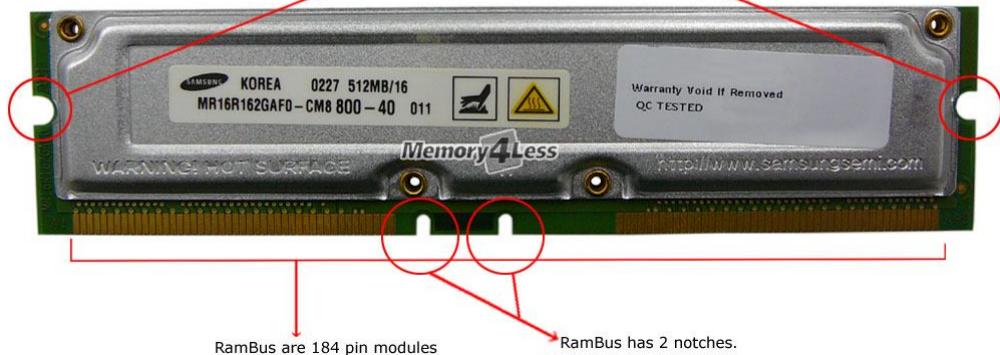
Difference between SIMM and DIMM

| S.NO | SIMM | DIMM |
|------|--|---|
| 1. | In SIMM, Pins present in either facet are connected. | DIMM pins are freelance. |
| 2. | SIMM supports 32 bit channel for data transferring. | DIMM supports 64 bit channel for data transferring. |

| S.NO | SIMM | DIMM |
|------|---|---|
| 3. | SIMM consumes 5 volts of power. | DIMM consumes 3.3 volts of power. |
| 4. | SIMM provides the storage 4 MB to 64 MB. | DIMM provides the storage 32 MB to 1 GB. |
| 5. | The classic or most common pin configuration of the SIMM module is 72 pins. | The foremost common pin configuration of the DIMM module is 168 pins. |
| 6. | SIMMs are the older technology. | DIMMs are the replacement of the SIMMs. |
| 7. | SIMMs are installed in pairs at a time. | DIMMs are installed one at a time. |
| 8. | SIMMs are used by 486 CPU as well as early Pentium computers. | DIMMs are used by modern Pentium computers. |
| 9. | The length and width of SIMM are respectively 4.25 inches and 1 inch. | The length and width of DIMM are respectively 1.67 to 5.25 inches and 1 to 1.75 inches. |
| 10. | There are single notches in SIMMs. | There are two notches in DIMMs. |



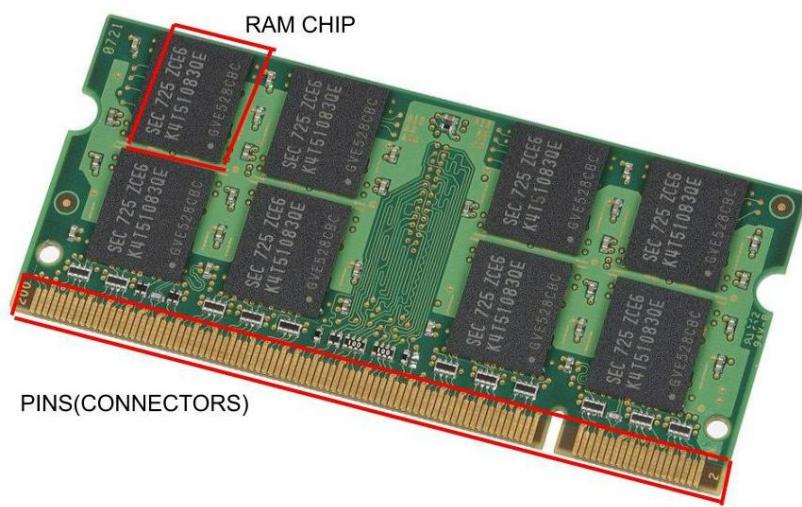
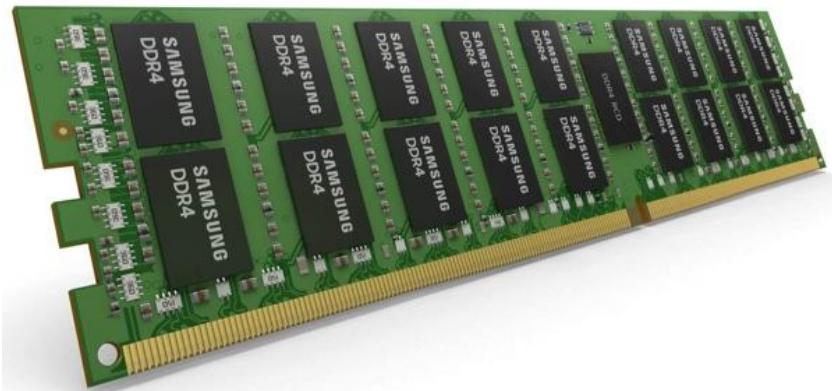
These are industry standard notches that are used to fit in the motherboard memory sockets



RamBus are 184 pin modules

RamBus has 2 notches.

DIMM



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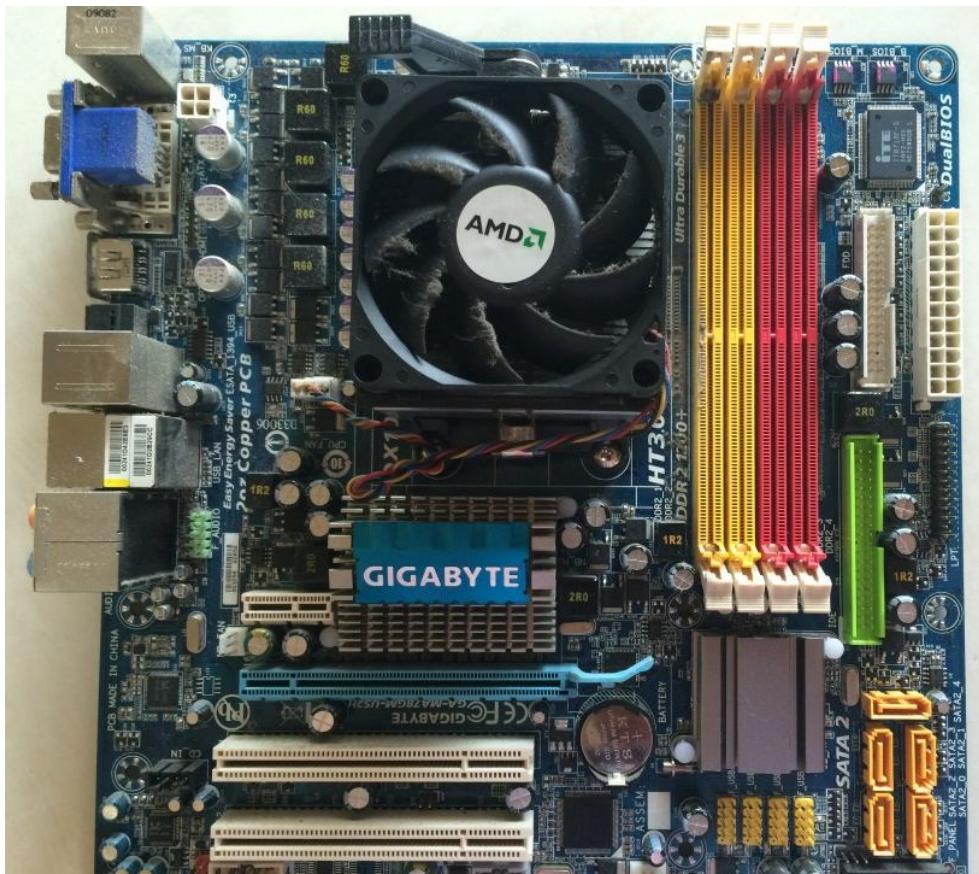
How to Install RAM:



Make sure to use a static-free work area when beginning any component change in your computer, and make sure the computer is unplugged.

Clear away any paper, tape, and electrical devices (including your smartphone) from the area.

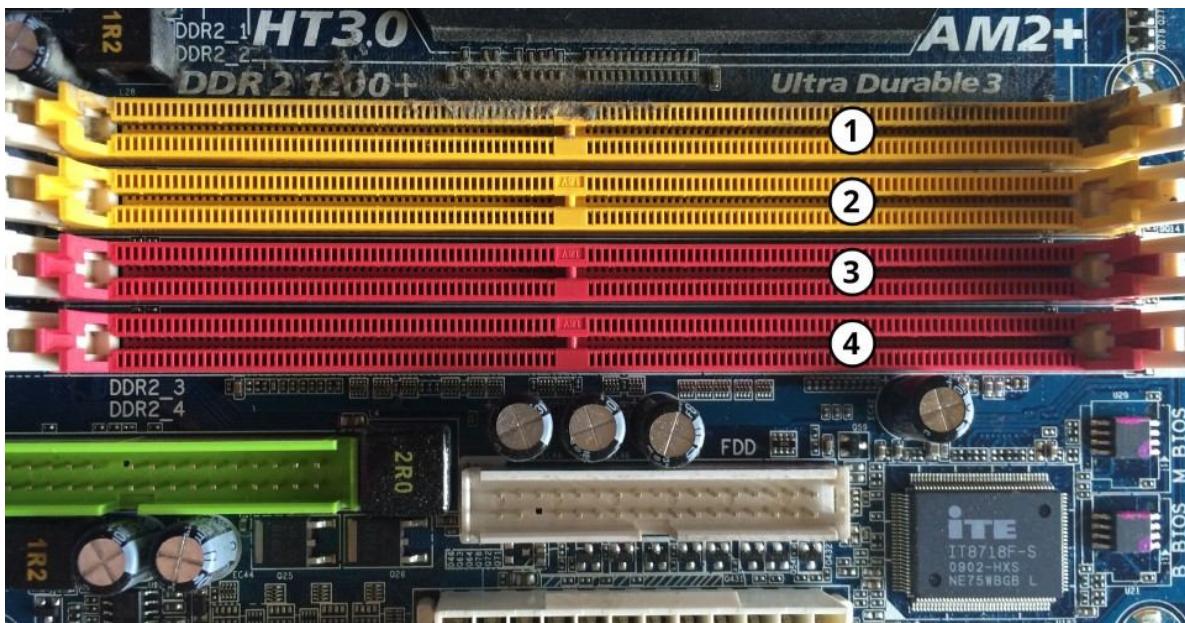
Always touch the metal chassis of your computer to ground yourself and draw away any static electricity



The RAM slots, at the right, are red and yellow.

Find out how much memory your computer can handle, and how much you want to add.

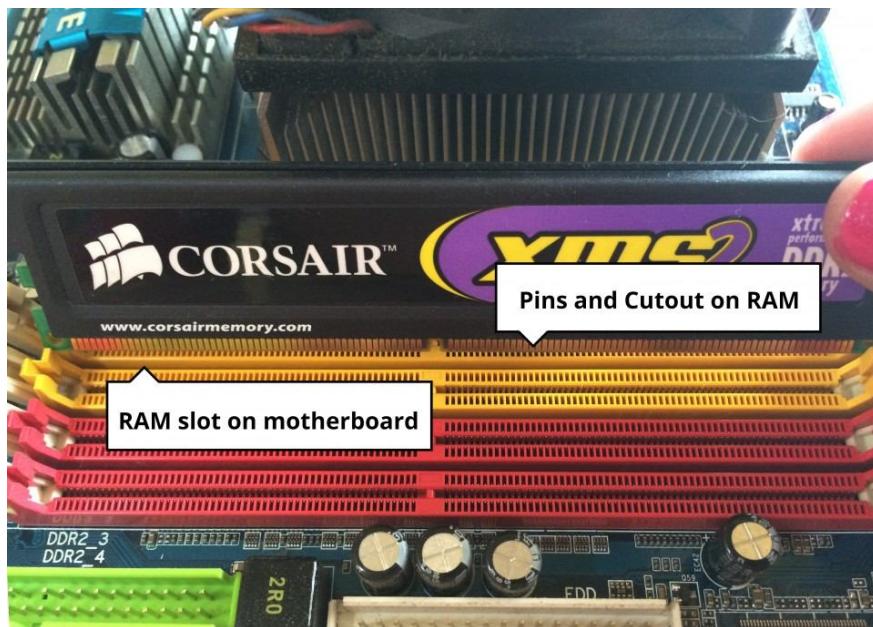
- Step 1: right-click on My Computer (or go to Control Panel > System and Security and under System, click on View Amount of RAM and processor speed))
- Step 2: use some Tool that will scan your system and return a report that tells you how much RAM your system can take, how much RAM you currently have, how many slots you have—both available and occupied—and even suggest which RAM to buy to upgrade.



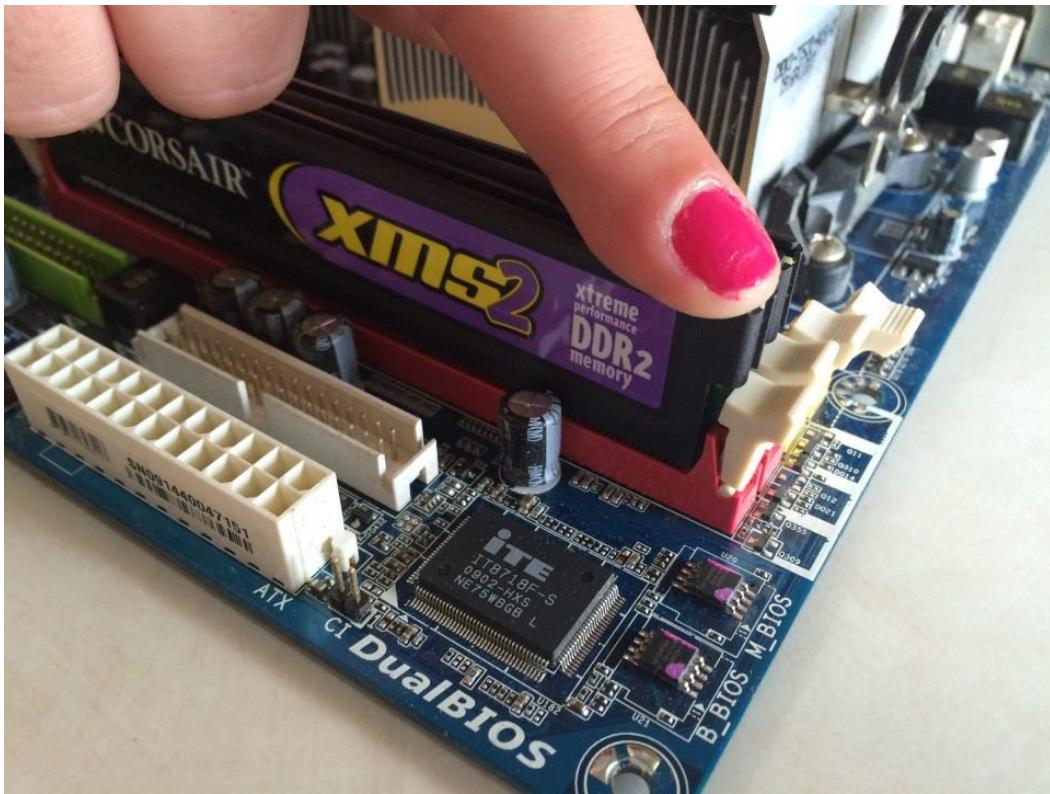
There are four RAM slots here.

If using unbalanced RAM (a 2GB and a 4GB module, for instance) pair up RAM in slots 1 and 3 or 2 and 4. If there is old RAM here and you are going to use it, pair the new RAM correctly. Try not to put three modules in a 4 module slot. It will be less effective

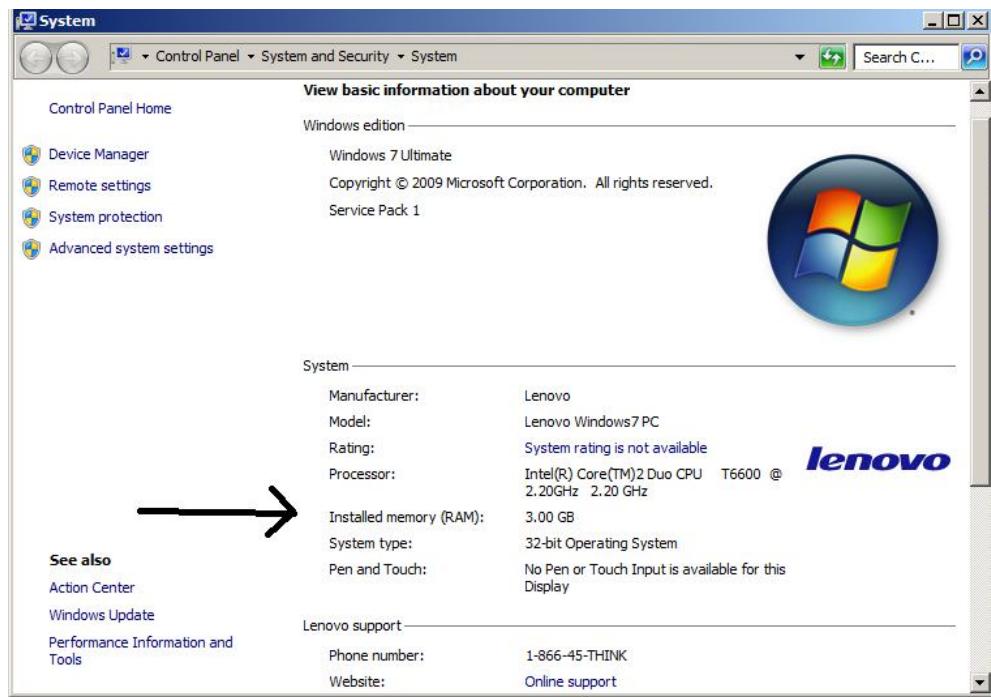
Unhinge the clips (on some motherboards, there is one clip, on others there are two—one on each end). Unseat the old RAM by pulling on each end, wiggling it up and down just a bit. Do not wiggle it from side to side.



Make sure that the pins and cutout on the RAM match the slot before placing the new RAM (if you purchased it according to the steps above, they should match). Never force a RAM module into a slot that doesn't match the notch on the module.



Make sure the RAM is seated securely; it takes a slight amount of force. If positioned properly, it usually snaps the retaining hinge into place. Unseated RAM is the major cause of the RAM not being recognized by the computer OS.



Plug the computer back in and start it up. On Windows 7 computers, click on the Windows tab, and right-click on My Computer (or go to Control Panel > System and Security > and under System, click on View Amount of RAM and processor speed), on Windows 8.1, right-click on the Windows tab, click System. Your new RAM should be seen immediately.

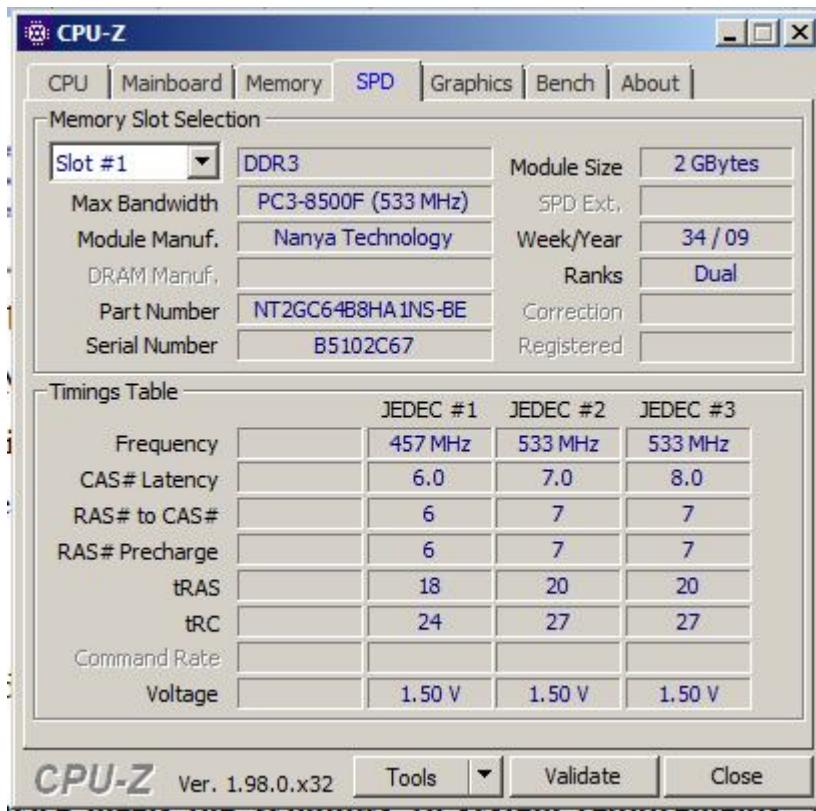
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Serial presence detect (SPD)

Serial presence detect (SPD) is information stored on an EEPROM chip when a computer is booted. It is located on an SDRAM memory module and communicates to the BIOS the module size, data width, speed and voltage, which are used to configure the module memory controller for maximum reliability and performance.

The manufacturer of the memory module will put the SPD information on the EEPROM chip. When a computer is turned on, if the BIOS is not provided with SPD, it will assume the memory module information, which presents no problem to some memory modules.

Parallel presence detect (PPD) data was used in earlier 72-pin SIMMs. However, the standard changed to SPD with the later model 168-pin DIMM. SPD encodes much more information.



Installation: Windows 10

1. **Check your device meets the Windows 10 system requirements.** The minimum specs needed to run Windows 10, so check your device is capable:

CPU: 1GHz or faster processor

RAM: 1GB for Windows 10 32-bit or 2GB for Windows 10 64-bit

Storage: 32GB of space or more

GPU: DirectX 9 compatible or later with WDDM 1.0 driver

Display: 800x600 resolution or higher

2. **Create USB installation media.** Visit Microsoft's Windows 10 download page and select “Download tool now” under the “create Windows 10 installation media” section. Transfer the downloaded installer tool to a USB drive.

3. **Run the installer tool.** Open the installer tool by clicking on it. Accept Microsoft's terms, and then select “Create installation media for another PC” on the “What do you want to do?” page. After selecting which language you want Windows 10 to run in, and which edition you want as well (32-bit or 62-bit), you'll be asked what type of media you want to use.

Installing from a USB drive is definitely the preferred option but you can also install from a CD or ISO file. Once you choose your device, the installer tool will download the required files and put them onto your drive.

4. Use your installation media. Insert your installation media into your device and then **access the computer's BIOS or UEFI**. These are the systems that allow you to control your computer's core hardware.

The process of accessing these systems is unique to each device, but the manufacturer's website should be able to give you a helping hand here. Generally, you'll need to **press the F2, F12 or Delete keys** as your computer boots up.

5. Change your computer's boot order. Once you have access to your computer's BIOS/UEFI you'll need to locate the settings for boot order. You need the Windows 10 installation tool to be higher up on the list than the device's current current boot drive: this is the SSD or HDD that your existing OS is stored on. You should **move the drive with the installer files to the very top of the boot order menu**. Now, when you restart your device the Windows 10 installer should load up first.

6. Restart your device. Save your settings in the BIOS/UEFI and reboot your device.

7. Complete the installation. Your device should now load up the Windows 10 installation tool on restart. This will guide you through the rest of the installation process.

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Installation - Upgrading to Windows 10: Upgrading from an older version of Windows

If you're upgrading to Windows 10 from Windows 7 or Windows 8, the process is much easier.

1. Download the installer tool. Visit Microsoft's Windows 10 download page and select “**Download tool now**” under the “**create Windows 10 installation media**” section.

2. Run installer tool. You can just upgrade your version of Windows directly from the installer tool, without creating separate installation media. When you reach the “**what do you want to do?**” section, **select “Upgrade this PC now.”**

3. Complete Windows 10 installation. Now the installer tool will guide you through the rest of the process. Just follow the steps to complete the installation process and you'll have Windows 10 installed on your device at the end of it.

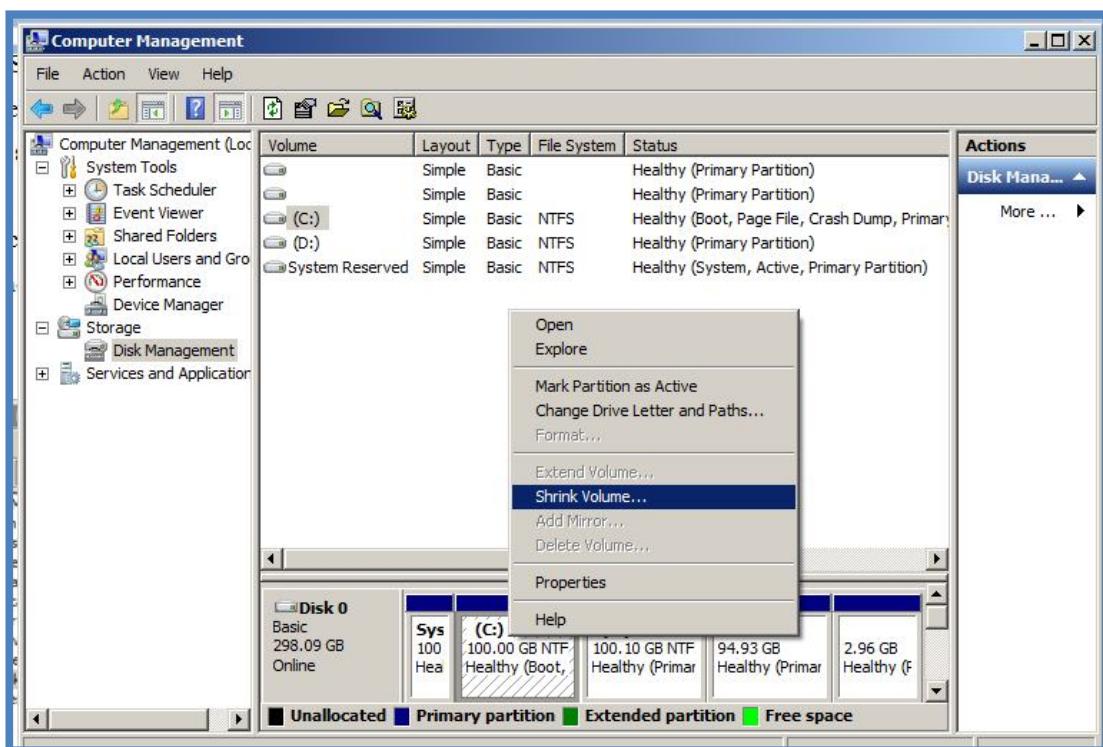
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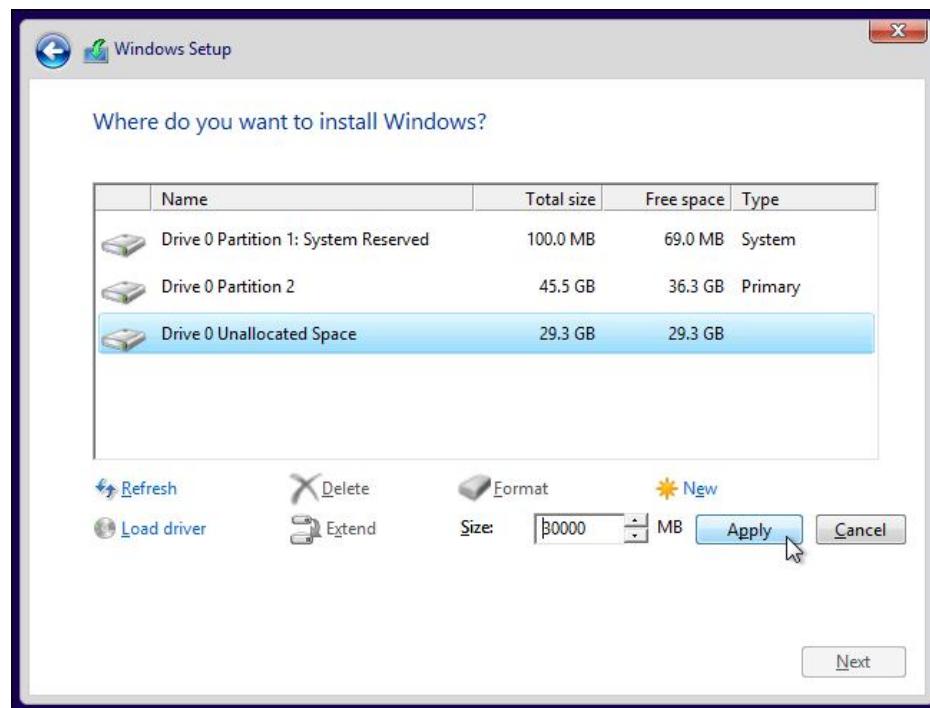
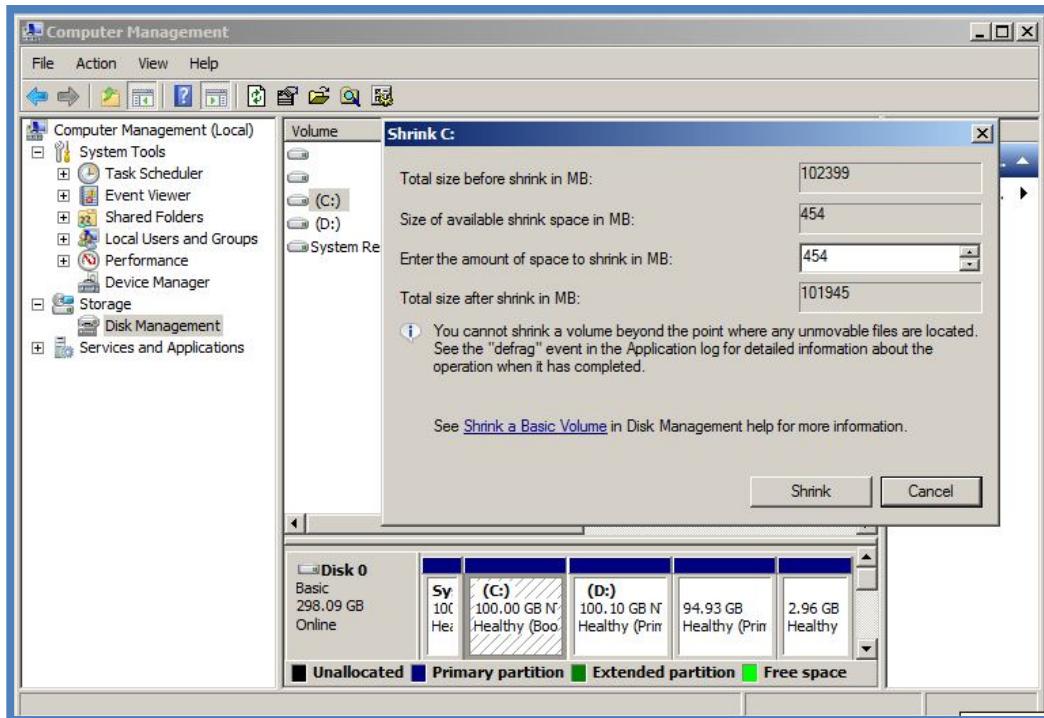
Preparing the System for Dual-Booting:

Different operating systems have different uses and advantages. Having more than one operating system installed allows you to quickly switch between two and have the best tool for the job. It also makes it easier to dabble and experiment with different operating systems.

If Separate Disk space is allocated for the installation of another Operating System, use that space during second Operating System.

If separate space is NOT allocated, then go to the existing operating system Device Manager, Select the Drive and Right Click and Apply Shrink Volume, it will ask the amount of Disk Space required for the new Operating System. Set the correct space for new operating system and restart the PC for loading new operating system as usual like loading from DVD/Pen Drive.





After Successful installation, the system will ask for choosing operating system to get load

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Working on Recovery Partition:

A recovery partition is a partition on the disk that helps to restore the factory settings of the OS (operating system) if there is some kind of system failure. This partition has no drive letter, and you can use only Help in Disk Management.



The recovery partition has two varieties:

- The first of the varieties is the most widespread and installed with the Windows operating system on a GPT disk and occupies a negligible amount of disk space.
- The second is set by the computer manufacturer (like Lenovo, Dell or HP). It occupies a significant amount of disk space since it is this part of the recovery partition that contains the manufacturer settings for application drivers and other things that allow you to restore these default settings. This partition is also called the OEM section.

New Recovery Partitions get created after every Windows Upgrade.

- A curious thing is that every time you update Windows, a new recovery partition is created. This happens due to a lack of free space in your recovery partition or in system reserved partition. As a result, you will get as many recovery partitions as you update your system.
- When you get a new recovery partition on your disk, the old recovery partition can be removed without worries, as it is nonfunctional. That's how you can get a bit of free space.

Deleting Recovery Partitions:

- Use Disk Manager, and select Old recovery Disk Partitions and delete (if sure)
- Use Diskpart utility to remove old recovery Disk Partitions with suitable commands
 - Diskpart → list disk → Select disk 0 (Assume Disk 0 is Listed) → list volume → select volume 1 (Assume Volume 1 is Recovery Partition) → Delete Volume 1

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Ten Windows Registry Tweaks:

Start the Settings of Windows Registry opening the Registry Editor

- Hit **Win+R**
- Type **regedit**
- Click **OK.**

1. Add “Open with Notepad” to the context menu

When you right-click on your desktop the appeared list is called the **Context menu**. There are a few options available in the context menu but if you want you can even customize it accordingly and one such customization adding the **Open with Notepad** option.

- Navigate using the following route:-
 - Computer\HKEY_CLASSES_ROOT*\shell
- Right-click on **Shell> New> Key**. Then rename it to **Open With Notepad**.
- Right-click on **Open with Notepad> New> Key**. Then rename it to **Command**.
- Double-click on **Default** from the right panel of the Window, in the **Value data** section type “**notepad.exe %1**” and click **OK**.
- Now, close the Registry Editor, right-click on the file that you want to open with **Notepad**, and select the “**Open with Notepad**” option.

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2. Change your Logon Screen Background

Changing the wallpaper on your desktop is one of the easiest things to do in Windows. But if you can have that display any image you want, why not do the same with your logon screen?

Go to the Key:

- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Authentication\LogonUI\Background
 - Double click on “OEMBackground” to open it.
 - Change the value in the “Value data” field to 1.
 - Click OK.
-
- Using Windows Explorer, navigate to your Windows directory and go to the path C:\Windows\System32\oobe
 - If there’s a folder in here called “**info**,” go into it; if there’s a folder inside of that one called “**backgrounds**,” go into that. If neither exists, you’ll need to create them both first.

- Copy the image (it must be a JPEG, and smaller than 256KB in size) you want to use as your logon screen background into the **info\backgrounds** folder.
- Rename the image **backgroundDefault.jpg**

The next time you **restart** your computer, or **log out**, see this image as the new logon screen.

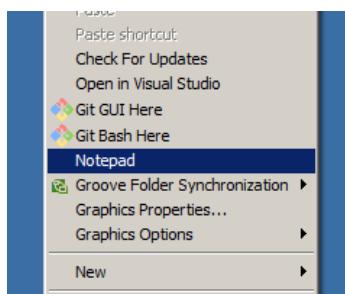
- If you chose an image that prevents the buttons and text from looking their best on the logon screen, you can adjust their appearance as well.
- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Authentication\LogonUI (Now **NOT** going into **Background** this time).
- Add a DWORD value called “**ButtonSet**.”
- Change its value to either **1** (darker text shadows and lighter buttons, intended for lighter backgrounds) or **2** (no text shadows and opaque buttons, for darker backgrounds); **0 is the Windows default.**

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3. Adding Applications to the Desktop Context Menu: Adding Notepad

Go to the Key:

- HKEY_CLASSES_ROOT\Directory\Background\shell
- Right-click on **Shell** → **New** → **Key**. Then rename it to **Notepad**
- Right Click on **Notepad** → **New** → **Key**. Then rename it to **Command**
- Select the **Command**. Double Click on **Default** on Right Pane. Set the **Value data** to “**notepad.exe**”
- Go to the Desktop → Right Click. Popup Menu will display **Notepad**



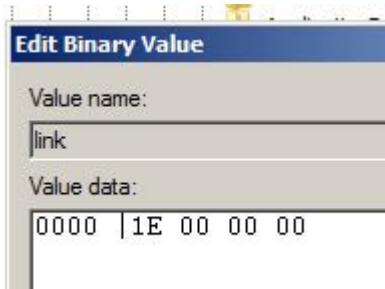
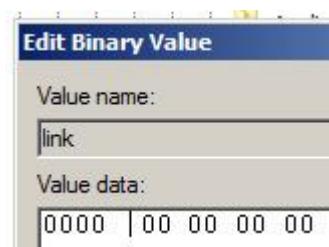
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4. Remove the “- Shortcut” Text by Editing the Registry Manually

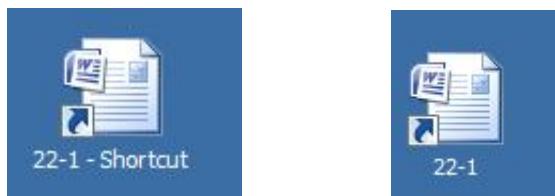
Go to the Key:

- HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Explorer

- On the right-hand side, scroll down and locate a value named **link**. (If it is not there, create it by right-clicking the **Explorer** key, choosing **New → Binary Value**, and then Renaming the New value “**link**”)
- Double click on link. In the “**Value data**” box, replace the current value with “**00 00 00 00**”. (Note that the current value will depend on what version and edition of Windows running. It doesn’t matter what’s there already. Just replace it with all zeroes.)

Old values in **Value data**New values in **Value data**

- Sign out and back in (or Restart your computer) to complete the change.
- Test it out by creating a new shortcut. Windows should no longer add the “- Shortcut” text.
- If you want to **reverse the changes**, just head back into the Registry and **delete the link** value.
 - This will work whether the value was already there or you created it yourself. Windows will recreate the value with the default setting when it needs to.



Output Before and After Registry Settings

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5. Change the Width of Window

- Navigate to **HKEY_CURRENT_USER\Control Panel\Desktop\WindowMetrics**
- Scroll to find the “**BorderWidth**” entry. (If it’s not there, create it. Right click in the right pane, select **New**, then Select “**String Value**,” and name the object **BorderWidth**.)
- Double click **BorderWidth** to open it. (Note down the number in that for recovery)

- Change the number in the “**Value Data**” field to the width you want to allot to the window (say -150).
- Click OK.
- Sign out and back in (or Restart your computer) to complete the change.



Output Before and After Registry Settings

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6. Disable Short cut Key Win-X (Test Win+D for Desktop, and Win+E for Explorer)

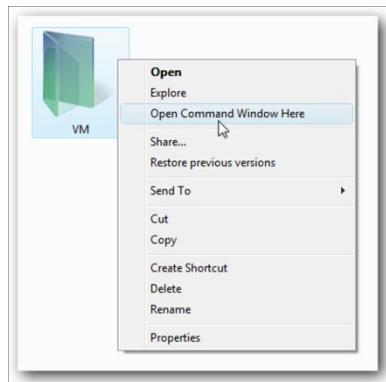
- Navigate to
HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Policies\Explorer
- Right Click on Explorer → New → Key → Create a **32-bit DWORD**. Rename it to value called **NoWinKeys**.
- Double Click on **NoWinKeys** and set the **Value data** to 1.
- Click Ok
- Sign out and back in (or Restart your computer) to complete the change.
- Try Win+D (by opening many application) and Win+E to go to Explorer – See the Changes.
- To **reverse** the changes, go to the Registry key, and delete **NoWinKeys** and Sign out/Restart

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7. Make " Open Command Window Here" Always Display for Folders or Drives

- Navigate to HKEY_CLASSES_ROOT\Directory\shell\cmd
- Select **cmd**. On Right Pane, Rename Key “**Extended**” to “**Extended-Orig**”
- Go to any Folder and Right Click on Folder, will get “**Open Command Window Here**”, with this one can work with Command Prompt.
- Do the Same thing for **Drive** by Navigating to
HKEY_CLASSES_ROOT\Drive\shell\cmd

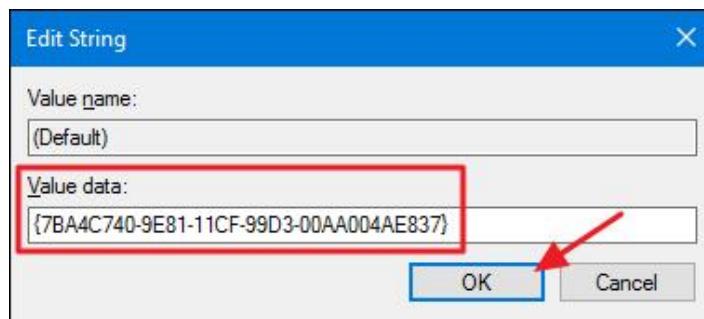
- Select **cmd**. On Right Pane, Rename Key “Extended” to “Extended-Orig”
- Go to any Drive in My Computer and Right Click on Drive, will get “**Open Command Window Here**”, with this one can work with **Command Prompt**.

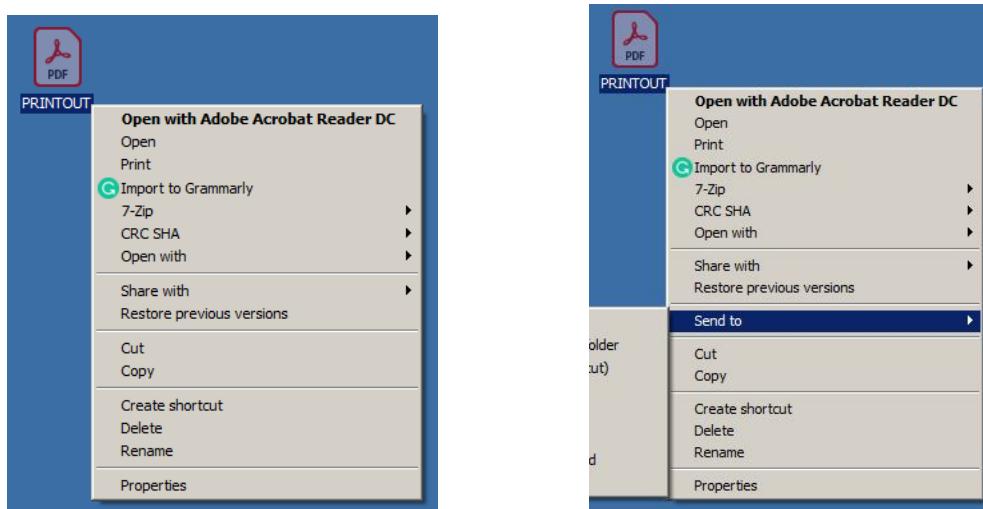


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8. Remove “Send To” from Menu in Windows

- Navigate to HKEY_CLASSES_ROOT\AllFilesystemObjects\shell\ContextMenuHandlers\Send To
- Select **SendTo**, in Right Pane Double Click on **Default**
- Note down the data (numbers) in **Value data** (Required for Value Recovery).
- Clear the Contents of Value data
- Click OK.
- To Test, Go to Desktop, Right on any File, “Send To” will not be visible.
- To reverse, the task, just head back into the Registry and Restore the “SendTo” Value data to Original Value i.e. {7BA4C740-9E81-11CF-99D3-00AA004AE837}
- To Test, Go to Desktop, Right on any File, “Send To” will be visible now.



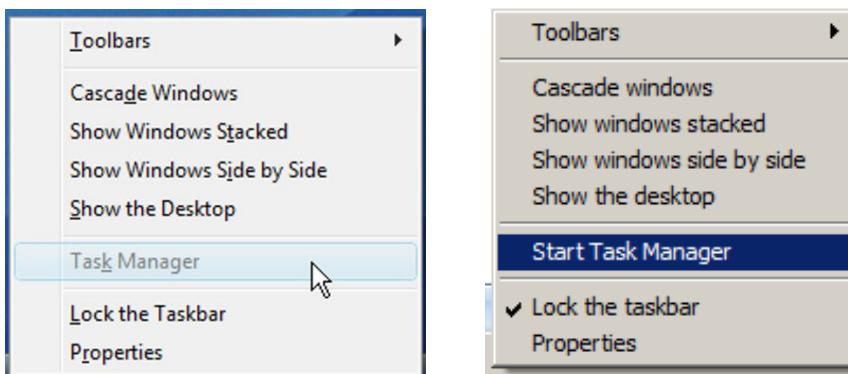


Output Before and After Registry Settings

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9. Enable and Disable Task Manager in Windows

- Navigate to
HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Policies
- If System is not found Create New Key **System**
- Right-click on **Policies** → **New** → **Key**. Then rename it to **System**
- Right Click on **System** → **New** → **DWORD (32bit)**. Then rename it to **DisableTaskMgr**
- Double Click on **DisableTaskMgr**, Set the Value data to 1 (For Disabling Task Manager)
- Click OK,
- Test it by right Click on Task bar.
- If you want to **reverse the changes**, just head back into the Registry and set the Value data of **DisableTaskMgr** to 0.



Output Before and After Registry Settings

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10. Change the Title Bar Text Color and Button Text Colors

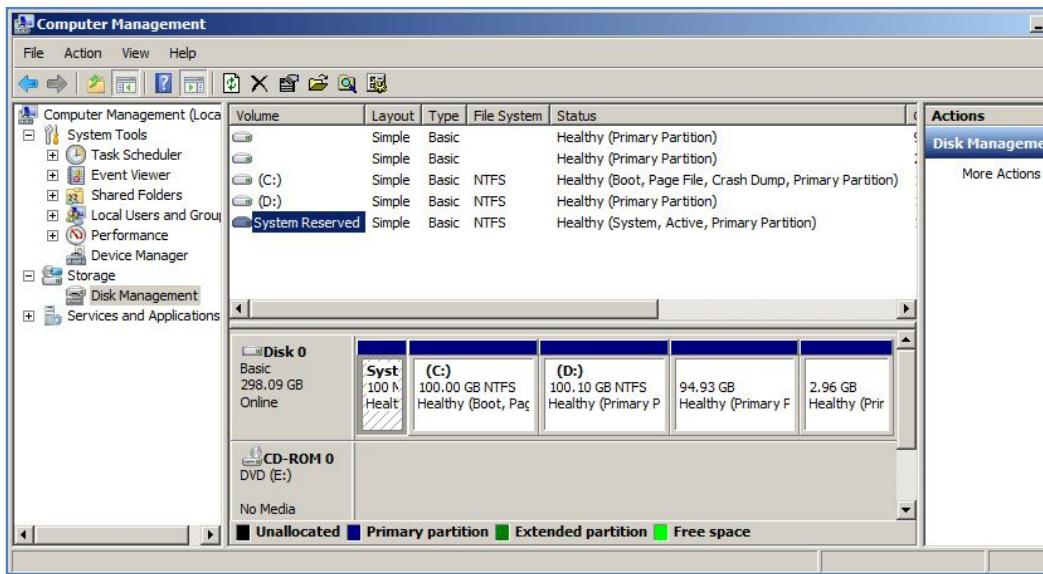
- Navigate to
HKEY_CURRENT_USER\Control Panel\Colors
- Select **Colors**, and on Right Pane Select **TitleText**
 - Set the **Value data** for **TitleText** to Color of your Choice in RGB format (Original Value is 255 255 255, it means Text appeared in Title bar is in pure **White** Color).
 - Set the color to 0 0 0 (means Title bar Text appears in Black Color)
- Select **Colors**, and on Right Pane Select **ButtonText**
 - Set the **Value data** for **ButtonText** to Color of your Choice in RGB format (Original Value is 0 0 0, it means Text appeared in Buttons is in pure **Black** Color).
 - Set the color to 0 0 255 (means Button Text appears in Blue Color)
- Click OK,
- Sign out and back in (or Restart computer) to complete the change.

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Disk Management Utilities:

Disk Management is a system utility in Windows that enables you to perform advanced storage tasks. Here are some of the things Disk Management is good for:

- To setup a new drive.
- To extend a volume into space that's not already part of a volume on the same drive
- To shrink a partition, usually extend a neighboring partition
- To change a drive letter or assign a new drive letter.



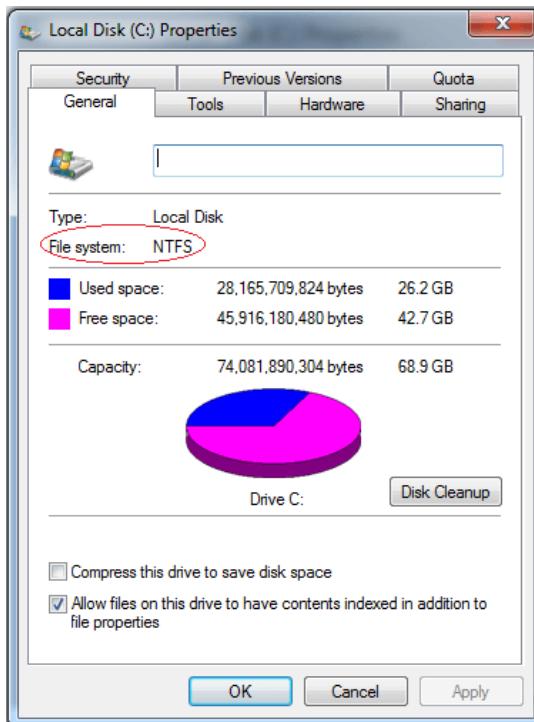
Here are some common tasks but that use other tools in Windows:

- To free up disk space
- To defragment your drives.
- To take multiple hard drives and pool them together, similar to a RAID

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What is a File System?

- A file system is a process of managing how and where data on a storage disk, which is also referred to as file management or FS.
- It is a logical disk component that compresses files separated into groups, which is known as directories.
- The file system enables you to view a file in the current directory as files are often managed in a hierarchy.
- It is abstract to a human user and related to a computer; hence, it manages a disk's internal operations.
- NTFS is the most common in modern times (Windows OS).
- It would be impossible for a file with the same name to exist and also impossible to remove installed programs and recover specific files without file management, as well as files would have no organization without a file structure.



- A disk (e.g., Hard disk drive) has a file system, even with type and usage.
- Also, it contains information about file size, file name, file location fragment information, and where disk data is stored and also describes how a user or application may access the data.
- The operations like metadata, file naming, storage management, and directories/folders are all managed by the file system.
- On a storage device, files are stored in sectors in which data is stored in groups of sectors called blocks.
- The size and location of the files are identified by the file system, and it also helps to recognize which sectors are ready to be used.
- Other than Windows, there are some other operating systems that contain FAT and NTFS file system.
- Apple product (like iOS and macOS) uses HFS+ as operating system is horizon by many different kinds of file systems.
- Different partitions of the same disk may use different file systems. That is, C Drive may use NTFS and D Drive may use FAT. But it means two separate partitions are there that use the same physical disk.

Examples of File Systems:

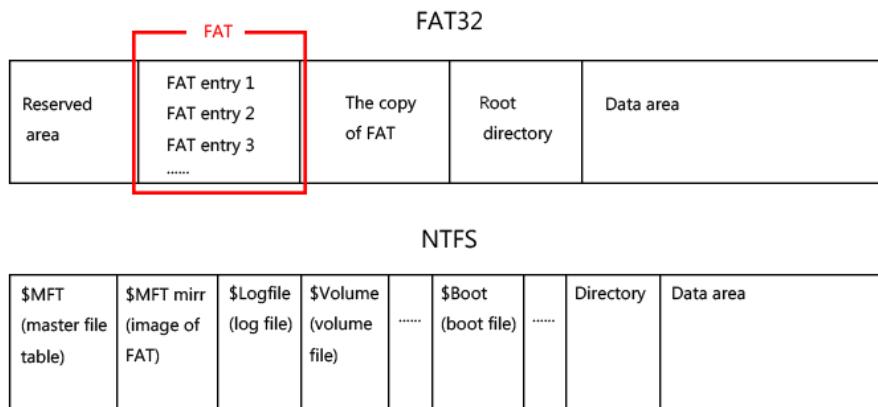
The examples of file systems are given below:

- **FAT:** FAT is a type of file system, which is developed for hard drives. It stands for **File Allocation Table**. On hard drives and other computer systems, it helps to manage files on Microsoft operating systems. In devices like digital cameras, flash memory, and other portable devices, it is also often found that is used to store file information. It also helps to extend the life of a hard drive as it minimizes the wear and tears on the hard disc. Now a days later versions of Microsoft Windows like Windows XP, Vista, 7, and 10 as use NTFS.
 - The **FAT8, FAT12, FAT32, FAT16** are all the different types of FAT (for file allocation table).
- **GFS:** A GFS is a file system, which stands for Global File System. It has the ability to make enable multiple computers to act as an integrated machine. When the physical distance of two or more computers is high, and they are unable to send files directly with each other, a GFS file system makes them capable of sharing a group of files directly. A computer can organize its I/O to preserve file systems with the help of a global file system.
- **HFS:** HFS (Hierarchical file system) is the file system that is used on a Macintosh computer for creating a directory at the time a hard disk is formatted. Generally, its basic function is to organize or hold the files on a Macintosh hard disk. Apple is not capable of supporting to write to or format HFS disks since when OS X came on the market. Also, HFS-formatted drives are not recognized by Windows computers as HFS is a Macintosh format. With the help of WIN32 or NTFS file systems, Windows hard drives are formatted.
- **NTFS:** NTFS is the file system, which stands for NT file system and stores and retrieves files on Windows NT operating system and other versions of Windows like Windows 2000, Windows XP, Windows 7, and Windows 10. Sometimes, it is known as the **New Technology File System**. As compared to the FAT and HFS file system, it provides better methods of file recovery and data protection and offers a number of improvements in terms of extendibility, security, and performance.

- **UDF:** A UDF is a file system, stands for **Universal Disk Format** and used first developed by OSTA (Optical Storage Technology Association) for ensuring consistency among data written to several optical media. It is used with CD-ROMs and DVD-ROMs and is supported on all operating systems. Now, it is used in the process of CD-R's and CD-RW's, called packet writing.

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How a file is located in FAT32/NTFS:



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Support on Large File

- FAT32 uses a 32-bit area to record file size in bytes, so a single file can only be up to 2^{32} bytes i.e. $2^2 \times 2^{30} = 4\text{GB}$.
- FAT32 can store file of size in the range 4G – 1byte, because we cannot have files of 0 length.
- To save a file which is larger than 4G NTFS is used.
- Maximum file size on a NTFS partition can be 2^{64} bytes i.e. $2^4 \times 2^{60} = 16\text{ EB}$.

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Types of file systems

There are various kinds of File Systems, which are as follows:

1. Disk file systems

On the disk storage medium, a disk file system has the ability to randomly address data within a few amounts of time. Also, it includes the anticipation that led to the speed of accessing data.

Without regard to the sequential location of the data, multiple users can access several data on the disk with the help of a disk file system.

2. Flash file systems

A flash file system is responsible for restrictions, performance, and special abilities of flash memory. It is superior to utilize a file system that is designed for a flash device; however, a disk file system is the basic storage media, which can use a flash memory device.

3. Tape file systems

A tape file system is used to hold files on the tape as it is a tape format and file system. As compared to disks, magnetic tapes are more powerful to access data for a long time, which are the challenges for a general-purpose file system in terms of creation and efficient management.

4. Database file systems

A database-based file system is another method for file management. Files are recognized by their characteristics (like a type of file, author, topic, etc.) rather than hierarchical structured management.

5. Transactional file systems

Some programs require one or more changes to fail for any reason or need several file systems changes but do not make any changes. For instance, a program may write configuration files or libraries and executables at the time of installing or updating the software. The software may be unusable or broken if the software is stopped while updating or installing. Also, the entire system may leave in an unusable state if the process of installing or updating the software is incomplete.

6. Network file systems

A network file system offers access to files on a server..

7. Shared disk file systems

A shared-disk file system allows the same external disk subsystem to be accessed by multiple machines, but when the number of machines accesses the same external disk subsystem, there may be occurred collisions in this condition; so, to prevent the collision, the file system decides which subsystem to be accessed.

8. Minimal file system

Early, to record and read the data in to cheaper Cassette Tape, a minimal file system is used (It is designed as an alternative to expensive microcomputer, disk and digital tape devices). On the cassette recorder, the user was informed about pressing "RECORD" when there was required to write data by system. And, to notify the system, press "RETURN" on the keyboard. Also, on the

cassette recorder, the user was needed to press the "PLAY" button when the system required to read data.

9. Flat file systems

The subdirectories are not available in the flat system. It contains the only directory, and all files are held in a single directory. Due to the relatively small amount of data space available, this type of file system was adequate when floppy disk media was available for the first time.

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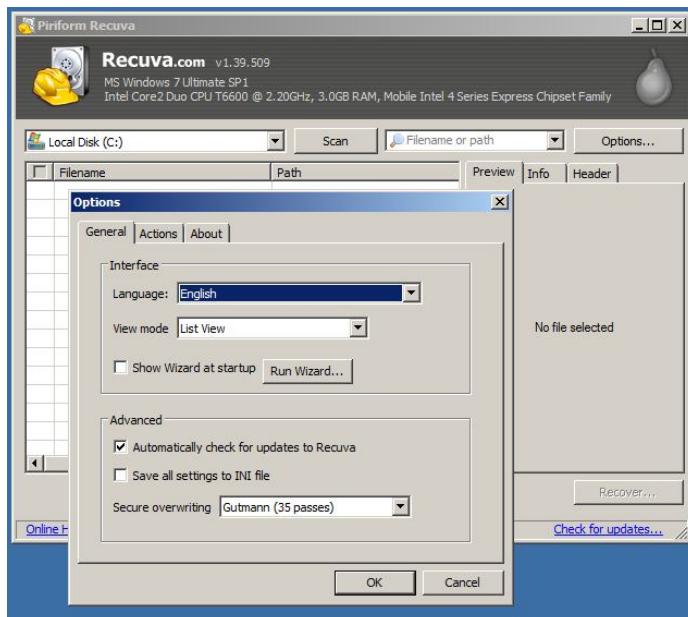
When a computer crashes, it can result in data loss. This can be loss of small files, or in the case of a large company, it can cause a company to lose a ton of money. There are many different types of Data Recovery Services that can be offered to recover data depending on the type of crash. Below are some of the services that are offered at many data recovery companies:

- **Hard Drive recovery:** Recovering data from Hard Disk Drives (Random Access Storage).
- **RAID Recovery:** Recovering data from extremely complex storage structure RAID systems.
- **Tape Recovery:** Recovering data from Tape Drives (Sequential Access Storage).
- **Optical Recovery:** Recovering data from Optical media. (Please do not attempt to fix. This will only make things worse.)
- **Removable Recovery:** Recovering data from Removable media like, floppy disks, zip drives, and other related storage media.
- **Digital Recovery:** Recovering data from Digital media devices like cameras, portable storage devices, and other flash media.

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Recuva: Data Recovery Software

- **Superior file recovery:** Recuva can recover pictures, music, documents, videos, emails or any other file type you've lost. And it can recover from any rewriteable media you have: memory cards, external hard drives, USB sticks and more!
- **Recovery from damaged disks:** Unlike most file recovery tools, Recuva can recover files from damaged or newly formatted drives. Greater flexibility means greater chance of recovery.
- **Deep scan for buried files:** For those hard to find files, Recuva has an advanced deep scan mode that scours your drives to find any traces of files you have deleted.
- **Securely delete files:** Sometimes you want a file gone for good. Recuva's secure overwrite feature uses industry- and military-standard deletion techniques to make sure your files stay erased.



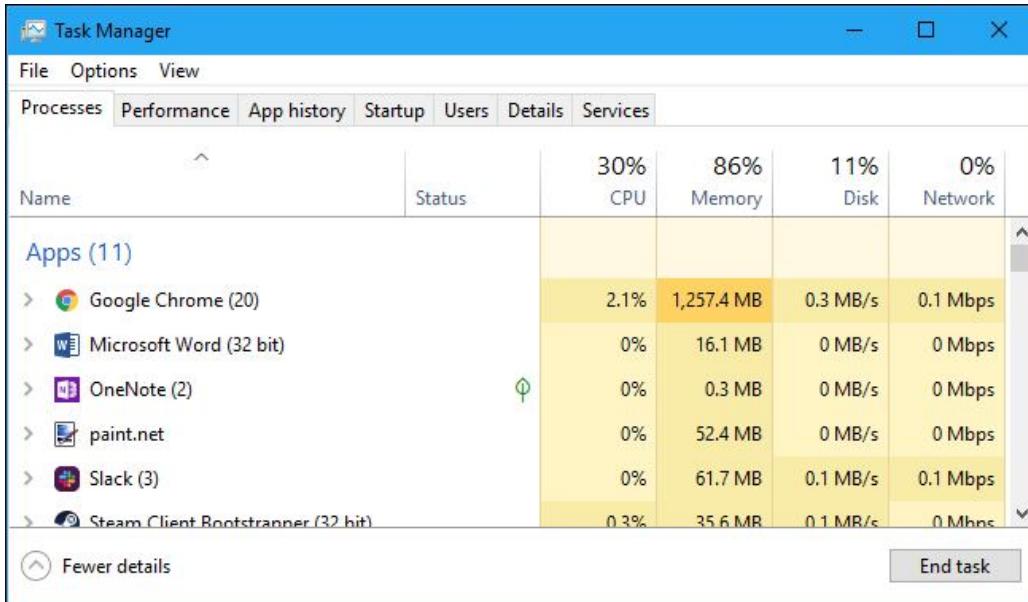
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Working with Task Manager:

- Task Manager displays the programs, processes, and services that are currently running on your computer.
- Task Manager can be used to monitor your computer's performance or to close a program that's not responding.

Way to Open Task Manager:

- Press Ctrl+Shift+Esc to open the Task Manager with a keyboard shortcut
- Right-Click the Windows taskbar and select “Task Manager.”

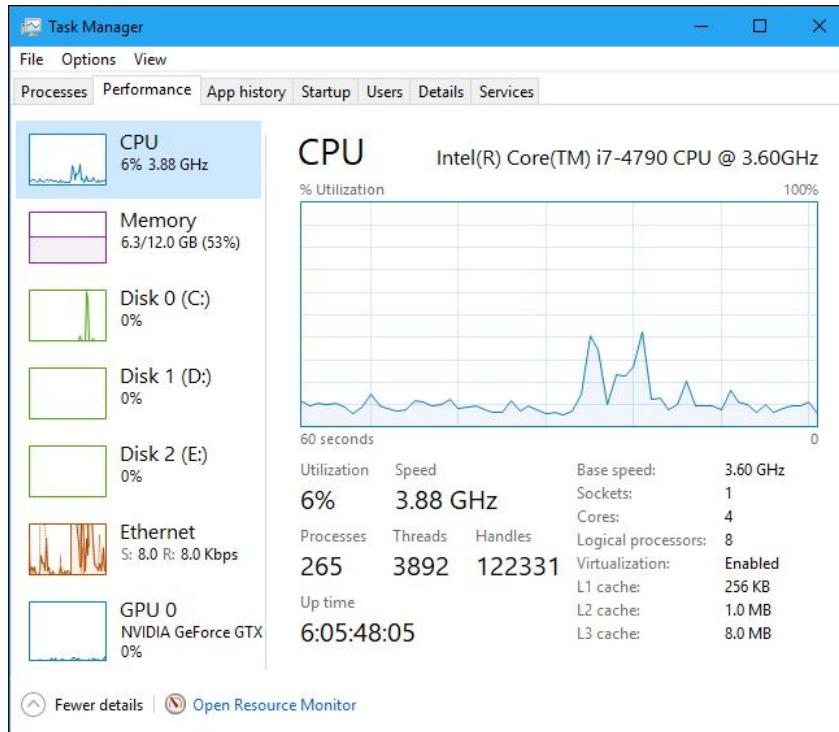


The Task Manager includes the following tabs:

- **Processes:** A list of running applications and background processes on your system along with CPU, memory, disk, network, GPU, and other resource usage information.
- **Performance:** Real-time graphs showing total CPU, memory, disk, network, and GPU resource usage for your system. Many other details like computer’s IP address, model names of your computer’s CPU and GPU etc. can be obtained here.
- **App History:** Information about how much CPU and network resources apps have used for your current user account. This only applies to new Universal Windows Platform (UWP) apps—in other words, Store apps—and not traditional Windows desktop apps (Win32 applications.)
- **Startup:** A list of your startup programs, which are the applications Windows automatically starts when you sign into your user account. You can disable startup programs from here, although you can also do that from Settings > Apps > Startup.
- **Users:** The user accounts currently signed into your PC, how much resources they’re using, and what applications they’re running.
- **Details:** More detailed information about the processes running on your system. This is basically the traditional “Processes” tab from the Task Manager on Windows 7.

- **Services:** Management of system services. This is the same information you'll find in services.msc, the Services management console.

Performance Information in Task Manager:



- The Performance tab shows real-time graphs displaying the usage of system resources like CPU, memory, disk, network, and GPU.
- If multiple disks, network devices, or GPUs are present that could be viewed all of them separately.
- The small graphs in the left pane shows resource usage over the last 60 seconds.

In addition to resource information, the Performance page shows information about system's hardware. Some different panes are:

- **CPU:** The name and model number of CPU, its speed, the number of cores it has, and whether hardware virtualization features are enabled and available. It also shows system's "uptime," which is how long system has been running since it last booted up.
- **Memory:** How much RAM the system has, its speed, and how many of the RAM slots on motherboard are used. It also shows how much of memory is currently filled with cached data.

- **Disk:** The name and model number of disk drive, its size, and its current read and write speeds.
- **Wi-Fi or Ethernet:** Windows shows a network adapter's name and its IP addresses (both IPv4 and IPv6 addresses) here. For Wi-Fi connections, it also shows the Wi-Fi standard in use on the current connection—for example, 802.11ac.
- **GPU:** The GPU pane shows separate graphs for different types of activity—for example, 3D vs. video encoding or decoding. The GPU has its own built-in memory, so it also shows GPU memory usage. It shows the name and model number of GPU here and the graphics driver version it's using.

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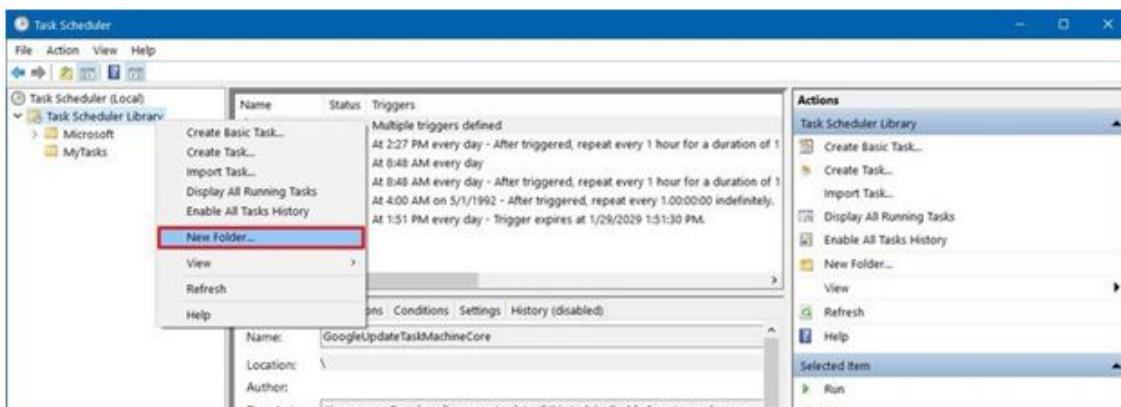
Working with Task Scheduler:

- Task Scheduler is a tool that allows you to create and run virtually any task automatically.
- Task Scheduler works by keeping tabs of the time and events on your computer and executes the task as soon as the condition is met.

How to create a basic task using Task Scheduler

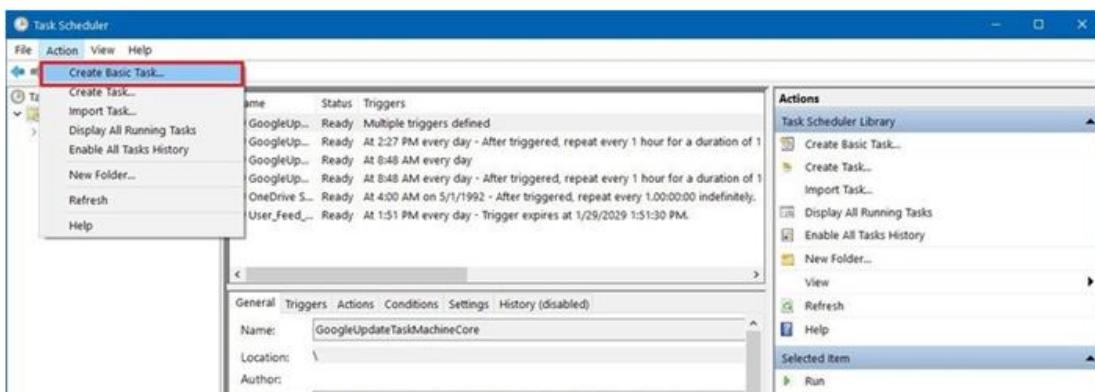
To create a task using basic settings on Windows 10, use these steps:

1. Open Start.
2. Search for **Task Scheduler**, and click the top result to open the experience.
3. Right-click the "Task Scheduler Library" branch, and select the **New Folder** option.

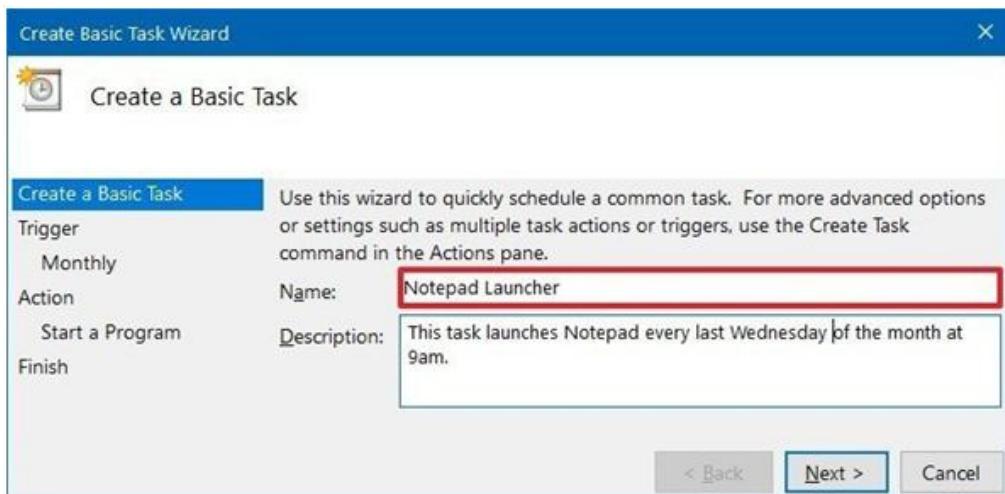


4. Type a name for the folder. For example, MyTasks. (This step isn't a requirement, but it's a recommended step to keep your tasks separate from the system and apps tasks.)
5. Click the **OK** button.
6. Expand the "Task Scheduler Library" branch, and select the **MyTasks** folder.

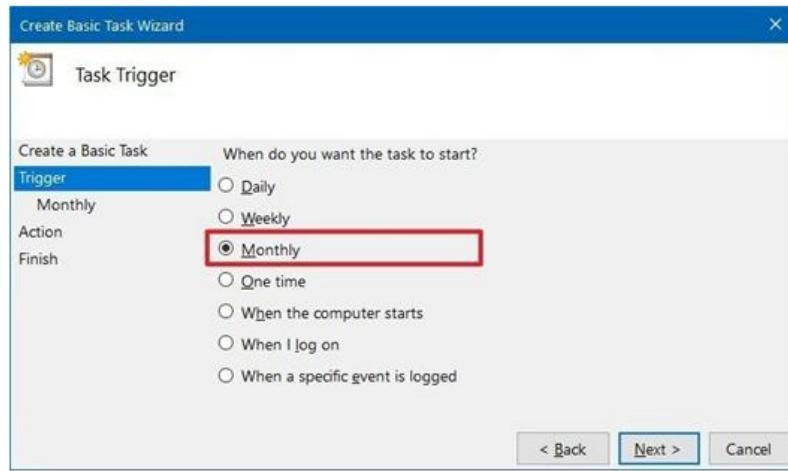
7. Click the **Action** menu.
8. Select the **Create Basic Task** option.



9. In the "Name" field, type a short descriptive name for the task. For example, Notepad Launcher.

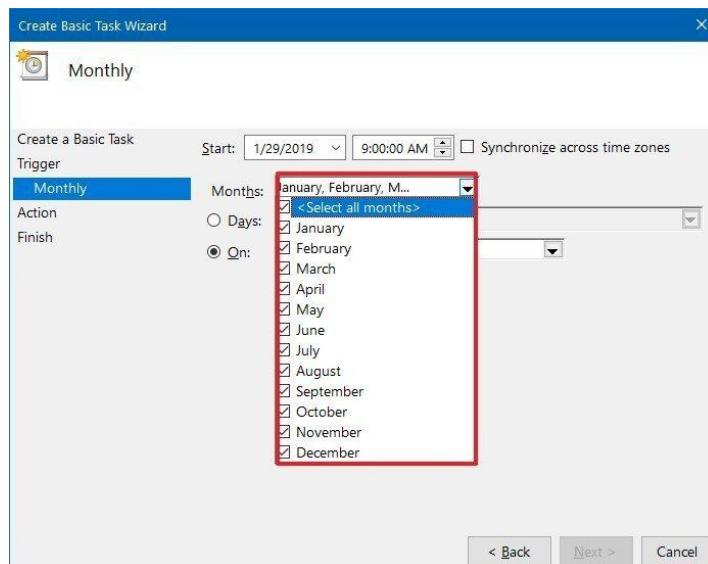


10. (Optional) In the "Description" field, create a description for the task.
11. Click the **Next** button.
12. Select the **Monthly** option.

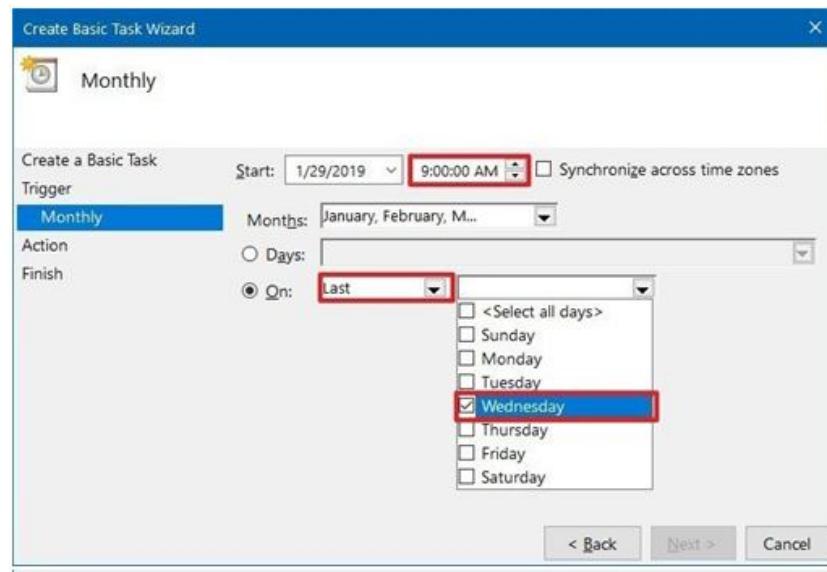


Task Scheduler allows you to select from a number of triggers, including on a specific date, during startup, or when you or a particular user signs in. Depending on your requirements, you'll need to configure additional parameters. In this case, we'll be selecting the option to run a task every month.

13. Click the **Next** button.
14. Using the "Start" settings, specify when the task should start running and the time (very important).
15. Use the "Monthly" drop-down menu to the months of the year that you want to run the task.

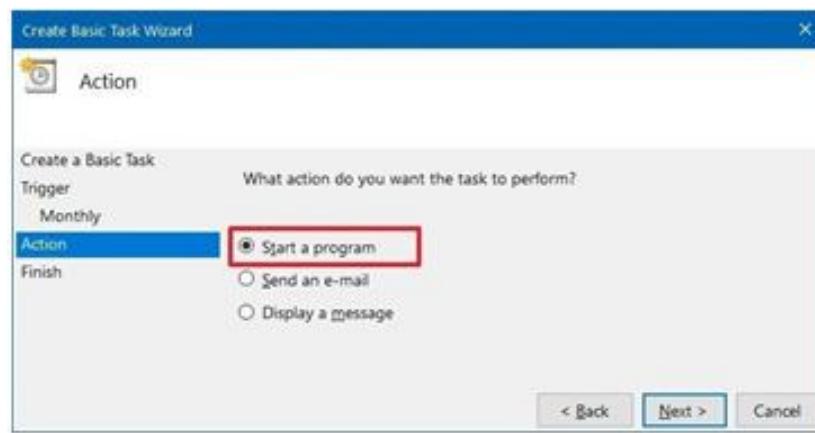


16. Use the "Days" or "On" drop-down menu to specify the days that the task will run.



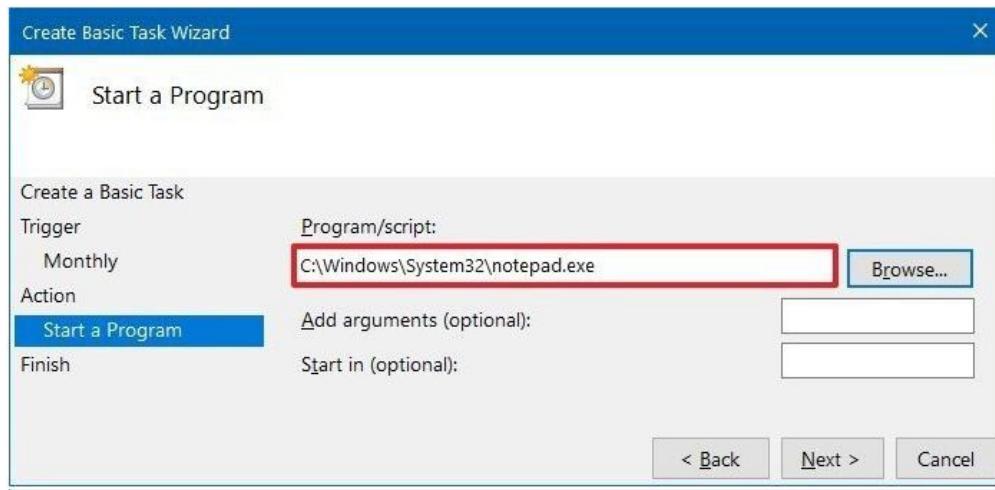
Quick Tip: Using the "On" setting may be your best option if you're planning to run a task during a specific day of the week.

17. Click the **Next** button.
18. Select the **Start a program** option to launch an app, run a command, or execute a script file.



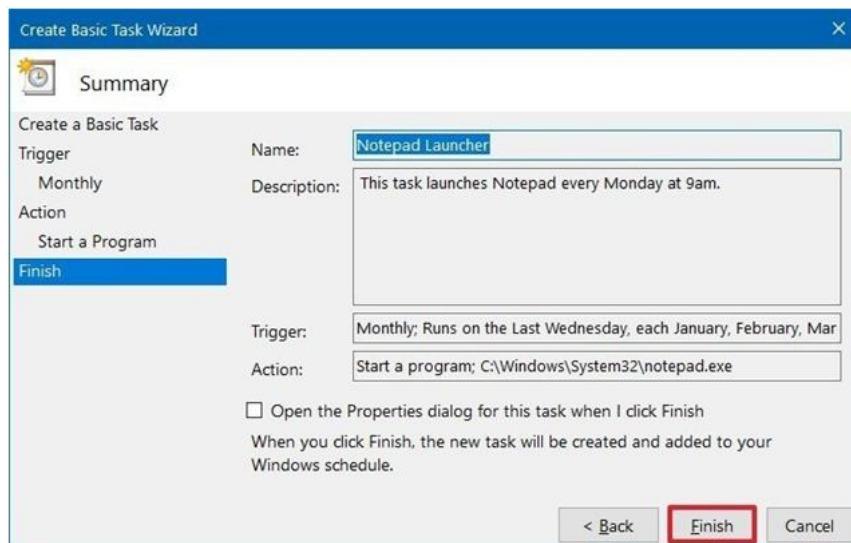
You can select the **Send an e-mail** or **Display a message** option, but these are deprecated features, which means that they may or may not work because Microsoft is no longer maintaining them.

- **Send an e-mail:** Triggers an email notification with a custom message on schedule, but it requires to specify an email server to work.
 - **Display a message:** Allows to display a text message on the screen on schedule.
19. In the "Program/script" field, specify the path for the application.



Quick Tip: If you don't know the path of the app, click the **Browse** button to find it.

20. (Optional) In the "Add arguments" field, you can specify arguments to run the task with special instructions.
21. (Optional) In the "Start in" field, specify the folder in which the program will start. (Usually, you can leave this setting empty.)
22. Click the **Finish** button.



Once you've completed the steps, the task will be saved, and it'll run automatically on the schedule you specified.

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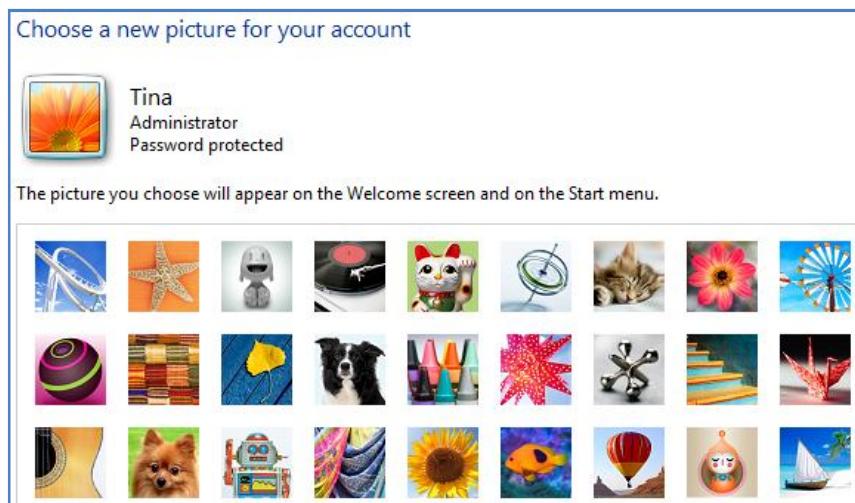
Customize Windows Desktop

1. Change the Welcome Screen

There are two basic things you can change that will affect the welcome screen. First of all, you can change your profile picture. Secondly, you can apply a hack or software to change the background image.

To change your profile picture, go to > *Start* and type > *User Accounts* into the bar that says > *Search programs and files*, then open the respective entry under > *Control Panel*. Next, select > *Change your picture*. You can now choose a default image or click > *Browse for more pictures...* at the bottom of the list to access your own files.

Once you have selected an image click the > *Change Picture* button and you're done.



2. Add Desktop Gadgets

Gadgets are tiny tools that sit on your desktop. They add functionality and quickly let you complete tasks without launching a large program. Some of my three favorite Windows gadgets are:

- Clipboard Manager - Manage your clipboard history, search entries, store favorite clips, and more.
- Skype Gadget - Keep a minimized Skype interface on your desktop and save space.
- The Magic Folder - Automatically sort files into pre-defined folders based on their file extension.



To browse, discover, and install gadgets, visit the Windows Live Gadget Gallery. To launch existing gadgets, go to > Start and type > Desktop Gadgets into the bar that says > Search programs and files, then open the respective entry under > Control Panel.

3. Change the Windows Theme

Changing the theme will have the greatest impact on your system in terms of look and feel. And you'll be surprised how easy it is. > Right-click desktop and select > Personalize..

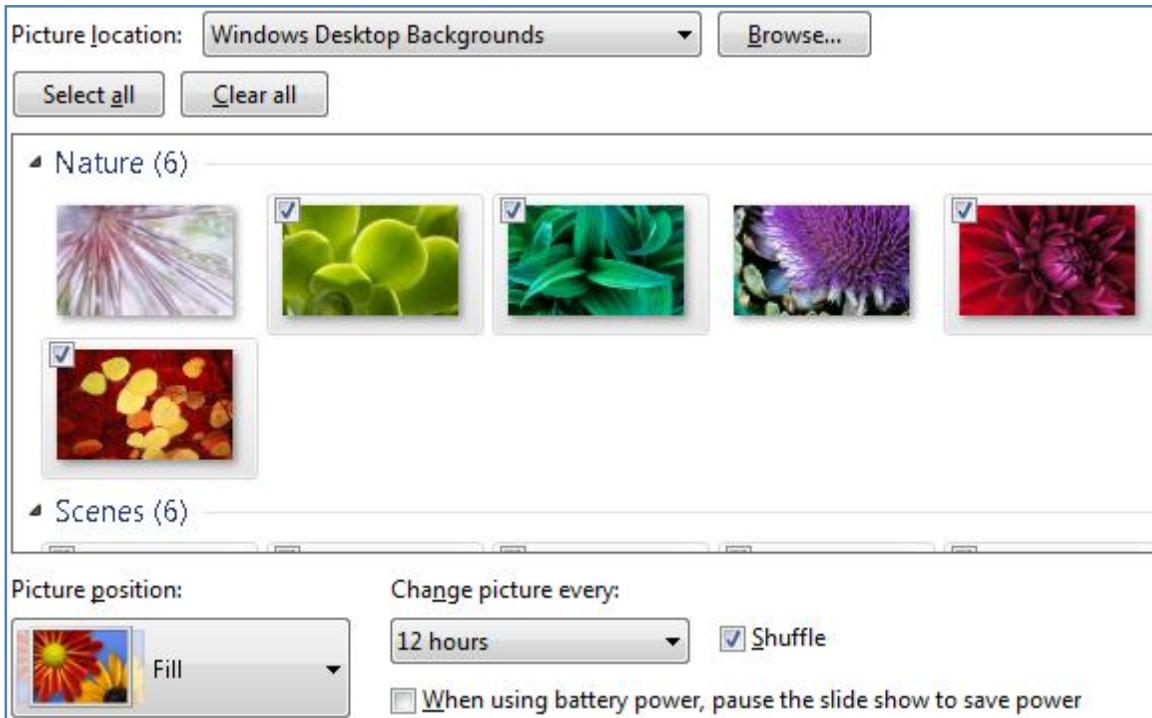


4. Create a Custom Desktop Slideshow

To add some variety to your desktop or showcase your own photos, you can create a custom desktop slideshow that will regularly change your wallpaper.

> Right-click desktop, select > Personalize, and click on > Desktop Background. To create a slideshow, you need to select any entry from the > Picture location drop-down menu other than the default 'Solid Colors'. Now > Browse for the folder that holds your pictures, > Select the ones

you like, choose a > *Picture position* and time interval to > *Change picture*. Finally click the > *Save changes* button and enjoy.

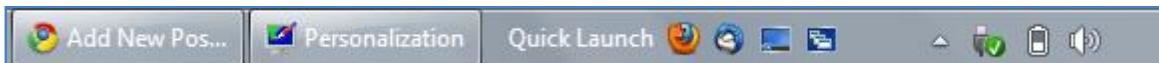


Like the > *Desktop Background* you can also customize > *Window Color* and > *Sounds* and so create your own custom theme. Don't forget to > *Save theme*!

5. Add Toolbars to Taskbar & Enable Quick Launch Bar

A toolbar located in your taskbar can provide instant access to often used programs, for example iTunes. Simply > right click Taskbar, expand > *Toolbars*, and check the ones you would like to see.

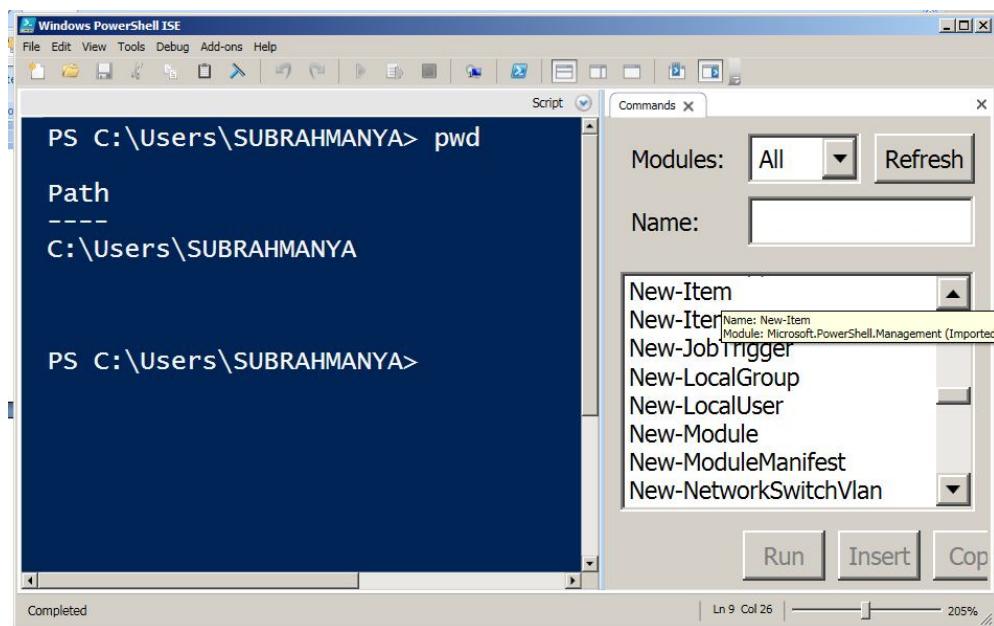
Follow the same steps outlined above and select > *New toolbar...*, enter the following path > %userprofile%\AppData\Roaming\Microsoft\Internet Explorer\Quick Launch and click > *Select Folder*. The Quick Launch bar will appear, but it needs more customization. > Right-click *Quick Launch* and uncheck > *Show title* and > *Show Text* to make it more compact. You can also uncheck > *Lock the taskbar* and then > *drag and drop Quick Launch* into place.



PowerShell ISE

- The Windows PowerShell Integrated Scripting Environment (ISE) is a host application for Windows PowerShell.
- In Windows PowerShell ISE, one can run commands and write, test, and debug scripts in a single Windows-based graphic user interface with multiline editing, tab completion, syntax coloring, selective execution, context-sensitive help, and support for right-to-left languages.
- One can use menu items and keyboard shortcuts to perform many of the same tasks that you would perform in the Windows PowerShell console. For example, when you debug a script in the Windows PowerShell ISE, to set a line breakpoint in a script, right-click the line of code, and then click Toggle Breakpoint.
- To open it you just go to Start - Search and then Type - PowerShell
- Command-line shell and scripting language built on the .NET Framework Designed specifically for system administration
 - Automate tasks on local and remote Windows machines
 - Originally designed as a replacement for the current command environment and BATCH files

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Start PowerShell by typing powershell

- Looks like command prompt, but with PS in front

- For help use:

`get-help <cmdlet name>`

- For help on all the possible get commands use:

`get-help -Name get-*`

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Execute basic commands in Windows using command prompt and PowerShell like listing the drives in a system, creating a new file, removing a file or directory, retrieving the list of processes and services

Basic Commands in Windows using Command Prompt:

| Command to be Practiced | Description |
|--|--|
| <code>dir</code> | Listing Files and Folders |
| <code>md FloderName</code> | To make the Directory |
| <code>rd FloderName</code> | To remove Directory |
| <code>cd NextFloderName</code> | Change Directory to successor Directory |
| <code>cd ..</code> | Change Directory to Previous Directory |
| <code>cd</code> | Display Current Working Directory |
| <code>del FileName</code> | Deleting File |
| <code>ren Oldfilename Newfilename</code> | Renaming Old File with New Name |
| <code>copy con FileName</code> | Create New file and Adding Contents, Copying Contents on the Console to File |
| <code>echo Text to be Displayed</code> | To Display the typed Text |
| <code>tasklist</code> | List of Processes running |
| <code>taskkill -pid Taskid</code> | End particular Process |
| <code>prompt UserPromptText</code> | To display the Prompt with user Defined Text |
| <code>cls</code> | Clear the contents in Console |
| <code>type FileName</code> | Display the Contents of the File |
| <code>exit</code> | Close the Command Prompt |

| | |
|--|--|
| copy <i>OriginalFile Copyoffile</i> | Copies the Contents of <i>OriginalFile</i> to <i>Copyoffile</i> |
| move <i>FileWithPath1</i> <i>FilewithAnotherPath</i> | File which is one path will be moved to another path with same or different name. |
| attrib [+h] [-h] [+r][-r] <i>FileName</i> | Attach the attributes to the File like, add hidden, remove hidden, add Read Only, Remove Read only |

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Simple DOS Command based Example:

- Create Folder named DTE
- Create **Four** Folders inside DTE as, Engineering, Diploma, Office, Polytechnic
- Create file named **diplomofile.txt** with initial Content “**Hardware Lab**” inside Diploma Folder
- Create file named **enggfile.txt** with initial Content “**Hello,** ” inside Engineering Folder
- Create file named **officefile.txt** with initial Content “**Welcome to** ” inside Office Folder
- Create file named **polytechnicfile.txt** inside the Polytechnic Folder in such a way that, the Final Content of the diplomofile.txt should be “**Hello, Welcome to Hardware Lab**”, which is obtained by placing of contents of respective files inside the Folders inside the DTE Folder.
- Create one **Command.cmd** and execution of this file should create above task automatically in Current Directory in one go.

Contents of file Command.cmd

- set path=%cd%
- md %path%\DTE %path%\DTE\Engineering %path%\DTE\Diploma
%path%\DTE\Office %path%\DTE\Polytechnic
- echo Welcome to > %path%\DTE\Office\officefile.txt
- echo Hello, > %path%\DTE\Engineering\enggfile.txt
- echo Hardware Lab > %path%\DTE\Diploma\diplomofile.txt
- type %path%\DTE\Engineering\enggfile.txt %path%\DTE\Office\officefile.txt
%path%\DTE\Diploma\diplomofile.txt >
%path%\DTE\Polytechnic\polytechnicfile.txt

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Experiments on Command Prompt Commands Executed:

| Commands List | Command Issued |
|----------------------|-----------------------|
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Basic Commands in Windows using PowerShell Prompt

Listing Drives in System

Get-PSDrive

Get Preset Working Directory

pwd

List all the Files and Folders in Drive

ls

New-Item cmdlet is used to create a text file and Set-Content cmdlet to put content into it.

Creating a new text file named test.txt

New-Item D:\temp\test\test.txt

Adding content to test.txt.

Set-Content D:\temp\test\test.txt 'Welcome to Hardware Lab'

Reading content of test.txt.

Get-Content D:\temp\test\test.txt

Output

Welcome to Hardware Lab

Adding content to the file test.txt.

Add-Content D:\temp\test\test.txt 'Good Lab'

Reading content of test.txt.

Get-Content D:\temp\test\test.txt

Output

Welcome to Hardware Lab

Good Lab

Display Number of Characters, Words and Lines in a File

Get-Content test.txt | measure-object -character -line -word

Output

| <i>Lines</i> | <i>Words</i> | <i>Characters</i> |
|--------------|--------------|-------------------|
| ----- | | |
| 2 | 6 | 31 |

Erasing content of test.txt.

Clear-Content D:\temp\test\test.txt

Create New Folder

Create Folder using New-Item cmdlet by passing the path using -Path as path of the directory and -ItemType as Directory.

New-Item -Path 'D:\temp\Test Folder' -ItemType Directory

Delete Folder

Remove-Item 'D:\temp\Test Folder1'

Remove the folder D:\Temp\Test Folder1 recursively. PowerShell confirms if directory is not empty.

Remove-Item 'D:\temp\Test Folder' -Recurse

You can see the content of temp folder in Windows Explorer where its folders are now removed.

Encrypt & Decrypt Using Cipher:

Using the **cipher** command to securely encrypt a **single** file is extremely easy, simply type the cipher command along with the /e parameter followed by the name of the file. The /e parameter stands for encrypt.

Cipher /e File.txt

*To undo the operation and **decrypt** the file simply replace the **/e** parameter with **/d**, which stands for decrypt.*

Cipher /d File.txt

*To check whether or not your file was indeed encrypted/decrypted use the cipher command **without** any parameters followed by the name of your file or folder:*

Cipher File.txt

The encryption **status** of your file or folder should appear at once.

If the result is **U** it means that the file is **unencrypted**.

If the result is **E** it means that the file is **encrypted**.

The command for encrypting and decrypting a folder is exactly the same.

Cipher /e Folder

*Replace the **/e** parameter with **/d** to decrypt the folder instead.*

This operation however will only perform the operation on the folder **itself** and not any of the contents inside it.

*To encrypt/decrypt **every** item within the folder you need to use the **/s** parameter.*

Cipher /e /s:Folder

The specified operation will now be performed on all the contents inside your folder as well.

To get list of Processes

Get-Process

To get list of Services

Get-Service

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Experiments on Power Shell: Commands Executed:

| Commands List | Command Issued |
|----------------------|-----------------------|
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What is E-waste and E-waste Recycling?

E-waste is short for electronic waste. That is, trash generated from broken, obsolete, and surplus electronic devices.

Typically, these electronics often contain toxic chemicals and hazardous materials. And improper disposing of these electronics can cause the release of toxic substances into our environment.

E-waste recycling then refers to the reprocessing and re-use of these electronic wastes. It is simple. It is a process that seeks to recover material from electronic waste.

- These electronic wastes may be in the form of home appliances like your air conditioners, televisions, electric cookers, air condoners, heater, DVDs, fans, microwaves, and radios. They may also be in the form of information tech equipment like your computers, laptops, mobile phones, batteries, hard disks, circuit boards, monitors.
- E-waste is quite crucial because electronics have a short useful life. As such, they become electronic waste at a swift pace.
- E-waste recycling is important to reduce environmental hazards and pollution. There is also the fact that it can protect our lives as humans and other life forms existing in our world. E-waste recycling is the reuse and reprocessing of electrical and electronic equipment of any type that has been discarded or regarded as obsolete.
- Recycling of e-waste is a growing trend and was initiated to protect human and environmental health mainly due to the widespread environmental pollution impacts of e-waste.
- Only 12.5% of e-waste is recycled.

Components of E-waste that Can be Recycled

Plastic

Plastic materials may be retrieved and sent for recycling. The recyclers can then use the plastic materials to manufacture items like plastic sleepers and vineyard stakes. You can also get fence posts, plastic trays, insulators, equipment holders, and much more.

Metal

Metals can also be retrieved and recycled to manufacture newer steel products and metals.

Glass

Extract glass from CRTs (Cathode Ray Tubes) of computer monitors and televisions. As CRT's contains several hazardous substances, such as lead a care must be taken while recycling CRT's.

- First, separate the CRT from the monitor or television. Then shred the CRT into small pieces. Remove the metals with over-band magnets. This helps you remove ferrous and even non-ferrous objects from that glass.

- After this, use washing lines to clear phosphors and oxides from that glass. The last step is called glass sorting. This is where you separate non-leaded from leaded glass. You can then use the extract to make newer screens.

Mercury

Devices containing mercury may be sent to recycling facilities using specialized technology to eliminate mercury. The end product of this elimination includes metric instruments, dental amalgams, and fluorescent lighting.

Circuit Boards

There are accredited and specialized companies smelting and recovering resources like tin, gold, silver, copper, palladium, and valuable metals.

Hard Disk

When shredded and processed, you can recover aluminum ingots from hard disks. These are particularly useful for automobiles.

Toner and Ink Cartridges

Recyclers in various manufacturing industries that remanufacture them take these toners and ink cartridges for recycling. They then use retrieved plastic and metals as raw materials for other products.

Batteries

One can take your scrap batteries to specialist recyclers to recover cadmium, steel, nickel, and cobalt for re-use in new batteries. They are also useful for fabricating stainless steel.

Apart from the listed objects, there is an endless list of other objects. But, overall, there's kind of hack to recycling any item or component. And no, e-waste recycling is not a one size fits all approach. However, there is a general way to go about it.

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Step-by-Step Process of E-waste Recycling

This is because e-scaps are typically sophisticated and manufactured from diverse elements such as metals, plastics, and glass. While this process often varies, there is a general process.

Step 1: Collecting and Transporting

This is the first stage of recycling e-waste. Here, recyclers place take-back booths or collection bins in specific places. When these bins get filled, the recyclers then transport the e-wastes to recycling facilities and plants.

Step 2: Shredding and Sorting

After collecting and transporting, the next step is to shred and sort the e-waste. The success of subsequent separation relies on shredding. And this is why efficiency is essential at this stage.

Shredding involves breaking e-waste into smaller pieces for proper sorting. With the use of hands, these tiny pieces get sorted and then manually dismantled. This is typically labor-intensive as waste items are, at this stage, separated to retrieve different parts.

After this, the materials get categorized into core materials and components. Then, these items get sorted into various categories. Typically, these category includes items that you can re-use as they are and those that require further recycling processes.

In any case, e-wastes are often manually sorted, while compounds such as fluorescent light, batteries, UPS batteries, and toner cartridges should not be crushed or shredded by hand.

Step 3: Dust Extraction

The tiny waste particles get smoothly spread via a shaking process on the conveyor belt. The smoothly spread e-waste pieces then get broken down even further. At this point, the dust gets extracted and discarded in an environmentally compliant manner. This way, there is no environmental degradation.

Step 4: Magnetic Separation

After this, a strong overhead magnet helps you separate steel and iron from other wastes. This way, you have successfully recycled the steel from the waste stream.

However, some mechanical processes may sometimes be required to separate circuit board, copper, and aluminum from other wastes particles. And this is especially where they are mostly plastic.

Step 5: Water Separation

After this, water separation tech becomes relevant to separate the glass from the plastic. You can then send leads that contain glass to smelters to use in the production of batteries, x-ray tubes, and new CRTs.

Step 6: Purification of Waste Stream

The next thing is locating and extracting leftover metals from plastics to purify the waste stream further.

Step 7: Preparing Recycled Materials For Sale

The final stage is preparing recycled materials for sale. Here, the materials separated during SSS get prepared for sale as raw materials to produce new electronics.



Benefits of E-waste Recycling

1. E-waste Recycling Helps to Conserve Available Natural Resources

E-waste recycling helps recover valuable materials from electronic products that are either old or no longer used. In turn, this saves and conserves natural resources.

This is because manufacturers can now obtain raw materials from recycled waste. Consequently, there is less need to go to earth for raw materials.

So, yes, there is less need to get copper or lead or metal from mother nature. You will need to remember that these materials are not inexhaustible to realize how much good this represents.

2. It Prioritizes Environmental Protection

As you may have observed from the processes explained above, e-waste recycling prioritizes environmental protection. It seeks to prioritize properly handling, processing and managing hazardous and toxic substances such as lead, mercury, and cadmium. All substances you may find in your e-waste stream.

As you have read, as one of the sub-steps of e-waste processing, any dust sorted from shredded particles must be disposed of in an environmentally friendly manner. This way, the hazards that these elements usually pose to our environment get substantially reduced, thanks to e-waste recycling.

3. Creates Jobs

E-waste recycling is creating new jobs for persons such as professional recyclers. What's more is that, by so doing, it has created a secondary market where recycled materials are the primary commodity.

The Environmental Protection Agency released findings that show the magnitude of economic benefits that comes from e-waste recycling. Guess what. This even beats the results derived at the REI Study earlier in 2016.

In a year, the US's recycling activities provided 757,000 jobs, \$6.7 billion tax revenues, and \$36.6 billion as wages.

By implication, for every thousand tons you recycle, there's 1.57 job created, \$ 76,000 wages paid, and \$ 14,101 tax revenues. It seems like a lot of benefit coming from trash, right? But there's more.

For a million laptops you recycle, you will have saved the equivalent of electric power capable of running 3657 households for one year. More, for a million cell phones, you can recover gold weighing 75 pounds, silver of 772 pounds, copper of 35,274 pounds, and palladium of 33 pounds. Amazing, right?

4. Saves Landfills and Reduces Global Warming

Usually, uncollected e-wastes get dumped at incinerators and landfills. By recycling e-waste, we are reducing the amount of e-wastes piling up at these places.

This is because two-thirds of waste on landfills are biodegradable and capable of breaking down and returning to their natural elements. As these wastes break down and decompose, they produce harmful gases (Methane and CO₂) – greenhouse gases – which heavily contribute to global warming.

Since landfills also pollute the water and soil in our local environment, activities like e-waste recycling, which seek to reduce these environmental concerns are not merely beneficial, but also life-saving.

Summary:

E-waste recycling is a serious global concern for a lot of reasons. It has a strong bearing on our immediate environment as humans and life on earth generally. It even promises significant economic returns for persons, communities, and even nations.

Many people have begun to tap from the floodgate of opportunities provided by e-waste recycling. In developing nations, entrepreneurs are taking advantage of e-recycling as a steady revenue stream and advancing environmental goals.

Although the steps involved might be labor-intensive, they are easy to follow. From collecting and separating to preparation for sale, there are several steps involved which you can easily flow with. And of course, you too can directly benefit from e-waste recycling and also help to save our planet.

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