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Detailed Overview of 27 Motherboard Components and Functions

Diploma in Information Technology (KCA University)



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27 Main Parts of Motherboard and its Function

Before digging deeper into the various motherboard components. Let's go over some fundamental terminology to be familiar with the content. So, let me know about computers. **What is a computer?** A computer is an electronic device that accepts raw data, processes it, and provides an output.

The motherboard is found in every electronic device, including tablets, smartphones, and PCs, and its size varies according to the device.

What is a Motherboard?

The motherboard is a huge printed circuit board (PCB) and holds all different components inside your computer. So, we can say printed circuit boards (PCB) and motherboard differ at components inside your computer. So, we can say printed circuit boards (PCB) and motherboard differ at components inside your

Location of Motherboard:

In Desktop PC: A desktop PC is a large square printed circuit plate in the PC's case. When you open the case inside the PC, you'll notice a large square printed circuit plate in the PC's case. When you open the case

In laptop: When you open the bottom cover of your laptop, you'll see the large PCB board that serves as the motherboard.

In smartphone: When you open the back cover of your smartphone and screw up some pins, you'll find your motherboard.

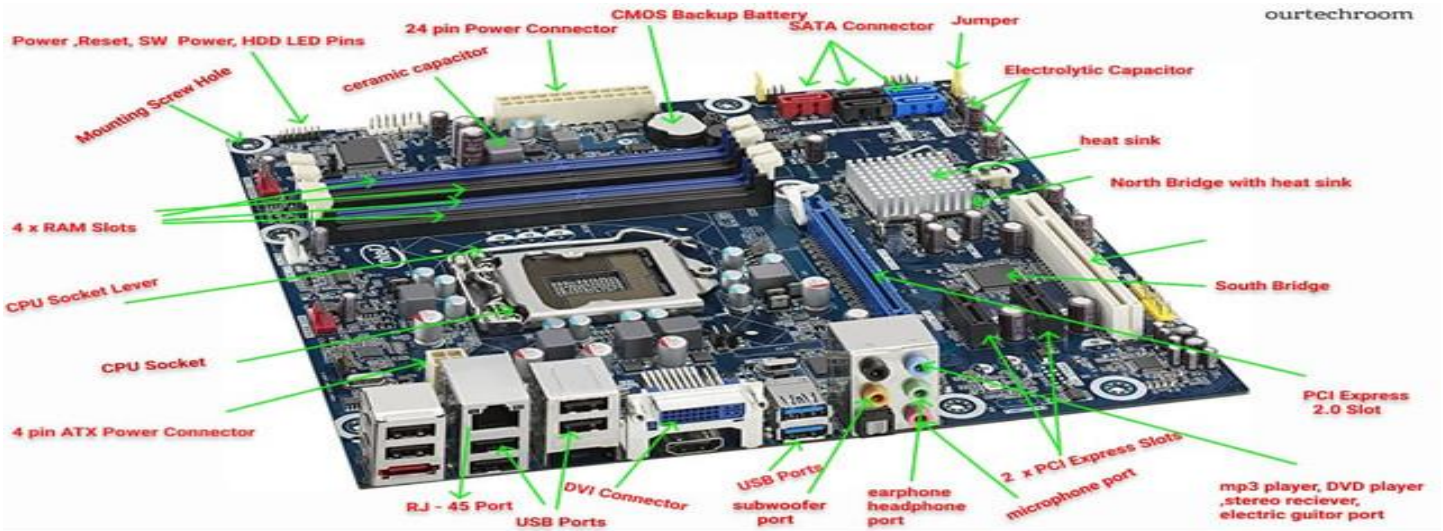
Types of Motherboard

The motherboard is a huge printed circuit board found in all programmable electronic devices. The component attached to the board may differ between systems. A desktop computer has different connectors and hardware than a smartphone.

CPUs, memory, storage, capacitors, transistors, slots, and connectors will be found in the majority of modern electronic devices.

You can easily grasp the components of other electrical devices if you understand all of the components on your desktop. As a result, this article focuses on desktop and laptop components.

Parts of Motherboard



Parts of MotherBoard

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Parts of the Motherboard are as follow.

- RAM Chip and RAM Slot
- CPU Chip and Socket
- PCI Slots
- ROM Chip
- Accelerated Graphics Port
- North Bridge
- SouthBridge
- CMOS Battery
- Power Supply Plug
- Parallel Port
- Serial Port
- SATA and PATA Connector
- USB Port
- DVI Port
- RJ-45 Port
- HDMI Port
- FDD Connector
- Optical Drive Audio Connector
- 1394 Headers
- F Audio Connectors
- Heat Sink
- Switches and Jumper
- Microphone port, headphone port, subwoofer port, guitar port, DVD player port, stereo receiver port
- Capacitor
- Transistor
- VRMs
- Mounting Screw Hole
- Power, Reset, SW, LED Pins

Now let's understand each of them.

1) RAM chip and RAM Slot

RAM is an acronym for Random Access Memory. It is also referred to as the primary memory. RAM (random access memory) is a type of temporary data storage device found in computers and other electronic devices. One important thing to know about RAM is **When the power is switched off, the data in RAM is deleted.**

In layman's terms, RAM is analogous to short term memory.RAM forgets its content as soon as power is off, and the Information stored in short-term memory will get lost after a few days.
RAM supports **bidirectional data transfer** from the CPU to memory during a write operation and from RAM to the CPU during a read operation. It acts as a bridge between the CPU and other devices such as HDDs, CDROMs, and PEN drives.

RAM is named after the fact that any memory address in RAM can be accessed directly from any location. Data in any memory location can be accessed if the row and column numbers are known.

DRAM, SDRAM, DDR, SRAM, CMOS RAM, VRAM, and other types of RAM are available on the market. RAM in the PC market typically ranges from 2 GB to 16 GB.

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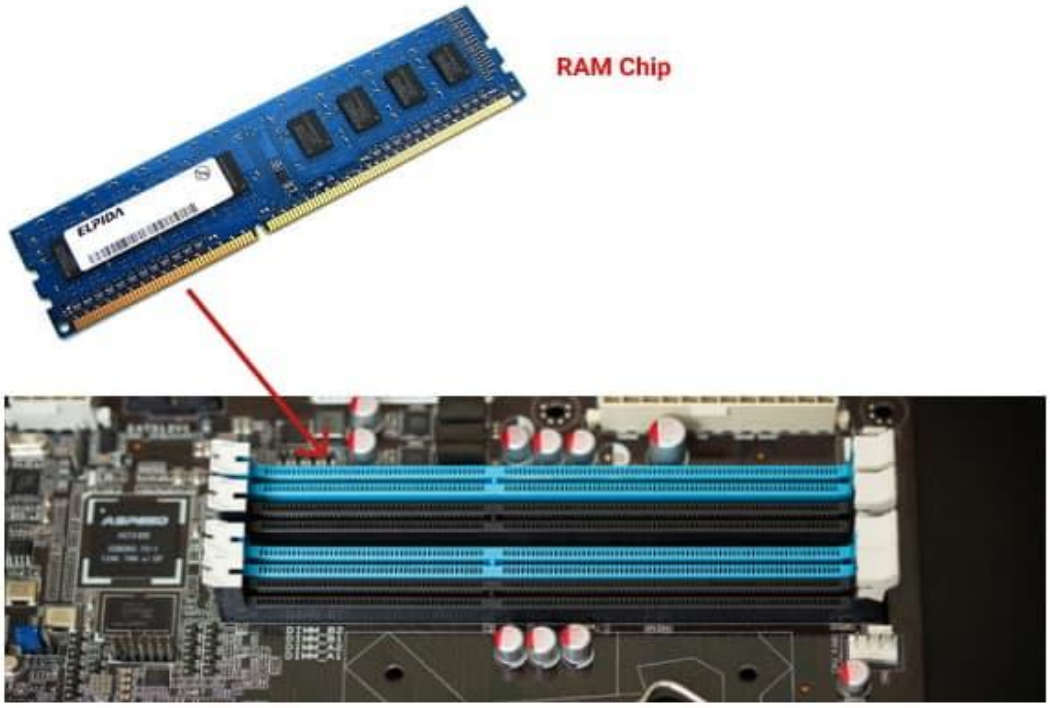


2) CPU Chip and Socket

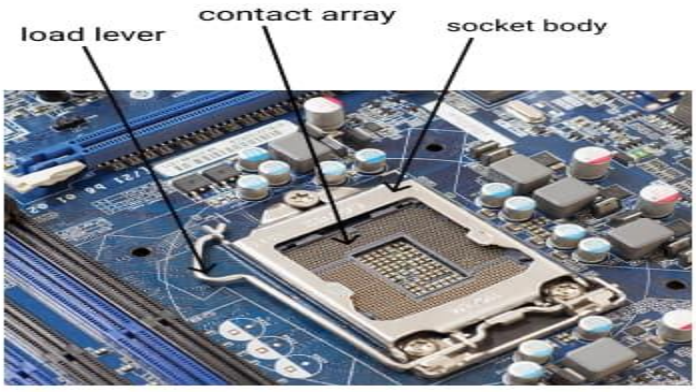
CPU is an abbreviation for Central Processing Unit. Computers and other electronic devices sometimes refer to the central processing unit (CPU) as their "brain" because it handles all of the device's decision-making functions.

All of the components and peripherals are either directly or indirectly connected to the CPU.

The primary role of the CPU is to perform basic arithmetic, logical, and input/output functions.



CPU Chip



CPU Socket

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CPU consists of 3 main typical components. ALU, CU and Registers

ALU: ALU is a CPU digital circuit (gates) that conducts all arithmetic and logical operations. ALU is capable of performing basic arithmetic operations such as addition, subtraction, multiplication, and division. ALU is capable of performing logical operations such as number and letter comparisons. A single CPU can have many ALUs.

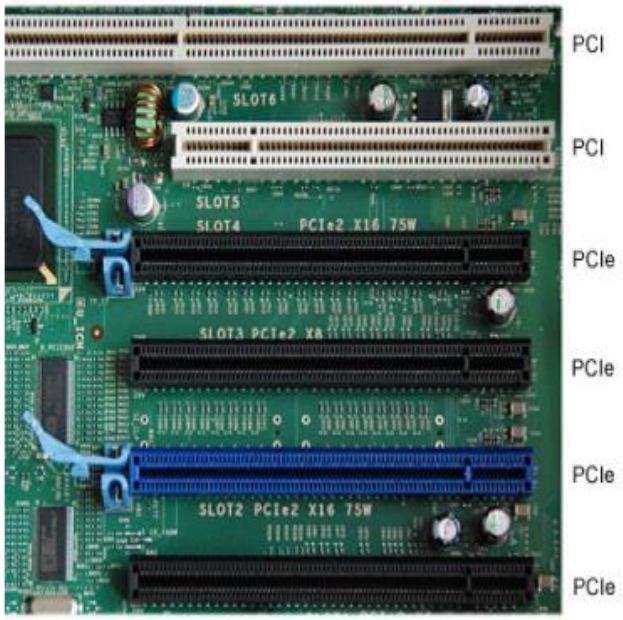
CU: The Control Unit (CU) is a digital circuit within the CPU that governs all processes. It enables and instructs various logical units, I/O devices, and the computer's memory on how to respond to program instructions from various components, as well as the user.

Registers: Registers are a form of temporary memory and ALU and CU rely on them. They are sometimes referred to as "Immediate Memory".CPU can instantly access, store and transport data and instruction from registered memory and process it.

3) PCI Slots and PCI Chip



PCI Chip



PCI Slots

PCI stands for Peripheral Component Interconnected and is an attached hardware component of the motherboard that enables you to connect various hardware components such as modems, disk controllers, NIC cards, Sound Cards, graphics cards, SSD add-on cards, RAID cards, and additional USB and serial ports without having to add or replace the motherboard.

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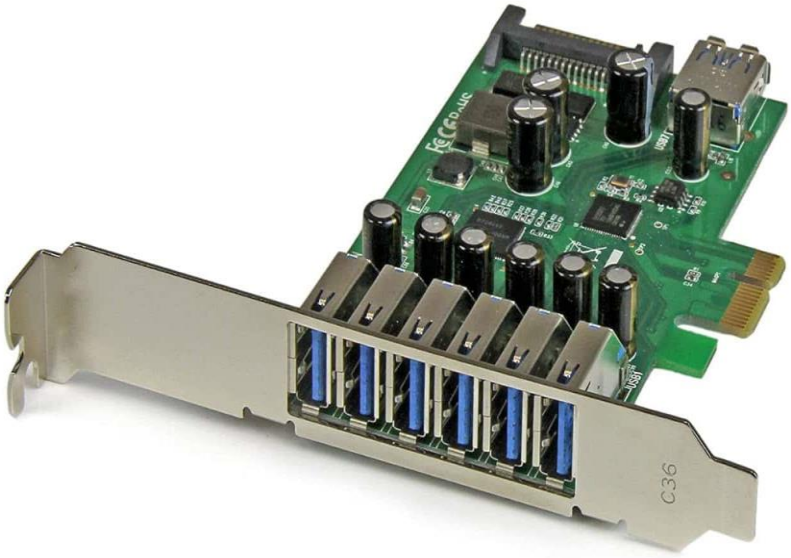
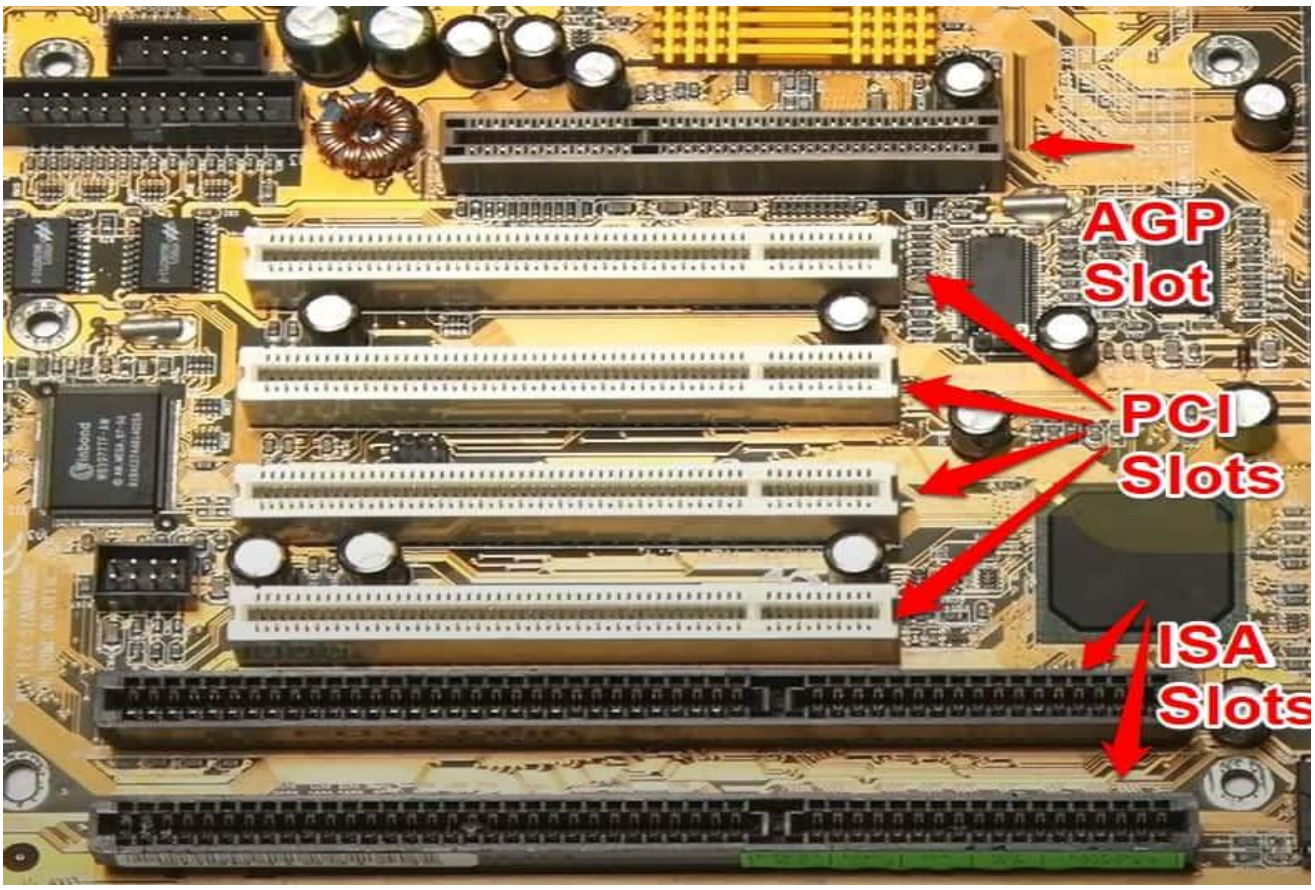


fig. USB PIC Card (To connect numerous USB devices)

Prior to the introduction of PCI in 1992, ISA and EISA were used for the same purpose. Later in 2004, the PCIe slot was invented, and it has now replaced PCI, AGP, and ISA slots.

Showing PCI slots, AGP slots, and ISA slots in the same picture:



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General FAQs

1. What is the full form of PCI and PCIe(or PCI-E)?

Ans: PCI stands for Peripheral Component Interconnected. PCIe stands for Peripheral Component Interconnected Express.

2. Do we have PCI slots on laptops?

Ans: Generally PCI slots are available on desktop PC but not in most laptops do not have **reusable PCI slots** because of their compact size and space. On some laptops, we can use it if you have ExpressCard Slots and can get adaptors to use PCI or PCIe.

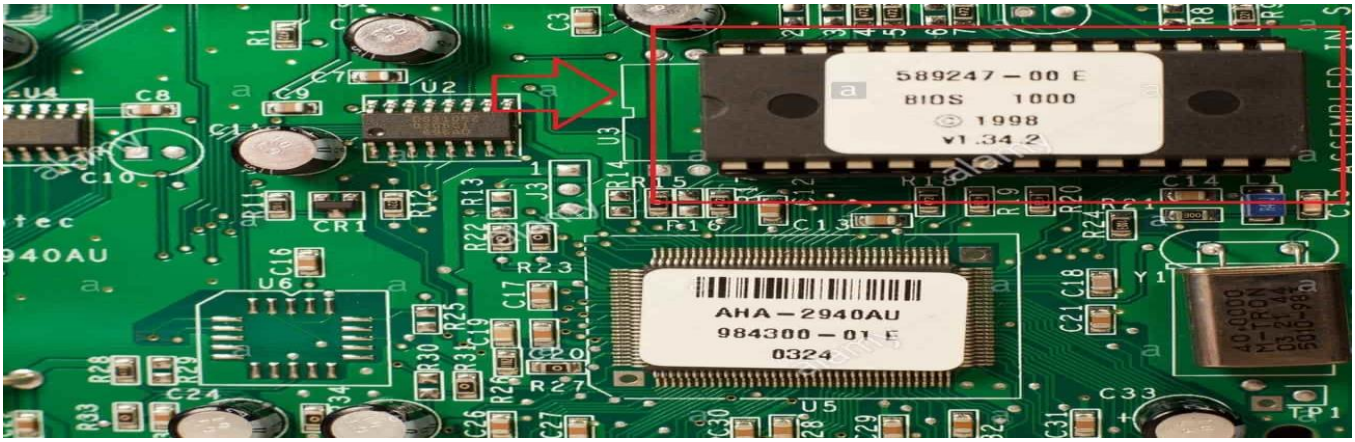
3. Check which version of the PCI slot is installed on the computer?

Ans: There are manual ways by going into the device manager. Better try using **CPU-Z software** for getting a detailed view of all versions of installed hardware.

4) ROM Chip

ROM is nonvolatile storage whose content will not get erased even after power is cut off. Content stored in ROM is impossible or very difficult to modify.

The BIOS information is kept in ROM, which is only a few KB in size and tells how to start, what to do when it starts, which driver to load, CPU fan speed information, boot sequences information, system date time, and so on.



5) AGP Slot and Chip

AGP Slot (Accelerated Graphics Port Slot) is a type of expansion slot similar to a PCI slot, although it is mostly used for graphics cards. Intel was the first to introduce it in 1996. This expansion slot is easily identifiable because it is usually brown in colour.

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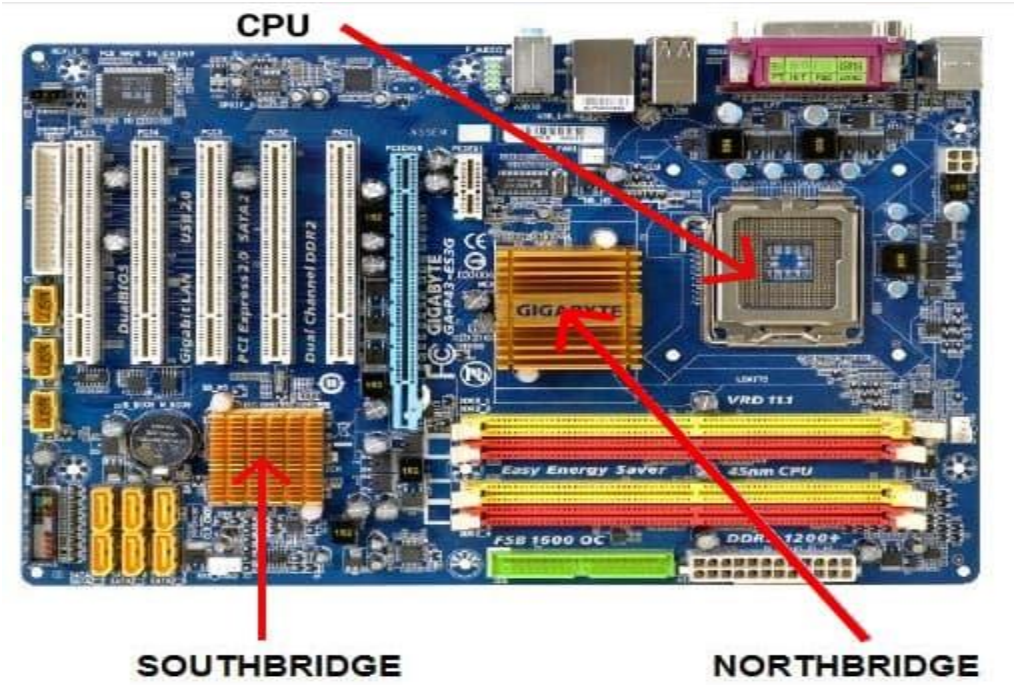
6) North Bridge

Characteristics of North Bridge:

- It connects southbridge to the CPU.
- It handles and communicates faster components on the motherboard like Main Memory, AGP, PCIe, ROM, and CPU.
- It acts as a controller for bus speed on the motherboard.
- Generally, it does lots of work with the CPU, so it is located near to the CPU generally with the heatsink.
- It is a core component and is directly connected to the CPU.

In some processors of Intel, all the functioning of northbridge is performed by the CPU.



7) South Bridge

The southbridge is an IC chip that manages and controls IO functionality on the motherboard. It does not have direct communication with the CPU, unlike Northbridge. **It typically handles low-speed devices due to its slower communication speed**. The CPU sends an instruction to the northbridge, which then sends it to the southbridge. It is linked to the PCI bus, ISA buses, IDE buses, audio, serial devices such as a mouse, keyboard, USB ports, and so on, as well as a SATA hard disk connector.

In size, it is smaller than the northbridge. And in some southbridge, we can find a heatsink attached to it.

8) CMOS Backup Battery

CMOS stands for "Complementary Metal Oxide Semiconductor" and is found in both laptop and desktop PCs in the form of a small circular coin. CMOS stores a variety of system data such as the current system clock,

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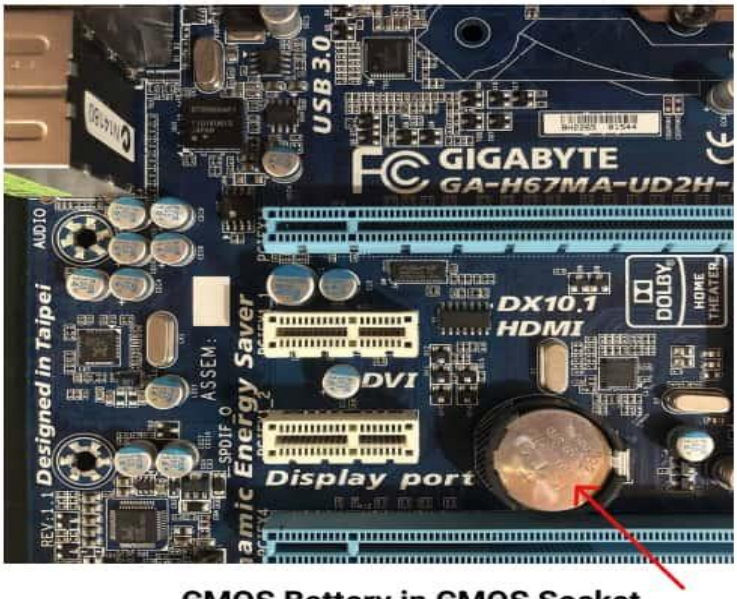
date, time, pulses, commonly used hardware settings, BIOS configuration settings, BOOT sequences, BIOS master/admin password, GPU, and virtualization settings, power management, and so on.

They can save those sets for a longer period of time, ranging from 2 to 10 years. Because it is constantly holding all of the above-mentioned settings, CMOS works even when your system is turned off.

CMOS battery looks like this:



CMOS Battery



CMOS Battery in CMOS Socket

CMOS is also called **CMOS RAM**, **COS-MOS**, and **NVRAM**(Non-Volatile RAM) in the market.

It is also called the RTC(Real Time Clock) of the computer system because even computer is shut down it is able to store all the required information that the system required to boot the system next time.

More About CMOS
1) CMOS chips were first introduced in the **IBM computer.**
2) CMOS is a **low-power technology chip** so it lasts longer.
3) CMOS can store usually up to **256 bytes** of information.
4) CMOS battery in laptop and desktop PC is **3V**
5) CMOS battery life lasts **2 to 10 years** (source: hp store)
6) Commonly used CMOS battery in PCs is a **CR2032 lithium coin cell**

CMOS FAQs

Q1) What happens if the CMOS battery Dies?

Ans: CMOS battery in PCs operates at **3V**.If the CMOS battery goes below **2.6V** then CMOS has more chances to lose BIOS Settings and hardware settings, dates, and times. Even sometimes the Operating System will also not load.

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9)Power Supply Plug

The primary function of the Motherboard's Power Supply plug is to supply power to the Motherboard and its attached components and peripherals.



fig. Power Supply Box provides power to the motherboard and devices like HDD, CDROM, Floppy etc

i) 24 (20 + 4) ATX power supply
In modern PCs, ATX power supply is provided which is a 24 Pin(20 + 4) Main Power Supply Connector (Older Pcs only have 20 Pin)

ii) 4 Pin or 8 Pin Connector
This port in the motherboard is to provide dedicated power to the CPU. Older PCs may not have this Plugin motherboard but modern computers can do lots of work like overclocking so, a dedicated cable is provided to the CPU.

8Pin connector can be split into two and each split part can be used as a 4 pin connector.

iii) PCI-Express 6-Pin or 8-Pin Connector
This is required to power the PCI-E port.PCI-E slot required 75W power to operate.
THE older PC does not have this.

iv) Molex
Molex pin is 4 power pin which is required to supply power to older CDROM and hard drives. Molex is nowadays used for Case Fan. (some have some do not have)

v) Berg: It is used for floppy drives in much older PCs.

vi) SATA power supply
Modern hard drives and CDROM uses SATA cable for power. In the motherboard, it is an L-shape port and so its cable is connected to the SATA port in one way only. In motherboard, it has 15 pins. It provides features of hot-swappable hard drives ie. plug and play hard drive features.

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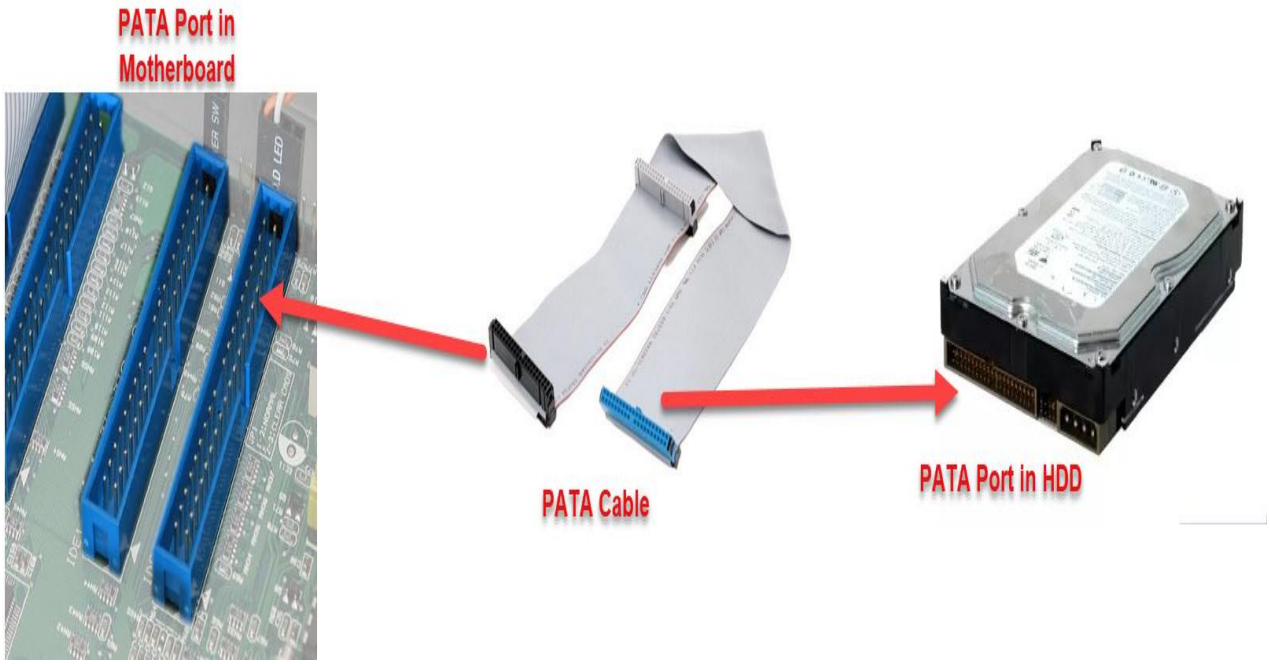
fig. Power Supply Cable connecting to devices and motherboard

10) SATA and PATA Port and Connector

PATA is an acronym that stands for Parallel Advanced Technology Attachment. It is a ribbon cable with 40 pins that is used to connect mass storage devices such as hard disks (HDD or SSD) and optical drives to a computer. Western Digital and Compaq introduced it in 1986.



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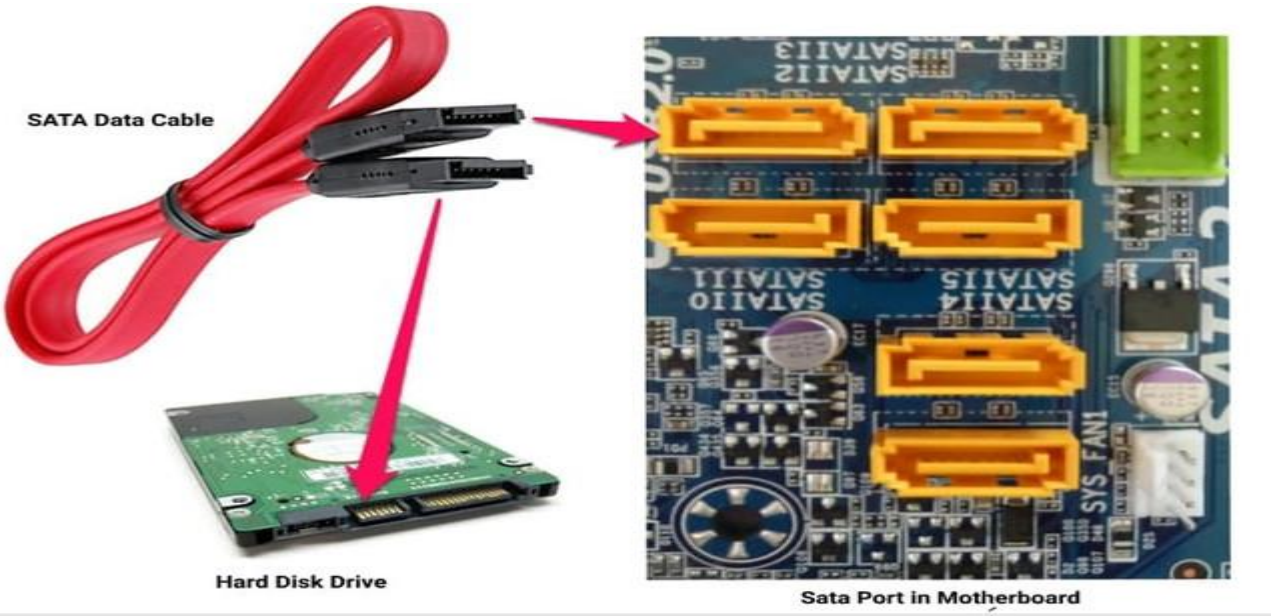
PATA Cable and Port

Every PATA cable has two or three connectors, one of which is connected to the adapter interfacing and the others to secondary storage devices. In modern computers, it is not used. It is outdated technology and is replaced by SATA Technology

Serial Advanced Technology Attachment is an abbreviation for Serial Advanced Technology Attachment. It is a 7-pin cable that is shorter and more powerful than the PATA connector, and it serves the same purpose. SATA's first version was released in 2000.



There are several advantages of using SATA over PATA

- **Reduce Cable Size**: The size of the SATA cable is shorter than the PATA cable. The maximum cable length of SATA cable is 18 inch and PATA's maximum cable length is ~ 39 inches.
- **Higher Bandwidth**: The bandwidth ranges of various PATA cable is between 16 MB/s - 133 MB/s. But bandwidth ranges of various SATA cable is between 150 MB/s - 600 MB/s.
- **SATA has hot-swappable features**: SATA cable from the devices can be plugged in and out even system is ON(But don't try with running hard disk or CDROM). Hot-swappable does not work with PATA. Try it(Remove SATA cable from CDROM, Restart your PC then insert SATA in CDROM, it will work.)

Try it (Remove PATA cable from CDROM, Restart your PC then insert PATA in CDROM, it will not work. Precaution: Don't do this hot-swap with PATA cable).

- SATA cable is **cheaper** than PATA cable.
- SATA offers an **external interface** but PATA doesn't.

11) eSATA Port

Some computer also has an external SATA port. It is used to connect external secondary devices like external HDDs and CD Rom. It is much faster than the USB 3.0 port.

12) eSATAp Port

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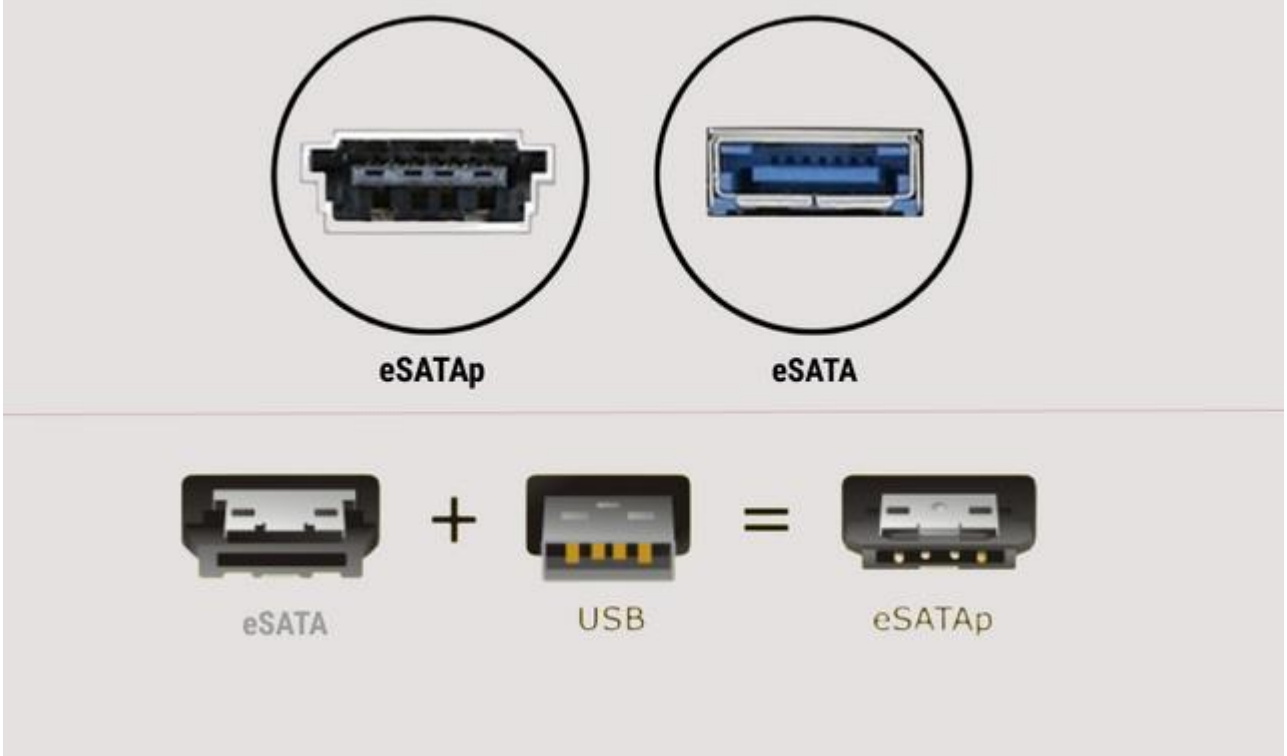
eSATAp is a port that supports both USB devices and eSATA.It is power over eSATA.



13) SCSI Port

SCSI is an abbreviation for Small Computer System Interface. It has the ability to connect up to 16 peripheral devices via a single bus, including one host adaptor. As a result, you can connect a scanner, CD ROM, Zip drive, and hard drive to a single SCSI cable chain. It is more expensive but performs better than IDE. It is now being phased out. It was available prior to the introduction of the IDE.

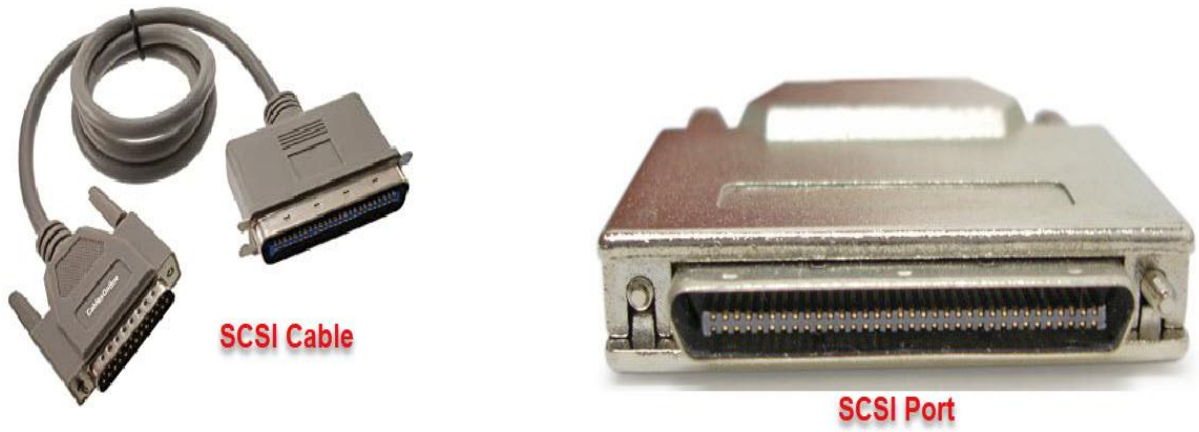


fig. SCSI Cable and Port

14) Parallel Port

A parallel port is used to transfer data through multiple communication channels in parallel. Printers, scanners, Zip drives, external HDDs, tape backup devices, external CD ROMs, and other similar devices.

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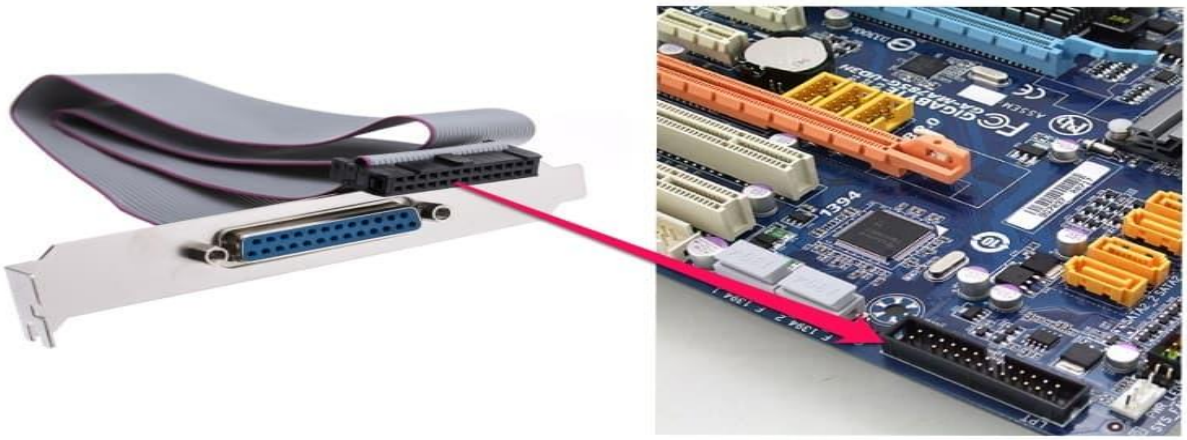
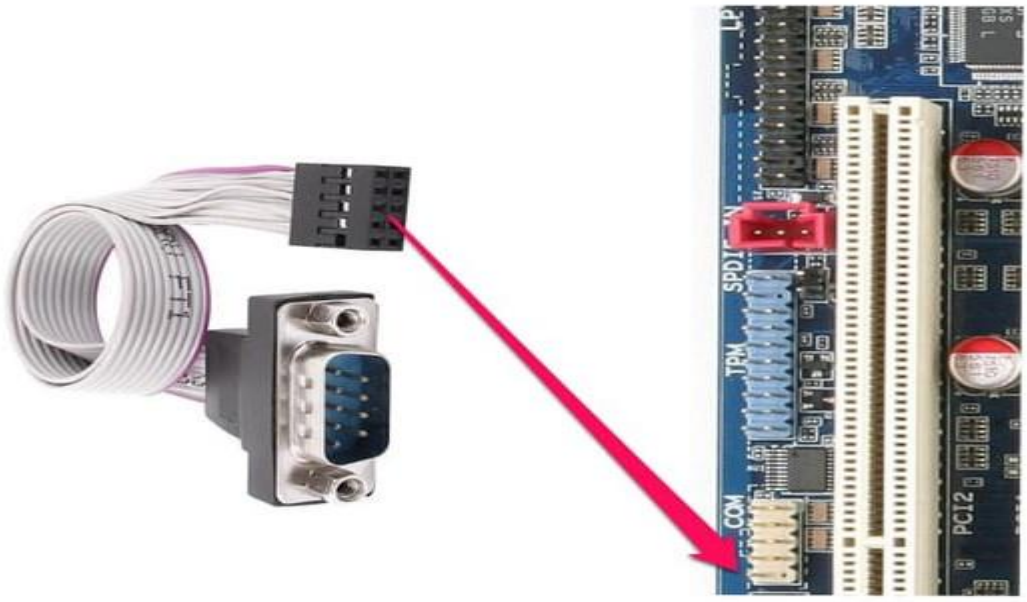


Parallel pin in motherboard

15) Serial Port

With a serial port, only one bit of data gets transferred at a time. It is found in an older PC to connect older keyboards, PDAs, external modems.



16) PS/2 Port

PS/2 port was popular in older desktop PCs.But now it is obsolete.

- PS/2 (green color) is for the mouse.
- PS/2 (purple) is for the keyboard.

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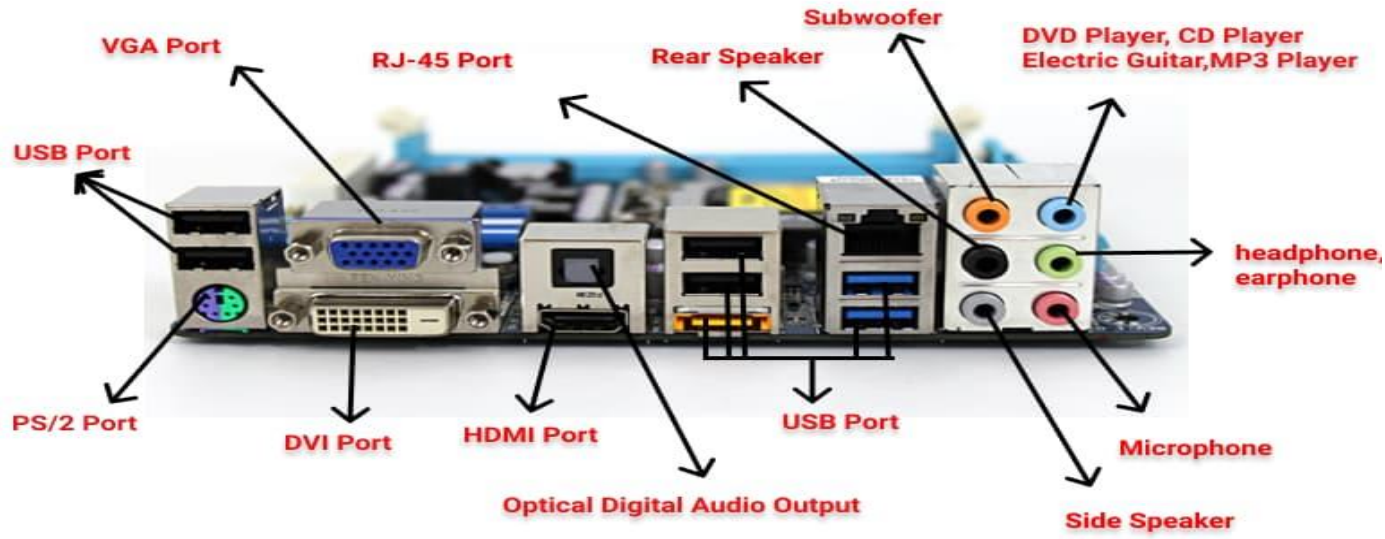

17) USB Port

Universal Serial Bus is the abbreviation for Universal Serial Bus. Its transfer rates are faster than the PS/2 connector, hence we don't see a PS/2 port on recent computers. USB ports come in a variety of shapes and sizes, including:

- Type A
- Type B
- Type C
- Type A Mini
- Type B Mini
- Type A Micro
- Type B Micro
- Type B Micro USB3

18) RJ-45 Port

Register Jack is abbreviated as RJ. It resembles a telephone jack, but it is slightly larger. RJ45 is also known as an Ethernet port because it is used to connect a computer to the internet. The RJ 45 port is used to connect to the Local Area Network via a twisted pair ethernet cable. The Ethernet cable has a connector that is connected to the RJ45 port.

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19) HDMI port

HDMI is an abbreviation for High Definition Multimedia Interface. It was created in the year 2002 AD. It appears to be a USB port, but it is much larger in size. HDMI is a digital interface that allows audio and video data to be transmitted in a single cable to digital devices such as a digital TV, projector, gaming console, computer, mobile devices, digital camera, cable box, blu ray player, and so on.

20) Audio Port

Most desktop computer nowadays comes with 3 to 6 port.

- Green Color Port is a Line Out which is for headphones and stereo speakers.
- Pink /Light Pink Port for Microphones input.
- Light Blue Port is line In which is for mp3 players, DVD players, CD players, stereo receivers, turntables, electric guitar, and VCR audio outputs.
- Dolby Audio Black Port for rear speaker.
- The orange/yellow port is the Center/Bass Channel which is for the subwoofer



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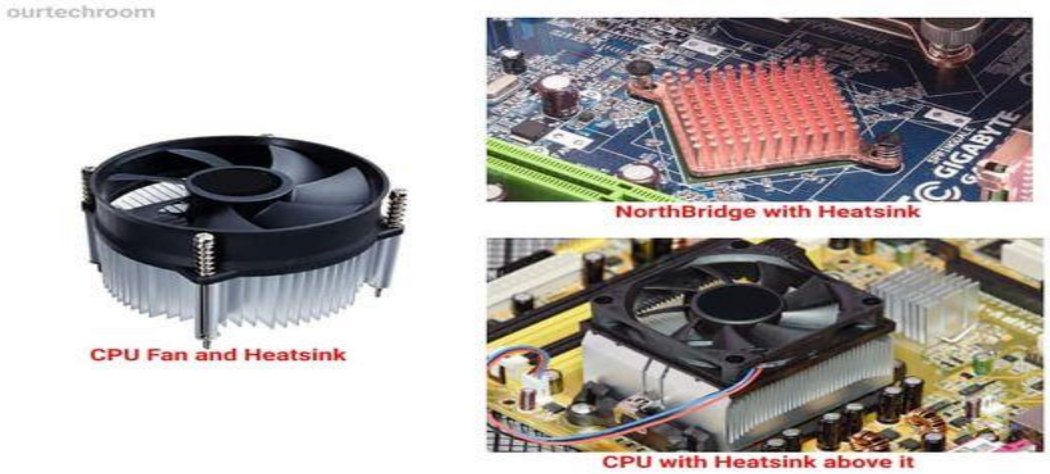
21) Heatsink

Heatsinks use a thermal conductor to reduce heat generated and prevent overheating from hardware components like CPU, GPU, northbridge, southbridge, RAM modules, etc. In general, that component that generates heat required a heatsink.

CPU has to perform a large number of tasks every second. While performing large tasks, it beings to generate heat and if heat is not maintained then
the processor will destroy itself. Also at the top of the heatsink will have a FAN and this FAN helps to cool down the heat sink. This is Air coolant Heatsink

But in the market, we will have a liquid coolant heatsink as well generally used in a high-end gaming environment, servers, and datacenter.



CPU Fan and Heatsink

NorthBridge with Heatsink

CPU with Heatsink above it

22) Switches and Jumper

Switches and jumpers are used to reconfigure the circuit onto an existing circuit board in a reversible way.

Jumper also called Jumper Shunt is a small circuit board used to close, open or bypass part of an electronic circuit.

Closed Stage Jumper: If the plug is pushed down over two pins, the jumper is referred to as jumpered.

Opened Stage Jumper: If there is no plug into the pin then it is an open stage.

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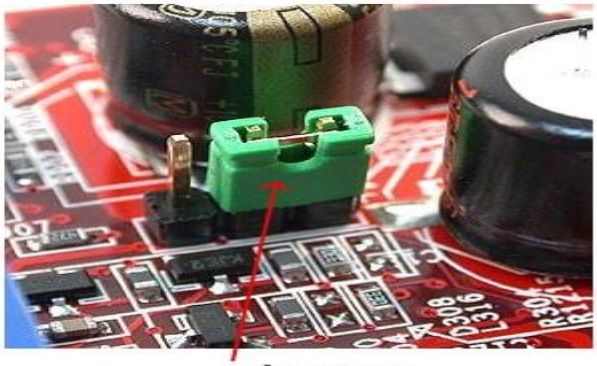


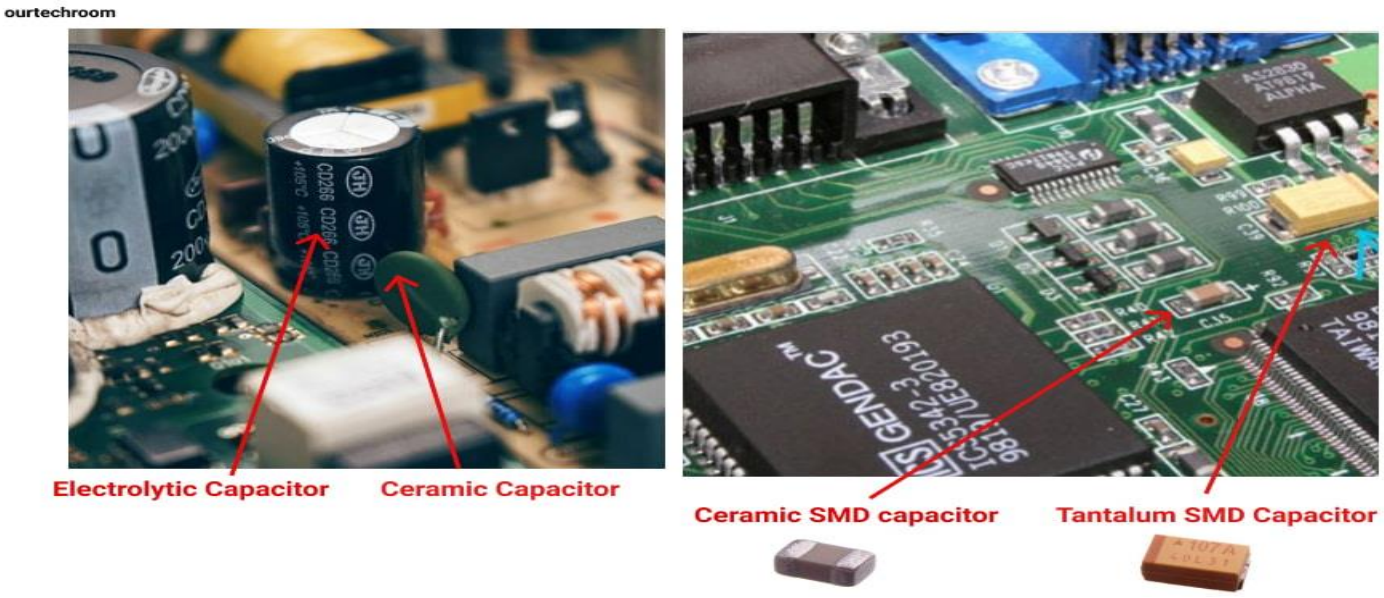
Jumper

🔥 Caution: Before adjusting jumper configuration make sure that the system is turned off otherwise system may get damaged.

23) Capacitor

A capacitor is an electronic device used for filtering, decoupling, and timing the circuit in the motherboard. There are more capacitors in the motherboard which mostly does decoupling functionality, so those capacitors are called decoupling capacitors. A decoupling capacitor is used for stabilizing power in each IC used in the system.

It comes with various voltage levels like 3.3 V, 5 V, and 12 V.



Suppose a circuit needs 5 V input than before that circuit there will be capacitors in parallel which allow up to 5 V to pass to that circuit.

24) Transistor and MOSFET

Transistor is used in most of the components of motherboard for various purposes like

- controlling the amount of current or voltage in the component

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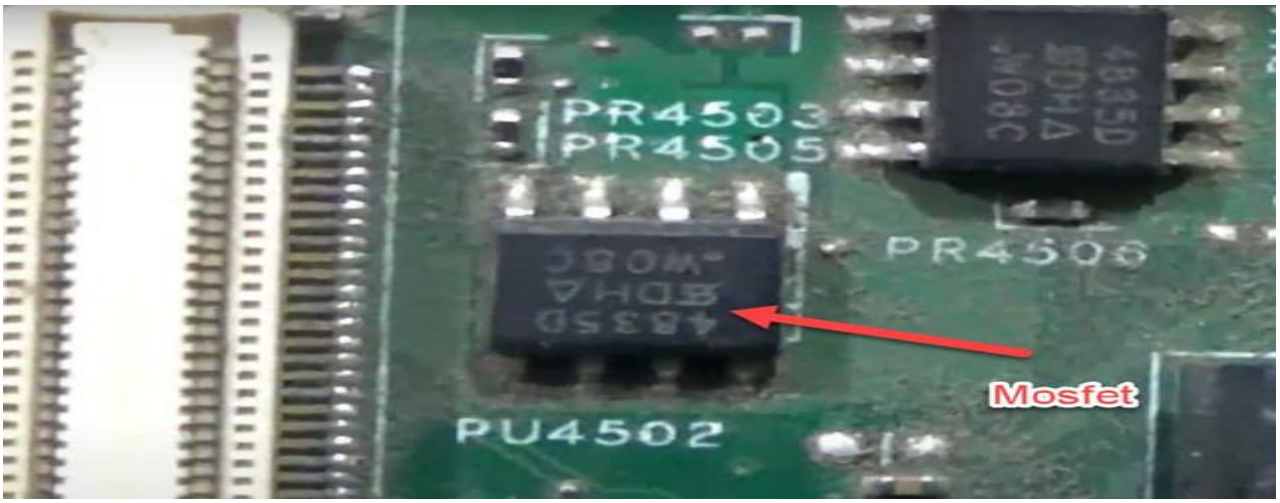
- amplification/modulation electronic signal
- switching of an electronic signal and electrical power.

Today's motherboard has SMD(Surface Mount Device) transistor which uses Surface Mount Technology(SMT). They are found mounted in the motherboard.

MOSFET(Metal Oxide Semiconductor Field Effect Transistor) is the most widely used transistor in motherboards.

Denoting letter for Mosfet and Transistor is same: ie. Q, PQ

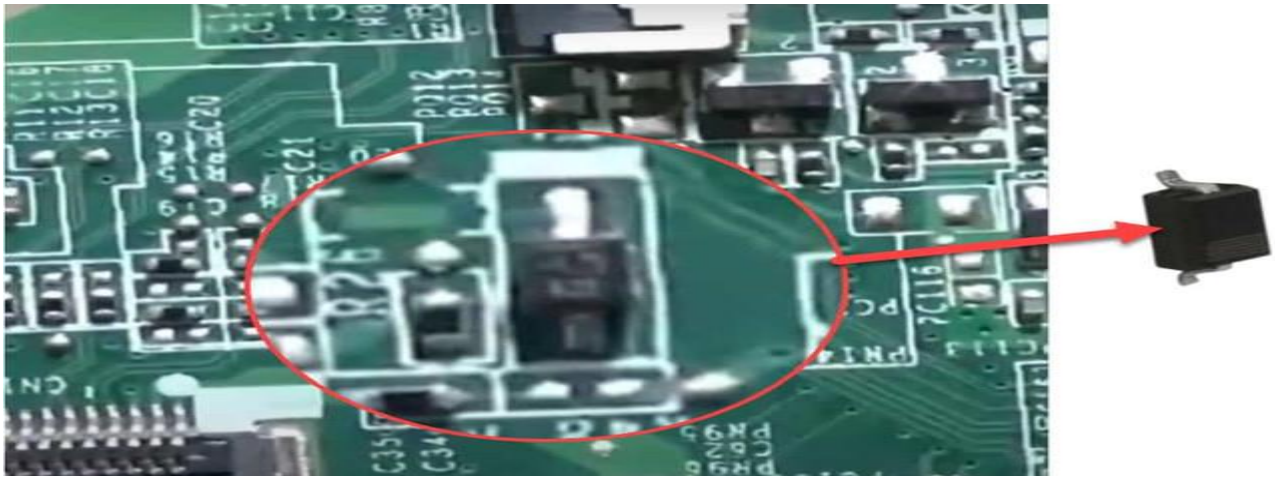


25) Diode

The motherboard in your laptop and the mobile phone both have SMD Diodes that are mounted on the motherboard.

The diode's primary function is to allow current to flow in only one direction, much like a one-way street. It aids in the conversion of voltage spikes in the motherboard by converting alternating current (AC) voltage spikes to direct current.

Denoting letter for Diode : D



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26) VRMs

VRMs stands for Voltage Regulator module.VRMs are electronic circuits located near the CPU and their main work is to provide steady and consistent voltage to the processor. As the Powersupply unit converts external voltage eg. 240 volts to 12V or 5 V, this voltage is again taken by VRMs first and then again step down and regulates these voltages and provides the continuous required power to the processor.

It is especially important for overclocking a CPU or GPU.



27) Mounting Screw Hole

Mounting holes let us mount our motherboard to a surface.

You simply have to pick a screw size that matches the size of mounting holes in your motherboard, find a surface to which it will be mounted and drill accordingly.

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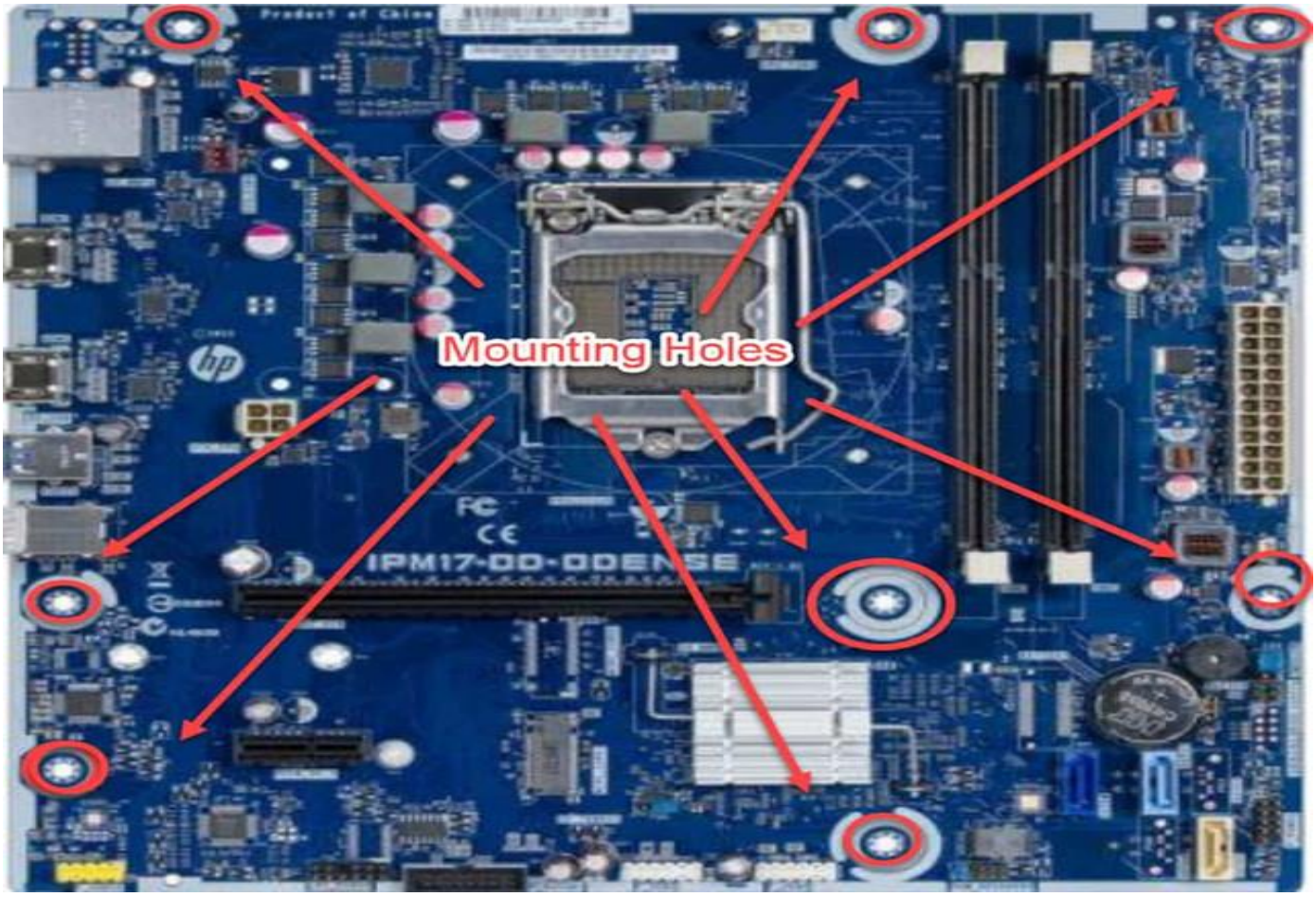

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