Chapter 1
First Look at Computer Parts and Tools
Objectives

• Learn about the various parts inside a computer case and how they connect together and are compatible
• Learn how to protect yourself and the equipment against the dangers of electricity when working inside a computer case
• Learn about tools you will need as a PC hardware technician and safety precautions when working around computer equipment
What’s Inside the Case

• Computer Case
  – Sometimes called “chassis”
  – Holds
    • Power supply, motherboard, processor, memory modules, expansion cards, hard drive, optical drive, other drives
    • Tower case – sits upright and can hold several drives
    • Desktop case – lies flat and sometimes holds monitor
    • Laptop case – mobile
    • All-in-one case – used with all-in-one computer
Figure 1-2 Inside the computer case
<table>
<thead>
<tr>
<th>Port</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Port Image" /></td>
<td>A <strong>VGA (Video Graphics Array)</strong> port, also called a <strong>DB-15 port</strong>, is a 15-pin female port that transmits analog video. (Analog means a continuous signal with infinite variations as compared to digital, which is a series of binary values—1s and 0s.) All older monitors use VGA ports.</td>
</tr>
<tr>
<td><img src="image2.png" alt="Port Image" /></td>
<td>An <strong>S-Video port</strong> is a 4-pin or 7-pin round video port sometimes used to connect to a television. The 7-pin port is shown on the left. The 4-pin port is missing the extra pins in the middle and is the more common type.</td>
</tr>
<tr>
<td><img src="image3.png" alt="Port Image" /></td>
<td>A <strong>DVI (Digital Video Interface) port</strong> transmits digital or analog video. Three types of DVI ports exist, which you learn about in Chapter 6.</td>
</tr>
<tr>
<td><img src="image4.png" alt="Port Image" /></td>
<td>An <strong>HDMI (High-Definition Multimedia Interface) port</strong> transmits digital video and audio (not analog transmissions) and is often used to connect to home theater equipment.</td>
</tr>
<tr>
<td><img src="image5.png" alt="Port Image" /></td>
<td>A <strong>DisplayPort</strong> transmits digital video and audio (not analog transmissions) and is slowly replacing VGA and DVI ports on personal computers.</td>
</tr>
<tr>
<td><img src="image6.png" alt="Port Image" /></td>
<td>A <strong>Thunderbolt</strong> port transmits both video and data on the same port and cable. The port is shaped the same as the DisplayPort and is compatible with DisplayPort devices.</td>
</tr>
<tr>
<td><img src="image7.png" alt="Port Image" /></td>
<td>A network port, also called an <strong>Ethernet port</strong>, or an <strong>RJ-45 port</strong>, is used by a network cable to connect to the wired network. Fast Ethernet ports run at 100 Mbps (megabits per second), and Gigabit Ethernet runs at 1,000 Mbps or 1 Gbps (gigabit per second). A megabit is one million bits and a gigabit is one billion bits. A bit is a binary value of one or zero.</td>
</tr>
</tbody>
</table>

*Table 1-1: Ports used with laptop and desktop computers*
PS/2 Keyboard Port
PS/2 Mouse Port
S/PDIF Ports
Serial Port
Serial ATA Port
IEEE 1394 Port
USB 2.0 Ports
RJ-45 LAN Ports
Center/Subwoofer
Side Speakers
Microphone
Line-Out
Wi-Fi Antenna In

PS/2 Keyboard
PS/2 Mouse
S/PDIF In
S/PDIF Out
Parallel Port
Serial Port
Firewire Port
USB Ports
RJ-45 Gigabit LAN
Microphone
Line In
Line Out
Side Right/Left
Center/Subwoofer
Rear Left/Right
Table 1-1  Ports used with laptop and desktop computers

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<thead>
<tr>
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<tr>
<td>Parallel</td>
<td>A <strong>parallel port</strong> is a 25-pin female port used by older printers. This older port has been replaced by USB ports.</td>
</tr>
<tr>
<td>Modem</td>
<td>A <strong>modem port</strong>, also called an <strong>RJ-11 port</strong>, is used to connect dial-up phone lines to computers. A modem port looks like a network port, but is not as wide. In the photo, the right port is a modem port and the left port is a network port, shown for comparison.</td>
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<td><img src="image1.png" alt="Image" /></td>
<td>A system usually has three or more round audio ports, also called sound ports, for a microphone, audio in, audio out, and stereo audio out. If you have one audio cable to connect to a speaker or ear buds, plug it into the lime green sound port in the middle of the three ports.</td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>An S/PDIF (Sony-Philips Digital Interface) sound port connects to an external home theater audio system, providing digital audio output and the best signal quality.</td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>A USB (Universal Serial Bus) port is a multi-purpose I/O port used by many different devices, including printers, mice, keyboards, scanners, external hard drives, and flash drives. Some USB ports are faster than others. Hi-Speed USB 2.0 is faster than regular USB, and Super-Speed USB 3.0 is faster than USB 2.0.</td>
</tr>
<tr>
<td><img src="image4.png" alt="Image" /></td>
<td>A FireWire port (also called an IEEE1394 port, pronounced “I-triple-E 1394 port”) is used for high-speed multimedia devices such as digital camcorders.</td>
</tr>
<tr>
<td><img src="image5.png" alt="Image" /></td>
<td>An external SATA (eSATA) port is used by an external hard drive using the eSATA interface. eSATA is faster than FireWire.</td>
</tr>
<tr>
<td><img src="image6.png" alt="Image" /></td>
<td>A PS/2 port, also called a mini-DIN port, is a round 6-pin port used by a keyboard or mouse. The ports look alike but are not interchangeable. On a PC, the purple port is for the keyboard, and the green port is for the mouse. Newer computers use USB ports for the keyboard and mouse rather than the older PS/2 ports.</td>
</tr>
<tr>
<td><img src="image7.png" alt="Image" /></td>
<td>An older serial port, sometimes called a DB9 port, is a 9-pin male port used on older computers. It has been mostly replaced by USB ports.</td>
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**Table 1-1**  Ports used with laptop and desktop computers
What’s Inside the Case

• Motherboard – sometimes called system board
  – Largest and most important circuit board
• Processor – central processing unit (CPU)
  – Processes most of the data and instructions for the entire system
  – CPUs generate heat and require a heat sink and fan (together called the processor cooler)
    • A heat sink consists of metal fins that draw heat away from a component
Motherboard
CPU
CPU Fans

Case Fan
Figure 1-2  Inside the computer case
What’s Inside the Case

- Expansion cards - also called adapter cards
  - A circuit board that provides more ports than those provided by the motherboard
  - Today, most ports are provided by motherboards (integrated ports)

![Figure 1-4 Ports provided by a motherboard](image-url)
Graphic/Video Cards
Wire/Wireless Cards
What’s Inside the Case

• Memory modules – random access memory (RAM)
  – Temporary storage for data and instructions as they are being processed by the CPU
  – Dual inline memory module (DIMM) slots hold memory modules

Figure 1-6  A DIMM holds RAM and is mounted directly on a motherboard
What’s Inside the Case

- Hard drives and other drives
  - Hard drives may also be called hard disk drive (HDD)
  - Permanent storage used to hold data and programs
  - Other drives include: optical drive and tape drive

**Figure 1-7** Two types of hard drives (larger magnetic drive and smaller solid-state drive) and a DVD drive
Hard drives 3.5” and 2.5”
DVD Drives
What’s Inside the Case

• Power supply – also called **power supply unit (PSU)**
  – Receives and converts house current (**converts AC to DC**) so that components inside the case can use it (**rectifier**)
  – Most come with a dual-voltage selector switch
    • Allows switching input voltage from 115V to 220V
Form Factors Used by Computer Cases, Power Supplies, and Motherboards

• Form factors: standards that describe the size, shape, screw hole positions, and major features of computer cases, power supplies, and motherboards
  – Necessary so that all will be compatible with each other

• Two form factors used by most desktop and tower computer cases and power supplies:
  – ATX
  – Mini-ATX
Form Factors Used by Computer Cases, Power Supplies, and Motherboards

• ATX (Advanced Technology Extended)
  – Most commonly used form factor today
  – Originally developed by Intel in 1995
  – It is an open, nonproprietary industry specification

• An ATX power supply has a variety of power connectors
  – Power connectors have evolved because new technologies require more power
  – Common ATX power connectors are listed on the following slides
Form Factors Used by Computer Cases, Power Supplies, and Motherboards

- **20-pin P1 connector**: used by the first ATX power supplies and motherboards
- **4-pin and 8-pin auxiliary connectors**: used to provide additional 12 V of power for evolving CPUs
- **24-pin or 20+4-pin P1 connector**: the older 20-pin P1 connector still worked in this connector
  - Supported the new PCI Express slots
- **6-pin and 8-pin PCIe connectors**: connect directly to the video card
  - Video cards draw the most power in a system
Power Supply
Figure 1-10  ATX power supply with connectors
Figure 1-16  P1 24-pin power connector follows ATX Version 2.2 and higher standards
Form Factors Used by Computer Cases, Power Supplies, and Motherboards

• MicroATX form factor
  – Major variation of ATX
  – Reduces total cost of a system by:
    • Reducing number of expansion slots on motherboard
    • Reducing power supplied to the board
    • Allowing for a smaller case size
  – Uses a 24-pin P1 connector
    • Not likely to have as many extra wires and connectors as those on the ATX power supply
Figure 1-18  This MicroATX motherboard by Biostar is designed to support an AMD processor
Drives, Their Cables, and Connectors

• Hard Drives
  – Two standards:
    • Serial ATA standard (SATA)
      – Used by most drives today
    • Parallel ATA (PATA) – slower than SATA
      – Also called IDE interface
      – Uses 40-pin ribbon cable and connector
      – Two connectors on a motherboard for two data cables
      – Accommodates up to four IDE devices
      – Uses a 4-pin power connector called a Molex power connector
IDE Cable

ATA/33 cable 40 wires
ATA/66 cable 80 wires

SATA Cable
Drives, Their Cables, and Connectors

- Floppy drive
  - 3.5-inch disk holding 1.44 MB of data
  - Uses a 34-pin twisted cable
  - Can hold up to two drives

Figure 1-28  The notch on the side of this floppy drive connector allows the floppy drive cable to connect in only one direction
Protecting Yourself and Equipment Against Electrical Dangers

- Important to understand electricity and how to protect yourself and equipment against it
- Must learn to prevent getting shocked or damaging a component
Measures and Properties of Electricity

- Alternating current (AC): oscillates between negative and positive voltage
  - House current is AC and oscillates 60 times in one second
- Direct current (DC): travels in one direction
  - Type of current used by most electronic devices
- Rectifier: a device that converts AC to DC
- Inverter: a device that converts DC to AC
- Transformer: devices that changes the ratio of voltage to current
Figure 1-30  A transformer keeps power constant but changes the ratio of current to voltage
Measures and Properties of Electricity

- AC travels on a **hot line** from a power station
- AC returns to the power station on a **neutral line**
- When AC follows an unintended path (one with less resistance) a **short** can occur
  - **Short**: a sudden increase in flow that can create a sudden increase in temperature
- The neutral line is grounded to prevent uncontrolled electricity in a short
  - **Grounding**: the line is connected directly to the earth, so that electricity can flow into the earth
Figure 1-31  A polarized plug showing hot and neutral, and a three-prong plug showing hot, neutral, and ground
For more information:
http://cnx.org/content/m42416/latest/?collection=col11514/latest
Figure 4-15 Normally, electricity flows from hot to neutral to make a closed circuit in the controlled environment of an electrical device such as a lamp.

Courtesy: Course Technology/Cengage Learning
Protect Yourself Against Electrical Shock and Burns

• When working with any electrical device, disconnect power if you notice a dangerous situation that might lead to electrical shock or fire.

• Potential dangers might include:
  – Power cord is frayed or damaged
  – Water or other liquid is spilled near
  – Device has been dropped or physically damaged
  – Smell a strong electronics odor
  – Power supply or fans make a whining noise
  – Smoke is observed or case feels unusually warm
Protect Yourself Against Electrical Shock and Burns

• When working on sensitive low-voltage equipment such as a motherboard or processor:
  – Ground yourself with an anti-static grounding bracelet connected to a ground

• When working with power supplies, printers, and CRT monitors that contain capacitors:
  – Do not ground yourself because power can flow through you to the ground and you may get shocked
  – Power supplies and monitors are considered a field replaceable unit (FRU), which means you are expected to know how to replace, not how to repair it
Protect Yourself Against Electrical Shock and Burns

• Never use water to put out a fire (water is a conductor)

• Use a fire extinguisher that is rated to put out electrical fires

• Fire extinguisher ratings:
  – Class A: can use water to put out fires caused by wood, paper, or other combustibles
  – Class B: can put out fires caused by liquids such as gasoline, kerosene, and oil
  – Class C: use nonconductive chemicals to put out a fire caused by electricity
Figure 1-33  A Class C fire extinguisher is rated to put out electrical fires
Protect the Equipment Against Static Electricity or ESD

- Electrostatic discharge (ESD): electrical charge at rest
  - When two objects with dissimilar electrical charges touch, electricity passes between them until charges are equal

- ESD can cause two types of damage:
  - Catastrophic failure: destroys the component
  - Upset failure: damages the component so that it does not work well
  - Both types permanently affect the device
Protect the Equipment Against Static Electricity or ESD

• To protect against EDS, always ground yourself with one or more of the following static control methods:
  – Ground bracelet: also called ESD strap, antistatic wrist strap, or ESD bracelet
    • Attach bracelet to the computer case to ground it
  – Ground mats: also called ESD mats
    • Often used by bench technicians who repair and assemble computers at workbenches or assembly lines
  – Static shielding bags: also called antistatic bags
  – Antistatic gloves: also called ESD gloves
    • Prevents ESD between you and a device when wearing
Protect the Equipment Against Static Electricity or ESD

- **Rule 1:** When passing a circuit board or other component to another person, ground yourself and touch the other person before you pass it.

- **Rule 2:** Leave components inside antistatic bags until ready to use them.

- **Rule 3:** Work on hard floors, not carpet.

- **Rule 4:** Don’t work on a computer in a cold and dry atmosphere.

- **Rule 5:** Remove packing tape and cellophane from around work area (materials that attract ESD).

- **Rule 6:** Keep components away from hair and clothing.
Tools Used By a PC Repair Technician

• Essential tools
  – Ground bracelet, ground mat, antistatic gloves
  – Flat-head screwdriver
  – Phillips-head or cross-head screwdriver
  – Torx screwdriver set (size T15)
  – Insulated tweezers
  – Extractor
  – OS recovery CD or DVD
• Many other non-essential tools exists
• Use a toolbox
• Reversible Torx® tool
• Parts gripper/picker
• Adjustable 6" wrench
• (2) nutdrivers, 3/16", 1/4"
• Spare-parts storage tube
• (3) Phillips screwdrivers
• (3) standard-blade screwdrivers
• Chip inserter and extractor
• Spring-loaded soldering clamp
• Compress and expand tweezers
• Needle-nose pliers with insulated handles
• Spring-loaded vacuum desoldering pump
• (6) soldering tools, cleaners, scrapers, picks
• 4-in-1 wire stripper, cutter, crimmer, sizer tool
• Padded vinyl zipper case, 11.6"W x 8.8"D (29.5 x 22.4 cm)
• 35-watt UL® listed soldering iron, removable tip, 6' cord
Ground bracelet, ground mat, antistatic gloves
Figure 1-38  Tools used by PC support technicians when maintaining, repairing, or upgrading computers
Power Supply Tester

- Power Supply Tester
  - Measures output of each power supply connector

Figure 1-42 Use a power supply tester to test the output of each power connector on a power supply
Multimeter

- Multimeter
  - Measures several characteristics of electricity in a variety of devices

**Figure 1-43** This digital multimeter can be set to measure voltage, resistance, or continuity
Proper Use of Cleaning Pads and Solutions

• Most cleaning solutions contain flammable and poisonous materials
  – Take care when using them
  – A Material Safety Data Sheet (MSDS) explains how to properly handle substances such as chemical solvents and how to dispose of them
    • Usually comes packaged with chemical
  – Organizations may require an accident report be filled out if accident occurs using dangerous products
Figure 1-45 Cleaning solutions and pads
Managing Cables

• Make sure cables are in a safe place
  – People can trip over cables left on floor (called a trip hazard)
• If cable must be ran across a path or where someone sits:
  – Use a cable or cord cover
Lifting Heavy Objects

• Follow these guidelines to avoid back injury:
  – Decide which side of object to face so that the load is most balanced
  – Stand close to the object with feet apart
  – Keep back straight, bend knees and grip load
  – Lift with legs, arms, and shoulders (not with back or stomach)
  – Keep the load close to your body and avoid twisting your body while holding it
  – To put object down, keep back straight and lower object by bending knees
Summary

• Ports on a computer might include video, network, sound, S/PDIF, USB, FireWire, eSATA, and PS/2
• Internal computer components include the motherboard, processor, expansion cards, DIMM modules, hard drive, optical drive, floppy drive, tape drive, and power supply
• Form factors used by cases, power supplies, and motherboards are ATX and MicroATX
• Power connectors include the 20-pin P1, 24-pin P1, 4-pin and 8-pin auxiliary motherboard, 4-pin Molex, 15-pin SATA, 4-pin FDD, 6-pin PCIe, and 8-pin PCIe
Summary

• Standards used by hard drives and other drives to interface with motherboard and power supply are serial ATA (SATA) and parallel ATA (PATA)
• Units used to measure electricity include volts, amps, ohms, joules, and watts
• Microcomputers require DC which is converted from AC by the PC’s power supply
• A power supply and CRT monitor contain dangerous charges even when unplugged
• Never use water to put out an electrical fire
Summary

• To protect against ESD use a ground bracelet, ground mat, antistatic bags, and antistatic gloves
• Special tools a PC support technician might need include a POST diagnostic card, power supply tester, multimeter, and loopback plugs
• A MSDS explains how to handle chemicals
• Be careful not to lift a heavy object in a way that can hurt your back
• Make sure cables are not trip hazards