Chapter 2: PC Assembly

IT Essentials 8.0

Chapter 2 - Sections & Objectives

- 2.1 Assemble the Computer

  - Build a computer.

    - Define general and fire safety standards.

    - Connect the power supply.

    - Install the motherboard components.

    - Install internal drives.

    - Install the adapter cards.

    - Identify additional storage.

    - Connect computer components with appropriate cables.

2.1 Assemble the Computer

Video Explanation – General and Fire Safety

In this video explanation, you will learn about the general and fire safety precautions while working in a computer:

- Remove watches or jewelry
- Turn off and unplug equipment
- Remove clutter from workspace
- Cover sharp edges inside the computer
- Wear safety goggles
- Proper lifting procedures
- Fire extinguisher availability, rating, and use

Video Demonstration – Install the Power Supply

This is a video demonstration about installing the power supply:

Step 1: Open the computer case
Step 2: Align the screw holes on the power supply with the mount on the computer case.
Step 3: screw the power supply into place.

Select the Case and Fans

- The choice of motherboard and external components influences the selection of the case and power supply.
- The motherboard form factor must be matched with the correct type of computer case and power supply.

Factors affecting the choice of a computer case include:
- **Model Type** – The motherboard determines the type of case you can use. The size and shape must match.
- **Size** – A computer with many components will need more room for airflow to keep the system cool.
- **Power Supply** – Match the power supply rating and connection type to the motherboard.
- **Appearance** – There are many case designs to choose from.
- **Status Display** – LEDs mounted on outside of case tell you if the system has power, when the hard drive is in use, and when the computer is in sleep or hibernate mode.
- **Vents** – All cases have a vent on the power supply, and some have a vent in the back to draw air out of into the system. Some cases have even more vents.

Select the Case and Fans (Cont.)

Case fans should be installed to move cooler air into the computer case while moving heat out of the case.

Factors to consider when choosing a case fan

Factors	Consider ....
Case size	Larger cases often require larger fans because smaller fans cannot create enough air flow.
Fan speed	Larger fans can spin more slowly than smaller fans, which reduces fan noise.
Number of components	Multiple components in a computer create additional heat, which requires more fans, larger fans, or faster fans.
Physical environment	The case fans must be able to disperse enough heat to keep the interior of the case cool.
Number of mounting places available	Different cases have different numbers of mounting places for fans.
Location of mounting places available	Different cases have different locations for mounting fans.
Electrical connections	Some case fans are connected directly to the motherboard, while others are connected directly to the power supply.

Select a Power Supply

- Power supplies convert AC input to DC output voltages.
- Power supplies typically provide voltages of 3.3V, 5V, and 12V, and are measured in wattage.
- The power supply must provide enough power for the installed components and allow for other components that may be added at a later time.
- If you choose a power supply that powers only the current components, you might need to replace the power supply when other components are upgraded.

Factors to consider when choosing a power supply

Factors	Consider ....
Type of Motherboard	The power supply must be compatible with the motherboard.
Required Wattage	Add the wattage for each component. If the wattage is not listed on a component, calculate it by multiplying its voltage and amperage. If the component requires different levels of wattage, use the higher requirement.
Number of components	Make sure the power supply provides enough wattage to support the number and types of components plus another 25% at a minimum.
Type of components	Make sure the power supply provides the right types of power connectors.
Type of case	Make sure the power supply can be mounted in the desired case.

Lab – Install the Power Supply

In this lab, you will install a power supply in a computer case.

Video Demonstration – Install the CPU

This is a video demonstration about installing the CPU:

Step 1: Orient the CPU to the CPU slot.

Step 2: Press the CPU into the CPU slot.

Step 3: Lock the CPU into place.

Step 4: Apply thermal paste to the CPU.

Step 5: Install the heatsink.

Step 6: Secure the heatsink.

Video Demonstration – Install the RAM

This is a video demonstration about installing the RAM:

Step 1: Open the RAM slot levers.

Step 2: Orient the RAM chip to the motherboard slot.

Step 3: Lower the RAM chip into the slot.

Step 4: Press down firmly to lock the RAM chip.

Video Demonstration – Install the Motherboard

This is a video demonstration about installing the motherboard:

Step 1: Align the motherboard in the correct direction.

Step 2: Locate the standoffs.

Step 3: Install standoffs in the computer case.

Step 4: Align I/O plate to back of computer case.

Step 5: Lower motherboard into place.

Step 6: Install the screws into the standoffs.

Select the Motherboard

When selecting a replacement motherboard, make sure that it supports or accommodates:

- CPU
- RAM
- Video adapter, other adapter cards
- Socket and chipset on motherboard are compatible with the CPU
- The existing heat sink and fan assembly when reusing the CPU
- The number/type of expansion slots. They must match the existing adapter cards and allow for new cards
- The existing power supply connections must fit the new motherboard.
- New motherboard must fit into the current computer case.

Select the CPU and CPU Cooling

- Before you buy a CPU, make sure that it is compatible with the existing motherboard.
- Manufacturers' websites are a good resource to investigate the compatibility between CPUs and other devices.
- The following tables list the various Intel and AMD sockets available and their supported processors.

Intel Sockets

Intel Socket	Architecture
775	LGA
1155	LGA
1156	LGA
1150	LGA
1366	LGA
2011	LGA

AMD Sockets

AMD Socket	Architecture
AM3	Pin Grid Array (PGA)
AM3+	PGA
FM1	PGA
FM2	PGA
FM2+	PGA

Select the CPU and CPU Cooling (Cont. 1)

- The speed of a modern processor is measured in GHz. A maximum speed rating refers to the maximum speed at which a processor can function without errors. Two primary factors can limit the speed of a processor:
    - **Transmission Delay** - The processor chip is a collection of transistors interconnected by wires. Transmitting data through the transistors and wires creates delays.
    - **Heat Generation** - As the transistors change state from on to off or off to on, a small amount of heat is generated. The amount of heat generated increases as the speed of the processor increases. When the processor becomes too hot, it begins to produce errors.
- The front-side bus (FSB) is the path between the CPU and the Northbridge. It is used to connect various components, such as the chipset, expansion cards, and RAM.
- Data can travel in both directions across the FSB. The frequency of the bus is measured in MHz. The frequency at which a CPU operates is determined by applying a clock multiplier to the FSB speed. For example, a processor running at 3200 MHz might be using a 400 MHz FSB. 3200 MHz divided by 400 MHz is 8, so the CPU is eight times faster than the FSB.
- Processors are further classified as 32-bit and 64-bit. The primary difference is the number of instructions that can be handled by the processor at one time.

Select the CPU and CPU Cooling (Cont. 2)

- The CPU is one of the most expensive and sensitive components in the computer case.
- The CPU can become very hot; therefore, most CPUs require an air-cooled or liquid cooled heat sink, combined with a fan for cooling.

- The table lists several factors to consider when choosing a CPU cooling system.

Choosing a CPU Cooling System

Factors	Consider ....
Socket type	The heat sink or fan type must match the socket type of the motherboard.
Motherboard physical specifications	The heat sink or fan must not interfere with any components attached to the motherboard.
Case size	The heat sink or fan must fit within the case.
Physical environment	The heat sink or fan must be able to disperse enough heat to keep the CPU cool in warm environments.

Select the RAM

New RAM may be needed when an application locks up or the computer displays frequent error messages. To determine if the problem is the RAM, execute the RAM test in the BIOS. The speed of the new RAM must be supported by the chipset.

Memory may also be categorized as unbuffered or buffered:
- **Unbuffered memory** – This is regular memory for computers. The computer reads data directly from the memory banks making it faster than buffered memory.
- **Buffered memory** – Specialized memory for servers and high-end workstations that use a large amount of RAM. These have a control chip built into the module that assists the memory controller in managing large quantities of RAM.

Lab - Install the Motherboard in a Computer

In this lab, you will install a CPU, a heat sink/fan assembly, and RAM module(s) on the motherboard. You will then install the motherboard into the computer case.

Video Demonstration - Install the Drives

This is a video demonstration about installing the Drives:

Hard Drive

Step 1: Position the HDD so that it aligns with the drive ay opening. The power and interface connectors should be facing out towards the motherboard.

Step 2: Insert the HDD into the drive bay so that the screw holes in the drive line up with the screw holes in the case.

Step 3: Secure the HDD to the case using the proper screws.

Optical Drive

Step 1: From the front of the case, choose the drive bay that you want to hold the drive. Remove the faceplate from that bay if necessary.

Step 2: Position the optical so that it aligns with the 5.25 inch (13.34 cm.) drive bay opening at the front of the case.

Step 3: Insert the optical drive into the drive bay so that the optical drive screw holes align with the screw holes in the case.

Step 4: Secure the optical drive to the case using the proper screws.

Select Hard Drives

- You may need to replace an internal storage device when it no longer meets your customer's needs, or it fails.
- Signs that an internal storage device is failing might be unusual noises, unusual vibrations, error messages, or even corrupt data or applications that do not load.
- Internal drives usually connect to the motherboard with SATA while external drives connect with USB, eSATA, or Thunderbolt.
- Legacy motherboards may only offer the IDE or EIDE interface.
- When selecting a HDD, it is important to choose one that is compatible with the interfaces offered by the motherboard.
- Most internal HDDs are available in the 3.5 inch (8.9 cm) form factor, however 2.5 inch (6.4 cm) drives are becoming popular. SSDs are generally available in the 2.5 inch (6.4 cm) form factor.

- **Note**: SATA and eSATA cables are similar but they are not interchangeable.

Select Hard Drives (Cont.)

Factors to consider when purchasing a new hard disk drive are listed in the figure.

New Hard Drive Factors

- Internal or external
- HDD, SSD, or SSHD
- Hot-swappable
- Heat generation
- Noise generation
- Power requirements

Select Optical Drives

Factors to consider when purchasing an optical drive are listed below the figure.

New Optical Drive Factors

- Connector type
- Reading capability
- Writing capability
- Optical media type

Optical Drive Capabilities

Optical Device	Read CD	Write CD	Read DVD	Write DVD	Read Blu-ray	Write Blu-ray	Rewrite Blu-ray
CD-ROM	✅	❌	❌	❌	❌	❌	❌
CD-RW	✅	✅	❌	❌	❌	❌	❌
DVD-ROM	✅	❌	✅	❌	❌	❌	❌
DVD-RW	✅	✅	✅	✅	❌	❌	❌
BD-ROM	✅	❌	✅	❌	✅	❌	❌
BD-R	✅	✅	✅	✅	✅	✅	❌
BD-RE	✅	✅	✅	✅	✅	✅	✅

Install the Hard Drive

A computer case holds drives in drive bays. The table describes the three most common types of drive bays.

Drive Bay Width	Description
5.25 in. (13.34 cm.)	• Commonly used for optical drives. • Most full-size tower cases will have two or more bays.
3.5 in. (8.9 cm.)	• Commonly used for 3.5 inch HDDs. • Provide additional USB ports or smart card readers. • Most full-size tower cases will have two or more internal bays.
2.5 in. (6.35 cm.)	• Intended for smaller 2.5 inch HDDs and SSDs. • Smallest width bay. • Becoming increasing popular in newer cases.

- To install an HDD, find an empty hard drive bay in the case that will accommodate the width of the drive, as shown in the figure.
- When installing multiple drives in a case, it is recommended to maintain some space between the drives to help airflow and enhance cooling.
- Also, mount the drive with the metal side face up. This metal face helps to dissipate heat from the hard drive.

Install the Hard Drive (Cont.)
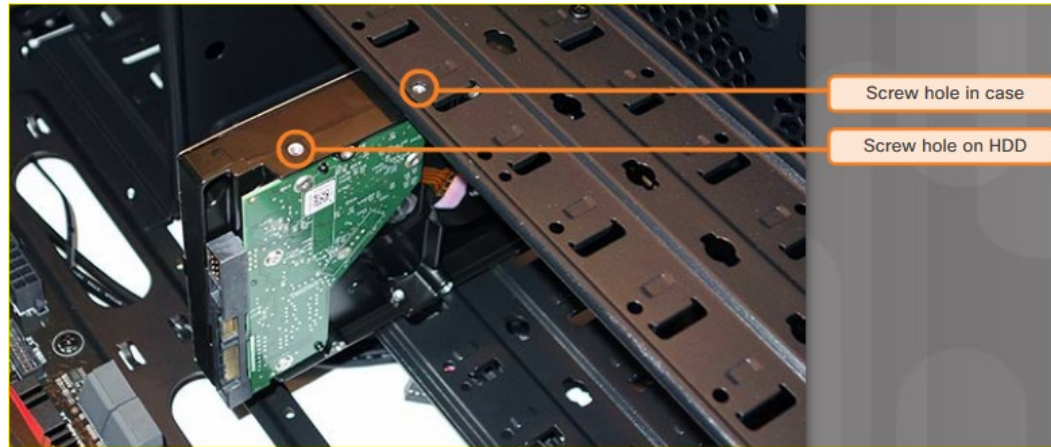
Installation Tip: Slightly hand-tighten all the screws before tightening any of them with a screwdriver. This will make it easier to tighten the last two screws.

Install the Optical Drive

Step 1. From the front of the case, choose the drive bay that you want to hold the drive. Remove the faceplate from that bay if necessary.

Step 2: Position the optical drive so that it aligns with the 5.25 inch (13.34 cm.) drive bay opening at the front of the case, as shown in the figure.

Step 3. Insert the optical drive into the drive bay so that the optical drive screw holes align with the screw holes in the case.

Step 4. Secure the optical drive to the case using the proper screws.

Installation Tip: Slightly hand-tighten all the screws before tightening any of them with a screw driver. This will make it easier to tighten the last two screws.

Lab – Install the Drives

In this lab, you will install the hard disk and optical drives.

Video Demonstration – Install the Adapter Cards

This is a video demonstration about installing the Adapter Cards:

Step 1: Find an empty PCIe x16 slot on the case and remove the small metal cover.

Step 2: Align the video adapter card to the appropriate expansion slot on the motherboard.

Step 3: Press down gently on the video adapter card until it is fully seated.

Step 4: Secure the video adapter card mounting bracket to the case with the appropriate screw.

Select Adapter Cards

Adapter cards are designed for a specific task and add extra functionality to a computer. There are a variety of adapter cards:

- Graphics
- Sound
- Storage Controller
- I/O
- NIC
- Capture

Adapter cards are inserted into two types of expansion slots on a motherboard:
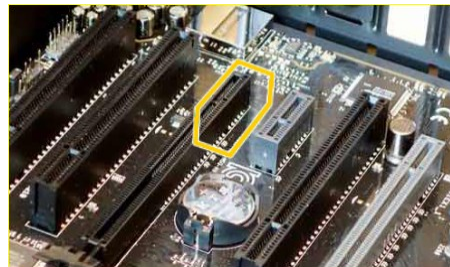
- Peripheral Component Interconnect (PCI)
- PCI Express (PCIe) – PCIe has four types of slots; x1, x4, x8, and x16.

Note: If the motherboard does not have a compatible expansion slot, an external device may be an option.

PCI
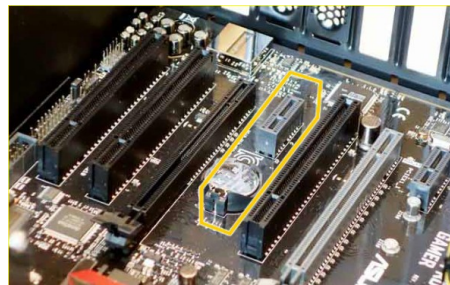
PCIe x1

PCIe x16
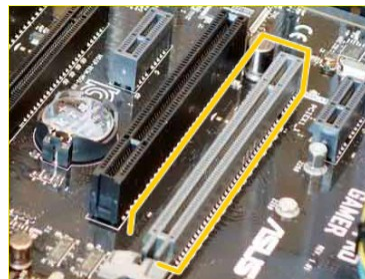
Other Factors for Adapter Card Selection

Before purchasing an adapter card, consider the following questions:
* What are the user's current and future needs?
* Is there an open and compatible expansion slot available?
* What are the possible configuration options?

Adapter Card	Consideration
Graphics Card	• Slot type • Amount and speed of video RAM (VRAM) • Graphics Processor Unit (GPU) • Maximum Resolution
Sound Card	• Slot type • Digital signal processor (DSP) • Port and connection types • Signal-to-noise ratio
Storage Controller Card	• Slot type • Connector quantity • Internal or external connectors • Card size • Controller card RAM • Controller card processor • RAID type

Other Factors for Adapter Card Selection (Cont.)

Before purchasing an adapter card, consider the following questions:
- What are the user's current and future needs?
- Is there an open and compatible expansion slot available?
- What are the possible configuration options?

Adapter Card	Consideration
I/O Card	• Slot ratio • I/O port type • I/O port quantity • Additional power requirements
NIC	• Slot type • Speed • Connector type • Wired or wireless connection • Standards compatibility
Capture Card	• Storage • Resolution and frame rate • I/O port • Format standards • Input interface types

Install the Adapter Cards

Expansion cards are installed into an appropriate slot on the motherboard.

- Many video adapter cards require separate power from the power supply using a 6-pin or 8-pin power connector.

- **Installation Tip**: Research the length of the video card. Longer cards may not be compatible with certain motherboards. Some adapter cards may come with mounting brackets of different heights to accommodate these cases.
- **Installation Tip**: Some cases have small slots at the bottom of the hole where the cover was removed. Slide the bottom of the mounting bracket into this slot before seating the card.

Lab - Install Adapter Card

In this lab, you will install a NIC, a wireless NIC, and a video adapter card

Select a Media Reader

Several media card formats have been developed over the years including:

- **Secure digital (SD)**
- **MicroSD**
- **MiniSD**
- **CompactFlash**
- **Memory Stick**
- **xD**

Choose a media reader based on current and future needs.

New Media Reader Factors

- Media cards supported
- Internal or external
- Size
- Connector type

Select External Storage

External USB flash drives, sometimes called thumb drives, are commonly used as removable external storage. External storage devices connect to an external port using USB, eSATA, or Thunderbolt ports.

Choose the correct type of external storage for your customer's needs. For example, if your customer needs to transfer a small amount of data, such as a single presentation, an external flash drive is a good choice. If your customer needs to back up or transfer large amounts of data, choose an external hard drive.

New External Storage Factors

- Port type
- Storage capacity
- Speed
- Portability
- Power requirements

Video Demonstration – Connect the Internal Power Cables

This is a video demonstration about connecting the internal power cables:
- **Step 1**: Align the 24-pin ATX power connector to the socket on the motherboard.
- **Step 2**: Gently press down on the connector until the clip clicks into place.
- **Step 3**: Align the 4-pin auxiliary power connector to the socket on the motherboard.
- **Step 4**: Gently press down on the connector until the clip clicks into place.
- **Step 5**: Align the CPU fan power connector to the socket on the motherboard.
- **Step 6**: Gently press down on the connector until the clip clicks into place.

Video Demonstration – Connect the Internal Data Cables

This is a video demonstration about connecting the internal data cables:

- **Step 1**: Align the SATA cable and plug one end into the motherboard socket.
- **Step 2**: Align the other end of the SATA cable and plug it into the smaller SATA port on the drive.

Lab – Install Internal Cables

In this lab, you will install the internal power and data cables in the computer.

Video Demonstration – Install the Front Panel Cables

This is a video demonstration about connecting the front panel cables:
- **Step 1**: Plug the power cable into the system panel connector in the location marked PWR_SW.
- **Step 2**: Plug the reset cable into the system panel connector in the location marked RESET.
- **Step 3**: Plug the power LED cable into the system panel connector in the location marked PWR_LED.
- **Step 4**: Plug the drive activity LED into the system panel connector in the location marked HDD_LED.
- **Step 5**: Plug the speaker cable into the system panel connector in the location marked SPEAKER.
- **Step 6**: Plug the USB cable into the USB connector.
- **Step 7**: Plug the audio cable into the audio connector.

Install the Front Panel Cables

- A computer case typically has a power button and visible activity lights on the front of the case.
- The case will include front panel cables that must be connected to a common system panel connector on a motherboard.
- Writing on the motherboard near the system panel connector shows where each cable is connected.
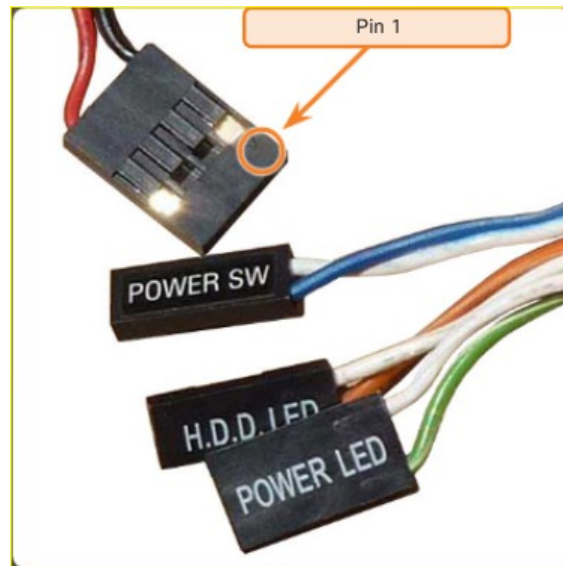

Front Panel Connectors
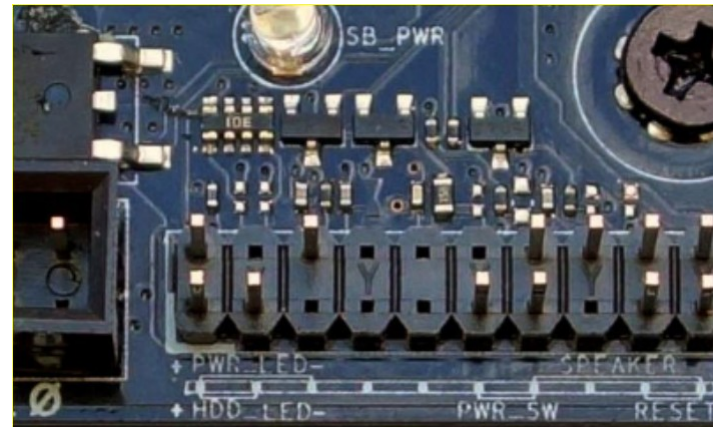
System Panel Connector

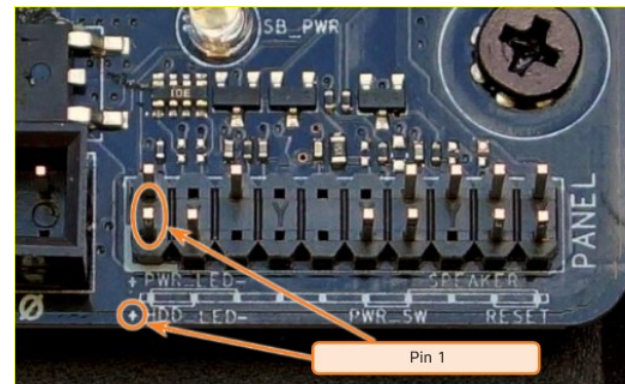# Install the Front Panel Cables (Cont.)

System panel connectors include:
- Power Button
- Reset Button
- Power LED
- Drive Activity LEDs
- System Speaker
- Audio

System panel connectors are not keyed. However, each front panel cable usually has a small arrow indicating pin 1, and each pair of LED pins on the motherboard system panel connector has pin 1 marked with a plus sign (+).


Pin 1 Arrow Indicator

System Panel Connector Pin 1 Indicator

Install the Front Panel Cables (Cont.)

New cases and motherboards have USB 3.0 or USB 3.1 capabilities. USB connector cables are often 9 or 10 pins arranged in two rows. These cables connect to USB motherboard connectors. This arrangement allows for two USB connections, so USB connectors are often in pairs. Sometimes the two connectors are together in one piece and can be connected to the entire USB motherboard connector.
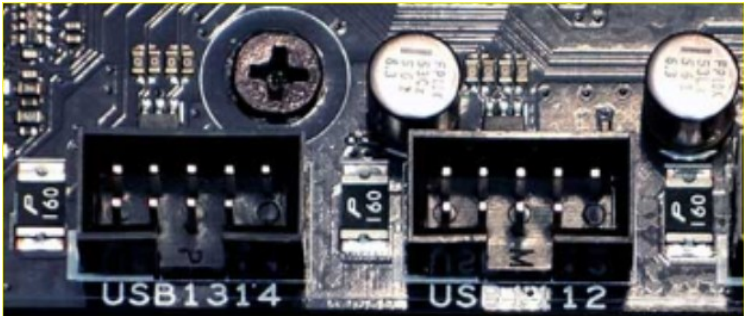
USB Motherboard Connectors
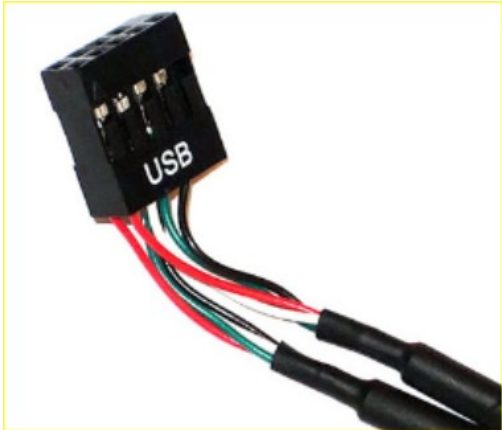
Internal USB Connector

Install the Front Panel Cables (Cont. 1)

Front Panel	Connection Specifics
Power Button	Aling pin 1 of the two-pin front panel power cable with the power button pins on the motherboard.
Reset Button	Aling pin 1 of the two-pin front panel reset button cable with the reset pins on the motherboard.
Power LED	Aling pin 1 of the front panel power LED cable with the power LED pins on the motherboard.
Drive Activity LED	Aling pin 1 of the front panel drive activity cable with the drive activity pins on the motherboard.
System Speaker	Aling pin 1 of the front panel system speaker cable with the system speaker pins on the motherboard.
Audio Cables	Due to the specialized function and variety of the hardware, consult the motherboard, case, and audio panel documentation for specific instructions.
USB	Aling pin 1 of the USB cable with the USB pins on the motherboard.

Install the Front Panel Cables (Cont. 2)

- Generally, if a button or LED does not function, the connector is incorrectly oriented.

- To correct this, shut down the computer and unplug it, open the case, and turn the connector around for the button or LED that does not function.

- To avoid wiring incorrectly, some manufacturers include a keyed pin extender that combines multiple front-panel cables (i.e., power and reset LEDs) connectors into one connector.

Installation Tip: The panel connector and case cable ends are very small. Take pictures of them to locate pin 1. Because space in the case can be limited at the end of assembly, a part retriever can be used to plug the cables into the connectors.

Lab - Install the Front Panel Cables

In this lab, you will install the front panel cables in the computer.

Video Demonstration – Complete the Computer Assembly

This is a video demonstration about completing the computer assembly:

- **Step 1**: Reattach the front panel (if necessary).
- **Step 2**: Plug the power cable into the power supply.
- **Step 3**: Orient and connect USB cables to USB ports.
- **Step 4**: Orient and connect the video cable to the video port on the video adapter.
- **Step 5**: Tighten the video cable screws to the video adapter.
- **Step 6**: Connect the network cable to the Ethernet port.
- **Step 7**: Connect the audio cables to the audio ports.
- **Step 8**: Place the side panel cover onto the case and slide it closed.
- **Step 9**: Tighten any screws to secure the side panel cover.

Lab – Complete the Computer Assembly

In this lab, you will install the side panels and the external cables on the computer.

2.2 Chapter Summary

Chapter 2: PC Assembly

- Build a computer.
  - Define general and fire safety standards.
  - Connect the power supply.
  - Install the motherboard components.
  - Install internal drives.
  - Install the adapter cards.
  - Identify additional storage.
  - Connect computer components with appropriate cables.