# **Chapter 1**

**Taking a Computer Apart and Putting It Back Together**

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| **At a Glance** |

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# **Overview**

This chapter serves as an introduction to the basic hardware components in a computer. Students will learn how to identify various hardware components inside desktop computers as well the tools they will need to work inside the case. Later in the text, students will learn how to work inside of a desktop and a laptop computer and how different components are removed or replaced in a case.

# **Objectives**

After completing this chapter, students will be able to:

* Disassemble and reassemble a desktop computer safely while being able to identify various external ports and major components inside a desktop and describe how they connect together and are compatible. You’ll be able to identify various tools you will need as a computer hardware technician.
* Disassemble and reassemble a laptop computer safely while being able to identify various external ports and slots and major internal components of a laptop. You will know what special concerns need to be considered when supporting and maintaining laptops.

# **Teaching Tips**

# **Exploring A Desktop Computer**

1. Encourage students that as they work through this chapter, they should follow all the safety precautions found in Appendix A, “Safety Procedures and Environmental Concerns.”

#### Step 1: Planning and Organizing Your Work and Gathering Your Tools

1. Discuss basic tips and best practices in planning and ensuring that work inside a case is performed safely.
2. Define how Electrostatic discharge (ESD), or static electricity, occurs and can damage electrical components in a computer.
3. Demonstrate how to use a ground bracelet or ESD strap to ensure that electrical components are not damaged when worked on.
4. Discuss the list of essential tools of a computer hardware technician:

* An ESD strap
* Flathead screwdriver
* Phillips-head or crosshead screwdriver
* Torx screwdriver set
* Tweezers
* Software (recovery CD or DVD)

1. Also discuss the list of tools that might not be essential, but may be convenient to have on hand.
2. Point out the importance of keeping software discs used for troubleshooting inside a hard plastic case to protect them from scratches and dents.

#### Step 2: Opening the Case

1. Introduce the different kinds of cases typically available, the tower case, the desktop case, an all-in-one case, and a mobile case.
2. Review Table 1-1, which lists ports you might find on a desktop or mobile computer.
3. Describe how a loopback plug can be used to test a network cable or port. Note that USB loopback plugs exist also.
4. Stress the importance of performing backups of critical data on a system prior to working on its components.
5. Give students information on how to properly prepare a computer for maintenance, and provide information on how cases are typically opened.
6. Provide instruction on additional pieces of the case that may need to be removed in order to gain access to internal components.
7. Note that students can clip a ground bracelet onto the side of a metal case to ensure safe handling of components.

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| ***Teaching***  ***Tip*** | In really complex systems, taking a picture of the internal parts prior to working inside a case can be helpful in troubleshooting connections later. Smartphone cameras allow for a bit more maneuverability inside of a computer case for this purpose. |

1. Use Figure 1-12 to locate and identify components within a PC, and note where to find the processor, RAM, and power supply. Students should be aware of how to identify a hard drive or disc drive.
2. Define the following internal components and discuss how each is used once they have been identified:
   1. Motherboard, central processing unit (CPU), and cooler (heat sink)
   2. Expansion cards
   3. Memory modules
   4. Hard drives
   5. Power supply
3. Explain how form factors help ensure that components will fit within a computer case, and that power requirements will be met properly.
4. Define the Advanced Technology Extended, or ATX form factor, and demonstrate how to identify the various power connectors common for the ATX form factor:
   1. 4-pin and 8 pin auxiliary connectors
   2. 24-pin or 20+4-pin P1 connector
   3. 6-pin and 8-pin PCIe connectors
5. Explain the microATX (MATX) form factor as a reduced size variation of the ATX form factor, and discuss the differences between these two standards.

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| ***Teaching***  ***Tip*** | Many different form factors exist, all with different intended uses. MiniITX motherboards, for example, are designed to be extremely low power, and are typically used in small form factor computers. |

#### Step 3: Removing Expansion Cards

1. Discuss techniques for keeping track of cable connections and placement of parts within a computer case, such as using diagrams.
2. Cover steps required to remove expansion cards from a computer, such as removing screws that hold the card in place. Use Figures 1-28 and 1-29 in your discussion.

#### Step 4: Removing the Motherboard

1. Detail how to remove a motherboard from a case, and note what cables must be removed, such as the front panel connectors. Explain the role of spacers or standoffs in keeping the motherboard from contacting the metal case and shorting circuits.
2. Explain that a POST diagnostic card (POST card) can be of help in discovering and reporting computer errors and conflicts that occur after you first turn on a computer.
3. Explain how the BIOS (basic input / output system) and UEFI (Unified Extensible Firmware Interface) stores system settings such as system time and motherboard configuration settings in firmware on the motherboard.
4. Discuss the power-on self-test (POST) process in testing critical hardware components for proper functionality, and explain how a POST card can help a technician determine why a POST test fails.

#### Step 5: Removing the Power Supply

1. Show how to remove the power supply from a case, noting where screws that hold the power supply in place are typically located.
2. Describe how a power supply tester can be used to help determine if a power supply is providing the proper power to electrical components.
3. Demonstrate how to use a multimeter to test electrical circuits, such as by determining continuity and voltages present.

#### Step 6: Removing the Drives

1. Point out that a computer might have one or more hard drives, an optical drive, or some other type of drive. Mention that most hard drives and optical drives today use the serial ATA (SATA) standard.
2. Demonstrate how to remove drives from the case, and show the removal of screws that keep drives in place. Point out that some cases have a removable bay for smaller hard drives. Use Figures 1-40 through 1-44 in your discussion.

#### Steps to put a Computer Back Together

1. Explain the optimal order in which components should be installed into the case, starting with power supply, drives, motherboard, and cards. Note that this order may differ depending on the case involved.
2. Show how a motherboard should line up with the IO shield on the back of the case.
3. Discuss what power cables should be connected to the motherboard. Students should be aware that a system will always need the main P1 power connector and most likely will need the 4-pin or 8-pin auxiliary connector for the processor.
4. Elaborate on what additional power requirements a motherboard might have, such as Molex and SATA power connectors.
5. The front panel connectors and their respective contact points on the motherboard can usually be identified by markings around the pins on the motherboard. List some of the common connectors:
   1. Power SW
   2. HDD LED
   3. Power LED+
   4. Power LED-
   5. Reset SW
6. Motherboard documentation should be discussed as a way of identifying pins and ports on the motherboard.
7. Explain how to connect ports that exist on the front of the PC (such as USB or sound) to the motherboard.
8. Discuss the installation of a video card or other expansion cards, and demonstrate how to ensure that a card is seated correctly.
9. List other devices that need to be connected to a computer, such as the monitor, keyboard, and mouse. Show where these devices plug in.
10. Cover some additional troubleshooting steps to take in the event the computer does not power on or work properly.

**Quick Quiz 1**

1. A processor, or CPU, typically has a fan along with which of the following mounted on top of it to keep it cool?
2. Power supply
3. Heat sink
4. RAM
5. Transistor

Answer: B

1. True or False: The microATX is the most commonly used form factor today.

Answer: False

1. Which electronic component below has a dual voltage selector switch?
   1. Hard drive
   2. Power supply
   3. RAM
   4. Processor

Answer: B

1. Select the power connector that is specified by the ATX Version 2.2 standard, which allows more power to the motherboard for PCI Express (PCIe) devices.
   1. 20 pin P1 connector
   2. 8 pin auxiliary connector
   3. 24+4 pin P1 connector
   4. 20+4 or 24 –pin P1 connector

Answer: D

1. Which of the following is used to keep the motherboard from contacting the case, preventing a short?
   1. Standoffs
   2. Headers
   3. Retention screws
   4. Case screws

Answer: A

## First Look at Laptop Components

1. Discuss the differences between a laptop or notebook, a netbook, and an all-in-one computer. Note what kind of features one might have over the other, and what hardware is typically included.
2. Discuss the different types of ports that are typically found on most laptops.
3. Explain to students that when a laptop is missing a port or slot you need, you can usually use a USB dongle to provide the port or slot. Discuss some of the examples using Figures 1-57 through 1-60.

#### Special Keys, Buttons, and Input Devices on a Laptop

1. Discuss what settings are often changeable via the keyboard on a laptop, such as volume, keyboard backlight, screen brightness, dual displays, Bluetooth and/or Wi-Fi, media options, and GPS on/off.
2. The touchpad device should be explained as the laptop’s primary pointing device, but explain that some people prefer to use a USB wired or wireless mouse instead of the touchpad.
3. Mention that some laptops have a GPS receiver to calculate its position on the earth. Most of these laptops provide a button or function key to turn the GPS on or off.

#### Docking Stations and Port Replicators

1. Discuss how a docking port is used to connect to a docking station that can provide additional interfaces to a laptop.
2. Explain that a port replicator (sometimes called a universal docking station) is a device that provides ports to allow a laptop to easily connect to peripheral devices, such as:
   1. External monitor
   2. Network
   3. Printer
   4. Keyboard and mouse
   5. Speaker
3. If possible, demonstrate how to connect to a docking station or port replicator.

#### Special Consideration when Supporting Laptops

1. Explain the differences between a laptop a desktop. Note what kind of features one might have over the other, and what hardware is typically included.
2. Discuss the costs of repair for laptops to desktop PCs, and note that components such as memory and processors are smaller and differ from their desktop counterparts.
3. Discuss what options for extended warranties on laptops typically exist, and give information on how to determine if equipment is currently under a warranty.
4. List some support websites for various hardware manufacturers. Students should be shown how to access warranty information via some of these websites. Use Table 1-3 in your discussion.
5. Elaborate on how to use service manuals to aid in disassembly and repair of a laptop, and discuss ways of obtaining service manuals.
6. Explain that some laptops may have additional information in the form of videos or user manuals that may aid in disassembly.
7. Encourage students to always check the Support or FAQ pages of the manufacturer’s website for help.
8. Provide information on what tools might be provided by the manufacturer for troubleshooting an issue or replaced part, such as PC-Doctor.

#### Working Inside a Laptop Computer

1. List some common tools necessary for disassembly of a laptop computer, such as screwdrivers, spudgers, tweezers, and torx screwdrivers.
2. Review steps to take to discharge static electricity prior to working on the internal components of a laptop.
3. Discuss methods of documenting the areas at which screws are removed or components are unattached from the system, either by note pad or digital camera.
4. Emphasize that the service manual is the best piece of documentation to have for a laptop, and will show where various screws are installed.
5. Note that any applied warranties to laptop equipment could be voided if opened.
6. Remind students not to use force when working with laptop components.
7. Point out that some laptops use ZIF connectors. Demonstrate how to disconnect a cable from a ZIF connector or use Figure 1-76 in your discussion.
8. Disassemble the laptop by removing each field replaceable unit (FRU) in the order given by the service manual for the laptop. Stress the importance of following the steps to remove each component in the right order.
9. Discuss the general tips students should follow when reassembling a laptop:

* Reassemble the laptop in the reverse order of the way it was disassembled.
* Tighten, but do not over tighten, all screws.
* Verify there are no loose parts inside the laptop before installing the battery or AC adapter.

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| ***Teaching***  ***Tip*** | Many popular laptops will have disassembly videos on YouTube. Always check online resources first if you can’t find a service manual for working on the laptop. |

#### Exploring Laptop Internal Components

1. Discuss the following components student will likely be instructed to remove when disassembling a laptop:

* Remove or disable the battery pack
* Remove the hard drive
* Remove memory
* Remove the wireless card
* Remove the optical drive
* Crack the case
* Remove the keyboard bezel
* Remove the system board
* Remove the CPU, heat sink, and fan

#### Exploring Inside an All-in-One Computer

1. Explain that an all-in-one may have some components that are meant for notebook computers and others that are meant for desktops.
2. Demonstrate how students might remove internal components such as the hard drive or optical drive.
3. Stress the importance of having a service manual for working inside of an all-in-one computer, and give a basic overview of how to gain access to the internal components of a typical all-in-one computer.

#### Maintaining Laptops

1. Stress that laptops and mobile devices usually do not last as long as desktop computers and are subject to more wear and tear. Discuss the guidelines for caring for a laptop or mobile device as outlined in the book.
2. List the cleaning tips that can be used to help maintain a well-used laptop.

**Quick Quiz 2**

1. Which of the following provides ports to allow a laptop to easily connect to a full-sized monitor, keyboard, and other peripheral devices?
   1. Docking station
   2. Battery pack
   3. Optical drive
   4. All-in-one computer

Answer: A

1. What can be used to provide detailed instructions for performing work internally on a specific model of laptop computer?

Answer: service manual

1. True or False: Because they are smaller and easier to produce, laptop replacement parts cost less than replacement parts for desktop computers.

Answer: False

1. True or False: Opening the case of a laptop under warranty most likely will void the warranty.

Answer: True

1. What type of connector requires very little force for insertion?
   1. FRU
   2. ZIF
   3. PCI
   4. IDE

Answer: B

# **Class Discussion Topics**

1. Many students may have had experience changing out a computer component or even building their own computers. What had to be replaced? If they built their own PC, have them discuss with classmates what parts they had to purchase.
2. Start a class discussion about issues students have seen with their laptops or laptops used by others. What steps did the student take to resolve the issues when dealing with their own equipment?

# **Additional Projects**

1. Have students review the specifications for their motherboard and determine the maximum amount of RAM that can be installed on the motherboard. Have them list the types and sizes of RAM modules that can be installed.
2. Based on the students’ examination of the motherboard disk controller ports and power supply connectors, have students determine the maximum number of disk drives that can be installed on their system. Have them research disk drives to determine the maximum amount of storage they can install on the system.

# **Additional Resources**

1. Hard Drive Technology

<https://www.backblaze.com/blog/hdd-versus-ssd-whats-the-diff/>

1. Hard Disk Drive (HDD) vs Solid State Drive (SSD): What’s the Difference?

<https://www.backblaze.com/blog/hdd-versus-ssd-whats-the-diff/>

1. How to Disassemble and Rebuild a Desktop Computer

<https://www.crucial.com/usa/en/disassemble-and-rebuild-a-desktop-computer>

1. How to Disassemble Any Laptop in Under 20 Minutes – HP DV6000

<https://www.youtube.com/watch?v=Zo8ifRRezsU>

1. Repair Manuals for Everything – iFixit

<https://www.ifixit.com/Guide>

1. Blog containing links to a number of service manuals for different laptops:

<http://www.tim.id.au/blog/tims-laptop-service-manuals/>

1. How to Build a PC

<https://www.wired.com/story/how-to-build-a-pc/>

1. Laptop Disassembly Tips

<https://www.crucial.com/usa/en/disassemble-and-rebuild-a-laptop>

1. Guide to Connector Technology

<https://www.cablestogo.com/learning/connector-guides>

**Key Terms**

For explanations of key terms, see the Glossary for this text.

* 4-pin 12-V connector
* 8-pin 12-V connector
* 20-pin P1 connector
* 24-pin P1 connector
* airplane mode
* all-in-one computer
* analog
* ATX (Advanced Technology Extended)
* ATX12V power supply
* audio ports
* base station
* BIOS (basic input/output system)
* Bluetooth
* cellular network
* central processing unit (CPU)
* chassis
* DB9 port
* DB15 port
* DE15 port
* desktop case
* digital
* DIMM (dual inline memory module)
* DisplayPort
* docking port
* docking station
* dual-voltage selector switch
* DVI (Digital Video Interface) port
* electrostatic discharge (ESD)
* Ethernet port
* expansion card
* external SATA (eSATA) port
* firmware
* form factors
* front panel connectors
* front panel header
* GPS (Global Positioning System)
* hard disk drive (HDD)
* hard drive
* HD15 port
* HDMI (High-Definition Multimedia Interface) port
* heat sink
* internal components
* keyboard backlight
* laptop
* loopback plug
* main board
* microATX (mATX)
* microprocessor
* modem port
* Molex connector
* motherboard
* multimeter
* netbook
* network port
* notebook
* optical connector
* PCI Express (PCIe)
* PCIe 6/8-pin connector
* port replicator
* POST card
* POST diagnostic card
* POST (power-on self test)
* power supply
* power supply tester
* power supply unit (PSU)
* processor
* PS/2 port
* RAM (random access memory)
* RJ-11 port
* RJ-45 port
* SATA power connector
* screen orientation
* serial ATA (SATA)
* serial port
* SO-DIMM (small outline DIMM)
* spacers
* SPDIF (Sony-Philips Digital Interface) sound port
* spudgers
* standoffs
* system board
* Thunderbolt 3 port
* touch pad
* tower case
* UEFI (Unified Extensible Firmware Interface)
* USB (Universal Serial Bus) port
* USB optical drive
* USB to Bluetooth adapter
* USB to RJ-45 dongle
* USB to Wi-Fi dongle
* VGA (Video Graphics Array) port
* video memory
* Wi-Fi (Wireless Fidelity)
* ZIF connectors