

Computer Cases (Towers)

Components of a computer case (front)

- Power button
- Front I/O Panel (on modern cases) may contain audio or USB ports
- LEDs (Power On, Hard Disk Activity)
- Temperature display (on newer cases)\
- Fan Vents for airflow

Most computer cases come in four distinct sizes: small form factor (SFF), mini tower, mid tower and full tower. The image below shows the distinct difference between PC case sizes:



All-in-One

Dell OptiPlex 3280 All In One - all-in-one -
Core i5 10500T 2.3 GHz - 8 GB - HDD 500 GB
- LED 21.5"

Roll over image to zoom

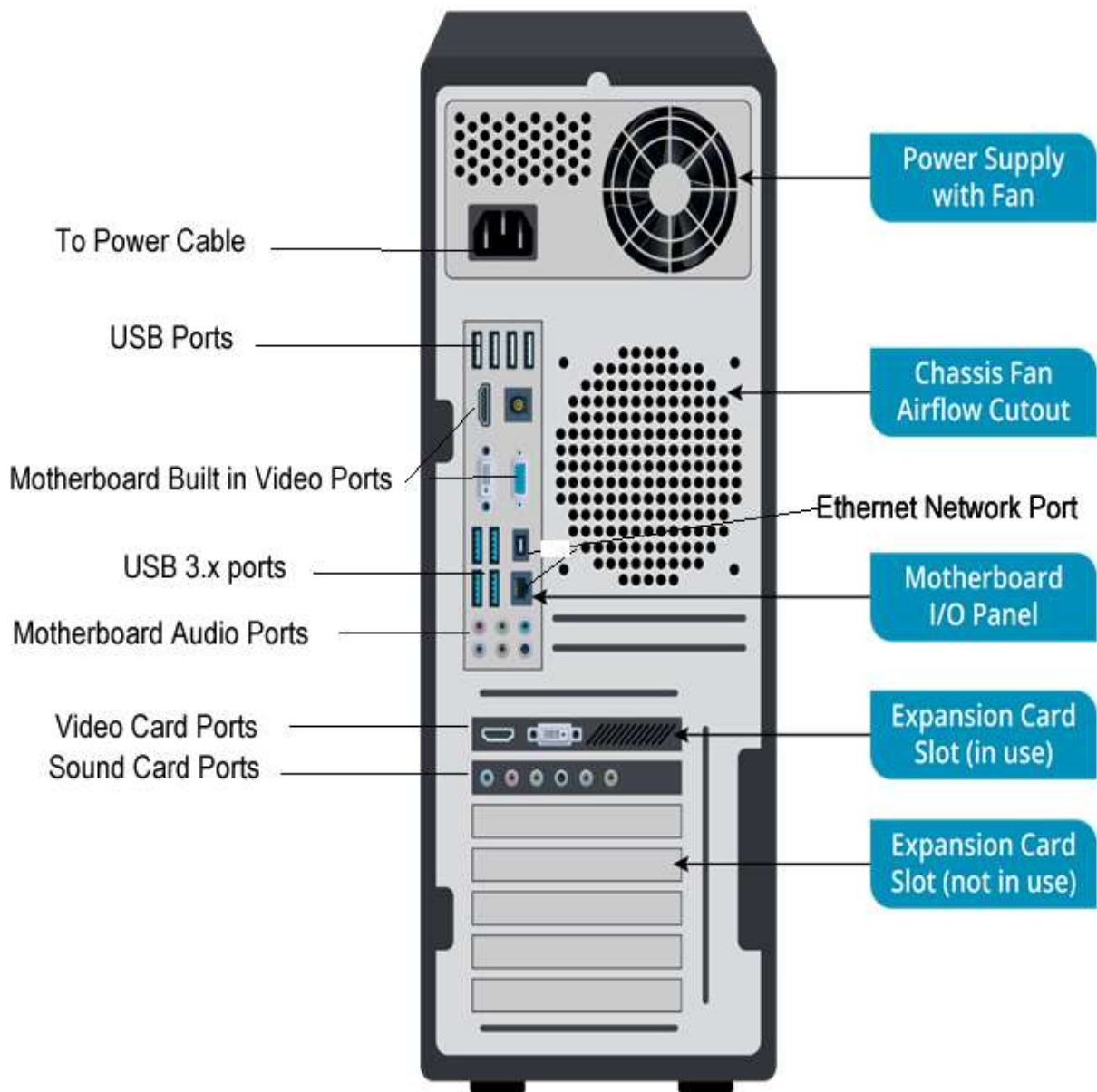


Comparison between cases

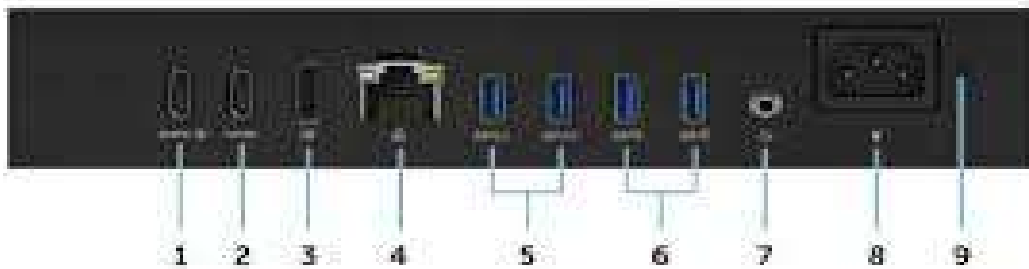
<https://www.cdw.com/content/cdw/en/articles/hardware/desktop-vs-all-in-one.html>

Rear Panel Ports and Features

Modern Tower Case Rear Ports (Textbook)



Dell All-in-One Ports



1	HDMI-in port (with discrete graphics card)	2	HDMI-out port (optional)
3	DisplayPort Dual-Mode Dp++	4	Network port
5	USB 3.1 Gen 1 ports with Power on/ Wake-up support	6	USB 3.1 Gen 2 ports
7	Audio out port	8	Power connector port
9	Power supply diagnostic light		

Tower Case Ports

- Power supply 3-prong connector

I/O ports to motherboard

- USB Ports 2.0 vs. 3.0 and 3.1, USB-C

USB 3.0 ports are fully backward compatible. This means that when a USB 2.0 drive or earlier is connected to a USB 3.0 or 3.1 port, the drive will work correctly. It's important to note that USB 3.0/3.1 drives are also compatible with USB 2.0 ports. However, a USB 3.x drive has the same transfer rate as a USB 2.0 drive when connected to a USB 2.0 port. In other words, a USB 3.0 drive must be connected to a USB 3.0 port to achieve high-speed data transfer.

USB speeds: USB 2.0 480 Mbps (60 MB/s) USB 3.0: 5 Gbps (640 MB/s) USB 3.1 Gen 1: 5 Gbps (640 MB/s) USB 3.1 Gen 2: 10 Gbps (1.25 GB/s)

- Video Ports
 - [HDMI](#): Audio and video signal, best for TV to PC connections.
 - [DVI](#): Video only, perfect for older systems or for 144Hz at 1080p.
 - [DisplayPort \(DP\)](#): The best connector for an audio and video signal, and can transmit 144Hz up to 4K.
DisplayPort looks similar to HDMI but is a connector more common on PCs than TV
 - [VGA](#): Old legacy video connector. Only to be used when nothing else available.
 - [USB-C](#): Formally known as USB Type-C. Connects to both hosts and devices, replacing various electrical connectors including USB-B and USB-A, HDMI, DisplayPort and 3.5mm audio cables and connectors.
 - [Thunderbolt](#): A hardware interface developed by Intel (in collaboration with Apple) that allows the connection of external peripherals and monitors to a computer. Thunderbolt 1 and 2 use the same connector as Mini DisplayPort, and Thunderbolt 3 uses the USB-C connector from USB.

- Thunderbolt (PC): Thunderbolt™ is a high-speed interface that operates using the USB-C connector. Thunderbolt™ ports provide additional capabilities, such as faster data transfer speeds and support for multiple protocols, including DisplayPort and peripheral component interconnect (PCI) express.
- Thunderbolt (Macintosh) You can use the Thunderbolt port on your Mac to connect a display, TV, or a device, such as an external storage device. And with the appropriate adapter, you can connect your Mac to a display that uses DisplayPort, Mini DisplayPort, DVI, HDMI, or VGA.



- Lightning (Macintosh) Lightning is a proprietary computer bus and power connector, created and designed by Apple Inc. The Lightning connector is used to connect Apple mobile devices like iPhones, iPads, and iPods to host computers, external monitors, cameras, USB battery chargers, and other peripherals.



- Network Port (Ethernet 100/1000 Mb/sec) and cable



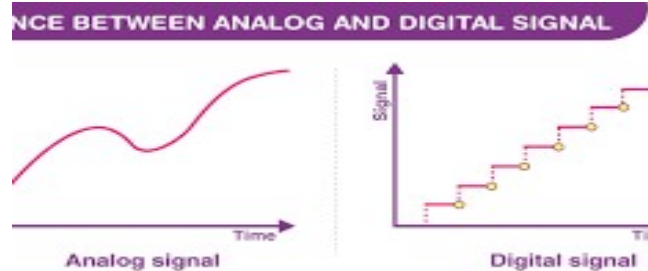
- Power Supply Fan Vents
- Expansion card ports and blocking plates



Note that the first expansion slot in the Powerpoint figure shown above is filled with an add-on graphic adapter. The second expansion slot in the figure is filled with an add-on Sound Card.

Analog vs. Digital Signals

Analog signals reproduce real-world data (waves), while digital signals convert this data into binary form. Interference can distort analog signals, making them unclear. Digital signals, however, remain clear despite interference because they only need to distinguish between ones and zeros.



1. Graphic adapter card with VGA, HDMI and DVI-I Ports



VGA

HDMI

DVI -I

2. Graphic adapter card with VGA (analog) HDMI and DVI-D (Digital Only) Ports



VGA

HDMI

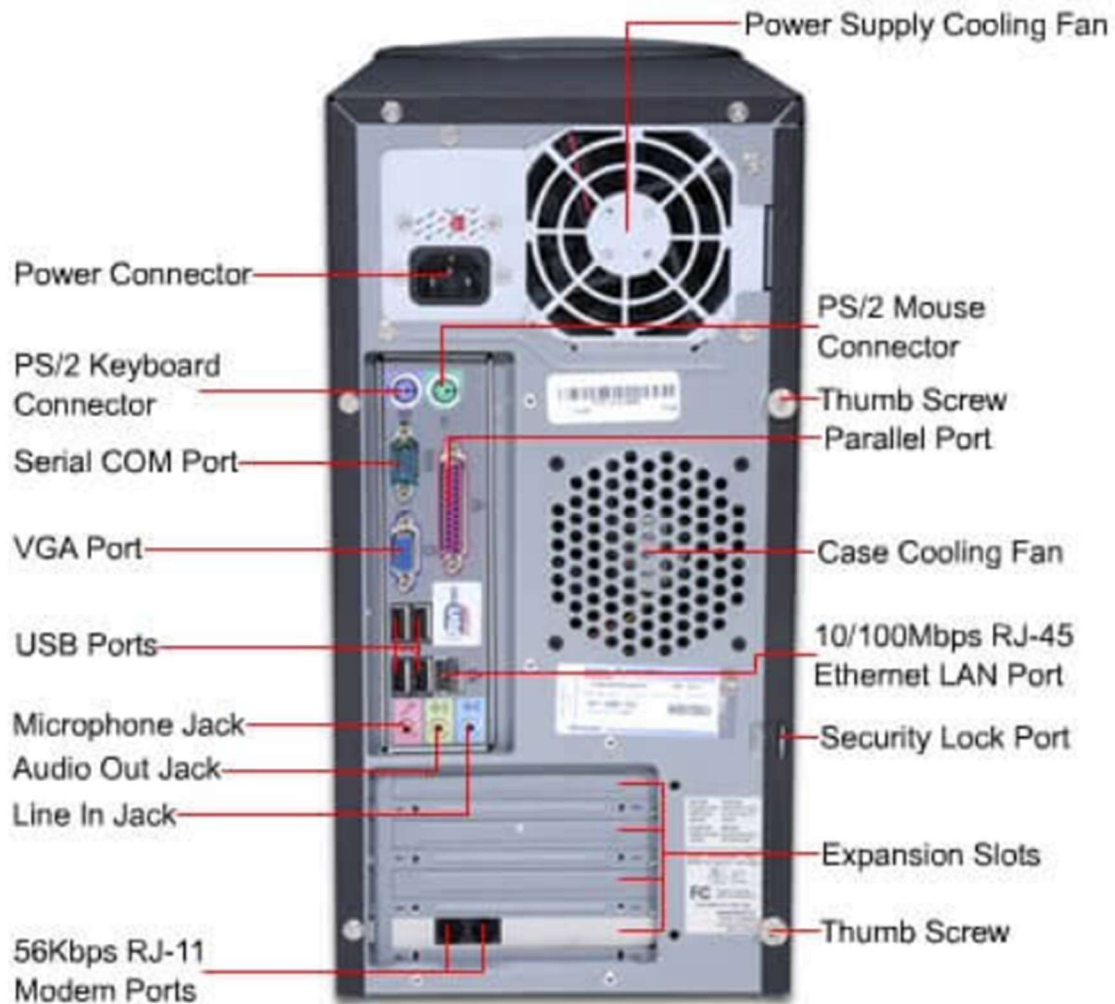
DVI-D

A DVI-D connector on a graphics card sends out a digital signal only, while a DVI-I connector can send out a digital signal (for digital displays such as flat panel LCD monitors) as well as analog signal (for older displays such as a CRT (Cathode Ray Tube) monitor) using a DVI to VGA adaptor shown in Figure 1. The graphics card shown in Figure 1, which shows a DVI-I (*Digital Video Interface-Integrated*) connector contains more pins than the DVI-D connector shown in Figure 2. The extra pins on a DVI-I connector carry the analog signal which the DVI-D connector does not have.

A DVI-D connector on a graphics card sends out a digital signal only, while a DVI-I connector can send out a digital signal (for digital displays such as flat panel LCD monitors) as well as analog signal (for older displays such as a CRT monitor) using a

Older Tower Legacy Rear Ports

(This will be discussed in detail later in this lesson)



Peripheral Devices

A computer peripheral, also known as a peripheral device, is an external device that connects to a computer to expand its capabilities. Peripheral devices are not essential to the functioning of a computer, but they enhance its functionality. These devices can be input devices, output devices, or both. Examples of input devices include a keyboard, mouse, scanner, and microphone, while output devices include a printer, speaker, and display. Other peripherals include storage devices such as external hard drives and flash drives, and networking devices such as routers and modems. A case will usually come with cables for its external ports (USB, audio, IO switch, etc) and any fans that come preinstalled. The motherboard often comes with one or two SATA cables for connecting various drives to its SATA

PC Case and Motherboard Cable Types

- Cables to connect display monitor(s) HDMI, Displayport, VGA, DVI-D/I, Thunderbolt/USB-C, see Powerpoint presentation)
- Cables to connect to motherboard ports (USB, audio to speakers), cables from case fans and internal fans to motherboard or power supply),
 - **Molex**
Molex connectors are used for providing power to the motherboard, fans, floppy disk drive, CD/DVD drive, video card, some older hard drive models, and more. Compatible connectors are available from many manufacturers, not just Molex



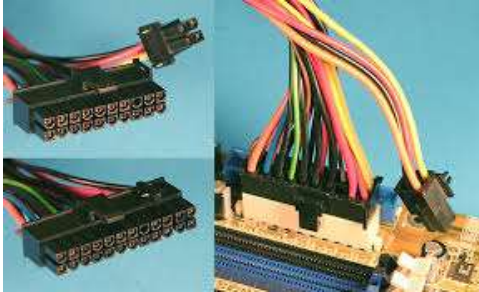
- **Internal SATA Cables:** Connect hard drive (SATA (Serial Advanced Technology Attachment), legacy PATA (Parallel Advanced Technology Attachment, not used on modern computers))



- External SATA: Connects external SATA devices (such as external hard drives) to your PC or Mac,



- Motherboard to Power supply



Review Activity: Cable Types and Connectors

LAB ACTIVITY Virtual WorkBench Lab: Upgrading/ Installing GPU and Daisy-Chain Monitors

Installing a New GPU

Once you're ready to install your GPU, turn off your PC, unplug it, open your case, and disconnect your current graphics card. Make sure to disconnect it from the motherboard and the power supply. Then, insert your new GPU into the motherboard and plug it into your PSU.

How to Daisy Chain Monitors for a Multi-Display Setup

Daisy chaining means connecting multiple monitors in a series using one video cable from one monitor to another monitor, rather than connecting each monitor directly to the computer. With DisplayPort or Thunderbolt daisy chaining, you can enjoy the flexibility of having multiple displays while keeping cables to a minimum. You can duplicate or extend the monitors dedicated to a different task or application.

Is DisplayPort the same as Thunderbolt?

Mini DisplayPort vs Thunderbolt: What's the Difference?

Thunderbolt is a specialized type of Mini DisplayPort connectivity

Topic 1B Install and Configure Motherboards

Motherboard Functions

What is PC System Architecture?

System Architecture is defined as: In reference to computers, software or networks, the overall design of a computing system and the logical and physical interrelationships between its components. The architecture specifies the hardware, software, access methods and protocols used throughout the system. It defines what is seen on the machine interface, which is targeted by programming languages and their compilers.

- Binary data and instructions: Instructions are sent to the CPU (Central Processing Unit) mounted on a motherboard in a binary format
 - Unlike the common decimal (base 10) format we use for everyday counting, binary instructions have only two electrical states: On (represented by "1") and Off (represented by 0)
- Central processing unit (CPU) and cache: The CPU is an electronic logic chip mounted on the motherboard that translates Binary On/Off electrical signals into instructions for running the computer's operating system and applications
- Binary numbers use a "Base 2" counting system instead of the common Base 10 system. Each place in the numerical format is a subsequent power of 2 instead of 10. Here is how you would count from 0 to 5 to transmit binary code instructions in Base 2:
 - 1=01 One unit at the right and no 2s in the next place
 - 2=10 No unit at the right and One 2 in the next place (0+2=2)

3=11 One unit at the right and one 2 in the next place ($1+2=3$)

4=100 No unit at the right, no unit in the next place, and one unit in the 4s place (2^2)

5=101 One unit at the right, no unit in the 2s place and one unit in the 4s place
($4+1=5$)

More Definitions

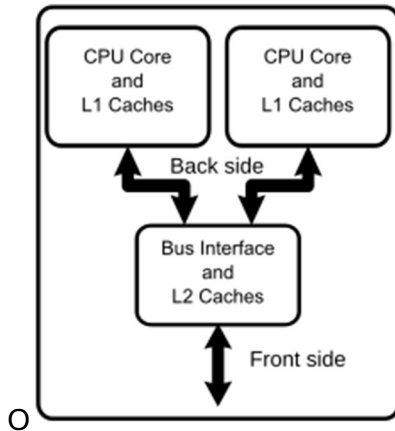
What is the CPU Cache

- The cache on a CPU is a bit of built-in small, fast memory, located closer to a processor core, which stores copies of the data sent to the CPU from frequently used main memory locations
- System memory: Random access memory (RAM) is the computer memory that stores information a program needs to allow it to run under an operating system, such as Windows (on a PC) or OS X (on a Macintosh).
- Mass storage: In computing, mass storage refers to the storage of large amounts of data in a persisting and machine-readable fashion. The earliest storage devices were punched paper cards, which were used as early as 1804 to control silk-weaving looms. Modern mass storage devices include all types of disk drives and tape drives.
- Removable storage: Removable media is a type of storage device that can be removed from a computer whilst the system is running. Examples include USB memory sticks (thumb drives) and External hard drives.

Clock speed and frequency multipliers

What Is Clock Speed?

- In general, a higher **clock speed** means a faster CPU. However, many other factors can come into play, as well.
- Some of these instructions involve simple arithmetic, while others are more complicated. Your CPU processes many instructions from different programs every second. The clock speed measures the number of cycles your CPU executes per second, measured in GHz (gigahertz).
- CPU clock speed is expressed in gigahertz — billions of cycles per second. Higher clock speeds generate more heat.
- The **base clock** is a lower frequency—often 100 MHz—that synchronizes various components on the motherboard in your system. It's provided by the chipset on the motherboard and serves as a kind of coordinator between your CPU and other components.
- The **Frequency Multiplier** is the speed ratio between the computer's Northbridge (formerly referred to as the frontside bus (FSB), and the CPU. For example, a 10x CPU frequency multiplier runs the CPU at 10 times the speed of motherboard components connected through the Northbridge. A CPU multiplier of 46 and a base clock of 100 MHz, for example, results in a clock speed of 4.6GHz.



The Northbridge connects to the memory on a motherboard through the front-side bus (also sometimes called the memory bus). The FSB acts as a pathway for data transfer between the central processing unit (CPU) and the memory, and the northbridge controls this communication.

The original front-side bus architecture has been replaced by [HyperTransport](#), [Intel QuickPath Interconnect](#), [Direct Media Interface](#) and nowadays by [Intel Ultra Path Interconnect](#) in modern Intel CPUs for personal computers.

- The EV6 bus served the same function for competing AMD CPUs (now replaced by the Athlon's Busses GTL). Both typically carry data between the central processing unit (CPU) and the memory controller hub, known as the Northbridge.

Note: Depending on the implementation, some computers may also have a back-side bus that connects the CPU to a built-in memory cache. This bus and the cache connected to it are faster than accessing the system memory (or RAM) via the front-side bus.

- The original front-side bus architecture on computers using Intel CPUs has been replaced by HyperTransport, Intel QuickPath Interconnect, Direct Media Interface—and most recently by Intel Ultra Path Interconnect in modern Intel CPUs for personal computers.
- In this case, a “cycle” is the basic unit that measures a CPU’s speed. During each cycle, billions of transistors within the processor open and close. This is how the CPU executes the calculations contained in the instructions it receives. CPU speed is determined by how many calculations the processor can perform per cycle (of electricity through the motherboard).

If you’re wondering how to check the clock speed on a Windows computer, click the Start menu (or click the Windows key) and type “System Information.” Your CPU’s model name and clock speed will be listed under “Processor.”

System Information		
File Edit View Help		
System Summary	Item	Value
Hardware Resources	OS Name	Microsoft Windows 10 Pro
Components	Version	10.0.19045 Build 19045
Software Environment	Other OS Description	Not Available
	OS Manufacturer	Microsoft Corporation
	System Name	KYNDRYL-PC
	System Manufacturer	LENOVO
	System Model	20S1S0QE00
	System Type	x64-based PC
	System SKU	LENOVO_MT_20S1_BU_Think_FM_ThinkPad T14 Gen 1
	Processor	Intel(R) Core(TM) i5-10310U CPU @ 1.70GHz, 2208 Mhz, 4 ...

Electrical Safety and ESD (Electrostatic Discharge)

Disconnect power from a computer before opening it and working inside the case.

Computer products that have the CE marking are designed and tested for immunity to international Electrostatic Discharge (ESD) standards. While these products have been designed and determined to be compliant with standard levels for ESD, there may be situations, such as low humidity levels, that can exacerbate ESD event occurrence.

Electrostatic discharge (ESD) events can harm electronic components inside your computer. Under certain conditions, ESD may build up on your body or an object, such as a peripheral, and then discharge into another object, such as your computer. To prevent ESD damage, you should discharge static electricity from your body before you interact with any of your computer's internal electronic components, such as a memory module.

You can protect against ESD and discharge static electricity from your body by touching a metal grounded object (such as an unpainted metal surface on your computer's I/O panel) before you interact with anything electronic. When connecting a peripheral (including handheld digital assistants) to your computer, you should always ground both yourself and the peripheral before connecting it to the computer. In addition, as you work inside the computer, periodically touch a metal-grounded object to remove any static charge your body may have accumulated.

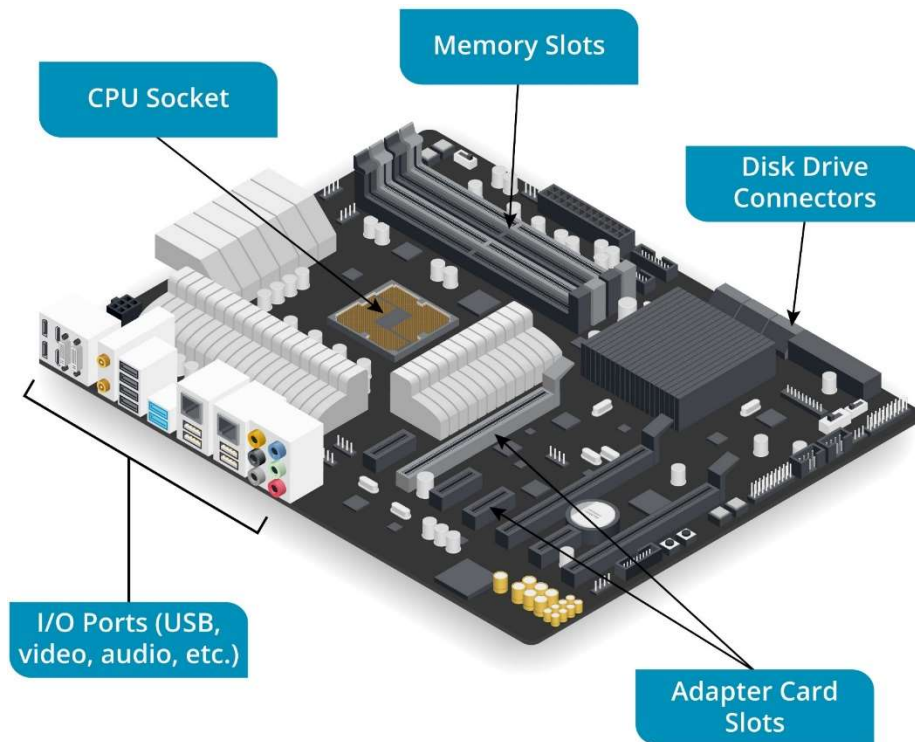
You can also take the following steps to prevent damage from electrostatic discharge:

- When unpacking a static-sensitive component from its shipping carton, do not remove the component from the antistatic packing material until you are ready to install the component. Just before unwrapping the antistatic package, be sure to discharge static electricity from your body.
- When transporting a sensitive component, first place it in an antistatic container or packaging.
- Handle all electrostatic sensitive components in a static-safe area. If possible, use an antistatic ESD wrist strap and/or other anti-static tools.
 - ESD Wrist Strap
 - Anti-static mat. ...
 - Anti-static bags. ...
 - Anti-static gloves. ...
 - Anti-static spray. ...



ESD Wrist Strap

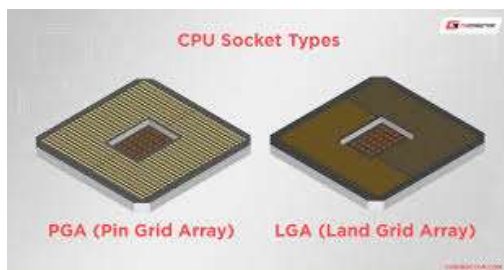
Motherboard CPU and System Memory Connectors



CPU sockets

Also known as a CPU slot, the CPU socket is used to connect a microprocessor with a printed circuit board (PCB) without soldering, allowing for the CPU to be installed or replaced more easily on the motherboard.

Common types of CPU sockets include the the Land Grid Array (LGA) used on Intel motherboards and the Pin Grid Array (PGA) found on AMD motherboards. The difference between the two is that PGA places the pins on the processor and the holes in the socket, whereas LGA has a socket with pins that you place the processor on.



Common Intel LGA CPU sockets include:

LGA 1700

Intel's 14th Gen Core processors use the same LGA 1700 socket as 12th and 13 Gen, so all 600 and 700 series boards will support these new CPUs as well, although they may need a BIOS update first. (Oct 18, 2023)

Intel has had to completely overhaul socket and processor sizes with its new LGA 1700 socket. Even though the company had been steadily increasing the number of pins, the socket size itself has remained static since 2004.

LGA 1200

Intel's 10th and 11th generation chips (Comet Lake and Rocket Lake) are slightly different in design from the previous generations, making them incompatible with the older sockets. The new LGA 1200 was rolled out to cater to these powerful processors.

While the overall footprint of the socket remains the same, there are more pins and other incremental improvements to let the new chips perform to their full potential. And as these processors get more popular, so do the LGA 1200 socket motherboards.

LGA 1151

Intel's LGA 1151 socket first appearing 2008 is now a legacy socket.

Common AMD PGA Socket

Socket AM4 is a **PGA** microprocessor socket used by AMD's central processing units (CPUs)

Memory Slots

Memory slots are used to contain the Random Access Memory (RAM) modules that store the data used to run an operating system and its applications. Currently the Memory slots on Desktop PC motherboards use DIMM (Dual Inline Memory Module) RAM.

What are front panel headers on the motherboard used for?

They allow you to connect the power button, reset button, and LED indicators on the front panel of the case.

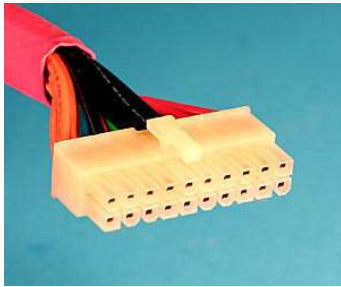
What are 9 pin USB Headers on the motherboard?

These are used for USB 3.x ports. If you look at any USB 2.0 or earlier plug it only has 4 contacts.

What are the audio headers on the motherboard used for?

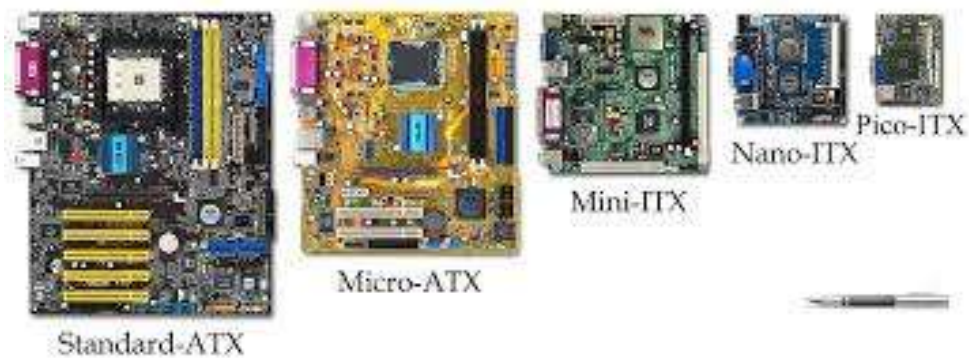
They allow you to connect to audio jacks on computer case

P1 Connector connects motherboard to the power supply in the case



Motherboard form factors

These are similar to the form factors for PC Cases.



Chipset

The chipset is a silicon backbone integrated into the motherboard that works with specific CPU generations. It relays communications between the CPU and the many connected storage and expansion devices.

Video Cards

Frame Rate

A frame is a digital data transmission unit in computer networking and telecommunication.

The frame rate shows how many images the GPU can capture or process in one second. Therefore, if your GPU can capture/process more images in one second, then it will produce a more detailed video or picture than one that captures less

Virtual Workbench Lab: Install a Motherboard

Use appropriate Antistatic ESD Tools, place all necessary components within easy reach in front of you (Risers, screws, etc.) and follow steps outlined by instructor to

Topic 1C Legacy Ports and Cables

Older Tower Legacy Rear Ports

