

CHAPTER**2**

Working Inside Desktop Computers and Laptops

After completing this chapter, you will be able to:

- Take apart a desktop computer and put it back together
- Explain the special considerations when supporting laptop computers that are different than supporting desktop computers
- Take apart a laptop computer and put it back together

Taking apart and servicing a computer are tasks that every A+ certified technician needs to know how to do. As part of your preparation to become A+ certified, try to find old desktop and laptop computers you can take apart. If you can locate the service manual for a laptop, you should be able to take it apart, repair it (assuming the parts are still available and don't cost more than the computer is worth), and get it up and running again. Have fun with this chapter and enjoy tinkering with these computers!

HOW TO WORK INSIDE A DESKTOP COMPUTER CASE

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In this part of the chapter, you learn how to take apart a desktop computer and put it back together. This skill is needed in this and other chapters as you learn to add or replace computer parts inside the case and perhaps even build a system from scratch. As you read the following steps, you might want to perform the Hands-On Projects, which allow you to follow along by taking a computer apart. As you do so, be sure to follow all the safety precautions found in Appendix A “Safety Procedures and Environmental Concerns.” In the steps that follow, each major computer component is identified and described. You learn much more about each component later in the text. Take your time—*don’t rush*—as you take apart a computer for the first time. It can be a great learning experience or an expensive disaster! As you work, pay attention to the details, and work with care.

STEP 1: PLAN AND ORGANIZE YOUR WORK

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When you first begin to learn how to work inside a computer case, make it a point to practice good organization skills. If you keep your notes, tools, screws, and computer parts well organized, your work goes smoother and is more fun. Here are some tips to keep in mind:

- ▲ Make notes as you work so that you can backtrack later if necessary. (When you’re first learning to take a computer apart, it’s really easy to forget where everything fits when it’s time to put it back together. Also, in troubleshooting, you want to avoid repeating or overlooking things to try.)
- ▲ Remove loose jewelry that might get caught in cables and components as you work.
- ▲ To stay organized and not lose small parts, keep screws and spacers orderly and in one place, such as a cup or tray.
- ▲ Don’t stack boards on top of each other: You could accidentally dislodge a chip this way. When you remove a circuit board or drive from a computer, carefully lay it on an antistatic mat or in an antistatic bag in a place where it won’t get bumped.
- ▲ When handling motherboards, cards, or drives, don’t touch the chips on the device. Hold expansion cards by the edges. Don’t touch any soldered components on a card, and don’t touch the edge connectors unless it’s absolutely necessary. All this helps prevent damage from static electricity. Also, your fingerprints on the edge connectors can cause later corrosion.
- ▲ To protect a microchip, don’t touch it with a magnetized screwdriver.
- ▲ Never ever touch the inside of a computer that is turned on. The one exception to this rule is when you’re using a multimeter to measure voltage output.
- ▲ Consider the monitor and the power supply to be “black boxes.” Never remove the cover or put your hands inside this equipment unless you know about the hazards of charged capacitors and have been trained to deal with them. The power supply and monitor contain enough power to kill you, even when they are unplugged.
- ▲ As you work, remember to watch out for sharp edges on computer cases that can cut you.
- ▲ In a classroom environment, after you have reassembled everything, have your instructor check your work before you put the cover back on and power up.

Now that you’ve prepared your work area and tools, put on your ESD strap and let’s get started with opening the computer case.

STEP 2: OPEN THE COMPUTER CASE AND EXAMINE THE SYSTEM

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Here are the steps to open a computer case:

1. **Back up important data.** If you are starting with a working computer, make sure important data is first backed up. Copy the data to an external storage device such as a flash drive or external hard drive. If something goes wrong while you’re working inside the computer, at least your data will be safe.

2. **Power down the system and unplug it.** Remove discs from the optical drive. Then power down the system and unplug the power, monitor, mouse, and keyboard cables, and any other peripherals or cables attached and move them out of your way.

Caution

When you power down a computer and even turn off the power switch on the rear of the computer case, know that residual power is still on. Some motherboards even have a small light inside the case to remind you of this fact and to warn you that power is still getting to the system. Therefore, be sure to always unplug the power cord before opening a case.

3. **Press and hold down the power button for a moment.** After you unplug the computer, press the power button for about three seconds to completely drain the power supply (see Figure 2-1). Sometimes when you do so, you'll hear the fans quickly start and go off as residual power is drained. Only then is it safe to work inside the case.



Figure 2-1 Press the power button after the computer is unplugged

4. **Have a plastic bag or cup handy to hold screws.** When you reassemble the computer, you will need to insert the same screws in the same holes. This is especially important with the hard drive because screws that are too long can puncture the hard drive housing so be careful to label those screws clearly.
5. **Open the case cover.** Sometimes I think figuring out how to open a computer case is the most difficult part of disassembling. If you need help figuring it out, check the user manual or website of the case manufacturer. To remove the computer case cover, do the following:
- ▲ Some cases require you to start by laying the case on its side and removing the faceplate on the front of the case first. Other cases require you to remove a side panel first, and really older cases require you to first remove the entire sides and top as a single unit. Study your case for the correct approach.
 - ▲ Most cases have panels on each side of the case that can be removed. It is usually necessary to only remove the one panel to expose the top of the motherboard. To know which panel to remove, look at where the ports are on the rear of the case. For example, in Figure 2-2, the ports on this motherboard are on the left side of the case, indicating the bottom of the motherboard is on the left. Therefore, you will want to remove the right panel to expose the top of this motherboard. Lay the case down to its

left so that the ports and the motherboard are sitting on the bottom. Later, depending on how drives are installed, it might become necessary to remove the bottom panel in order to remove the screws that hold the drives in place.

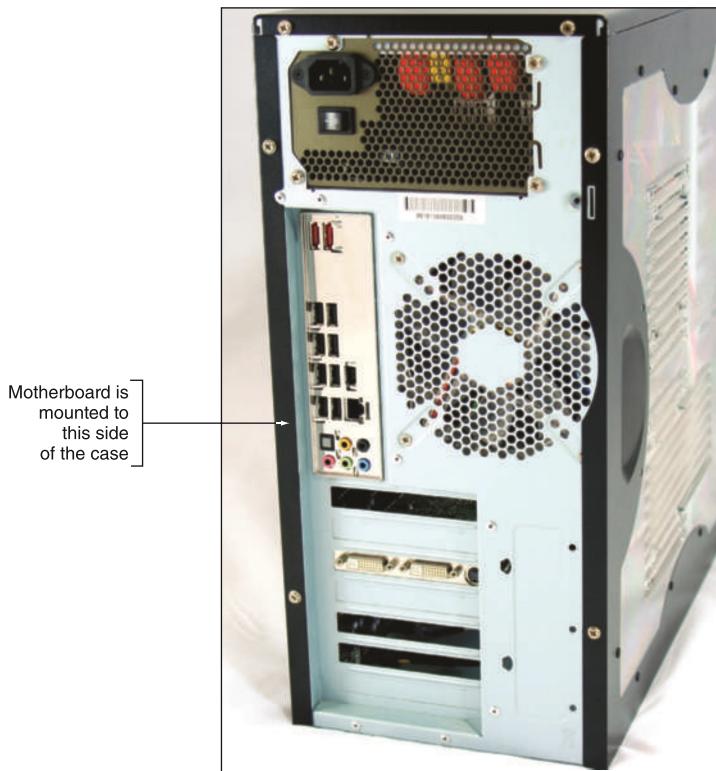


Figure 2-2 Decide which side panel to remove

- Locate the screws or clips that hold the side panel in place. Be careful not to unscrew any screws besides these. The other screws probably are holding the power supply, fan, and other components in place (see Figure 2-3). Place the screws in the cup or bag used for that purpose. Some cases use clips on a side panel in addition to or instead of screws (see Figure 2-4).



Figure 2-3 Locate the screws that hold the side panel in place



Figure 2-4 On this system, clips hold the side panel in place

- After the screws are removed, slide the panel toward the rear, and then lift it off the case (see Figure 2-5).



Figure 2-5 Slide the panel to the rear of the case

- Some cases require you to pop the front panel off the case before removing the side panels. Look for a lever on the bottom of the panel and hinges at the top. Squeeze the lever to release the front panel and lift it off the case (see Figure 2-6).



Figure 2-6 Some cases require you to remove the front panel before removing the side panel of a computer case

- ▲ Then remove a single screw (see Figure 2-7) and slide the side panel to the front and then off the case.

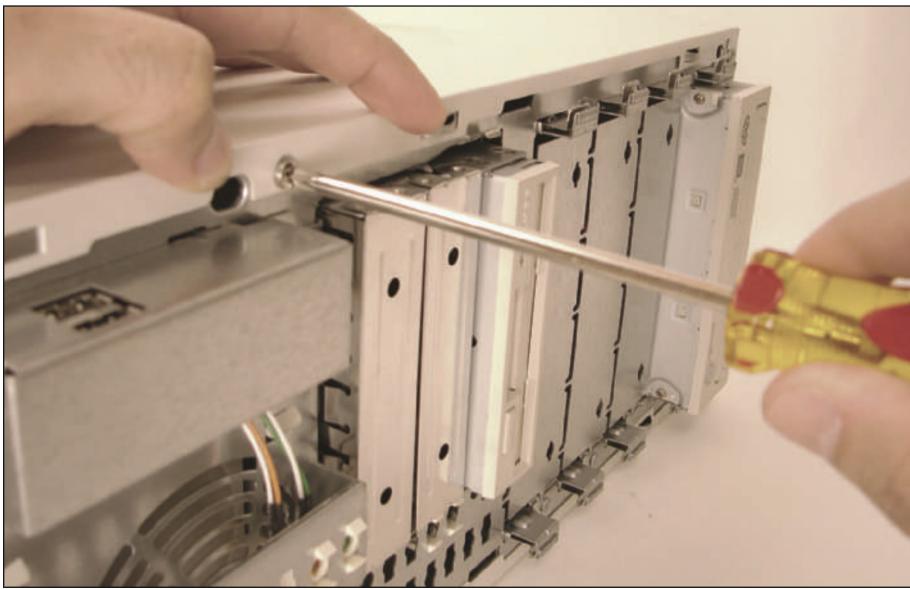


Figure 2-7 One screw holds the side panel in place

6. **Clip your ESD strap to the side of the computer case.** To dissipate any charge between you and the computer, put on your ESD strap if you have not already done so. Then clip the alligator clip on the strap cable to the side of the computer case (see Figure 2-8).

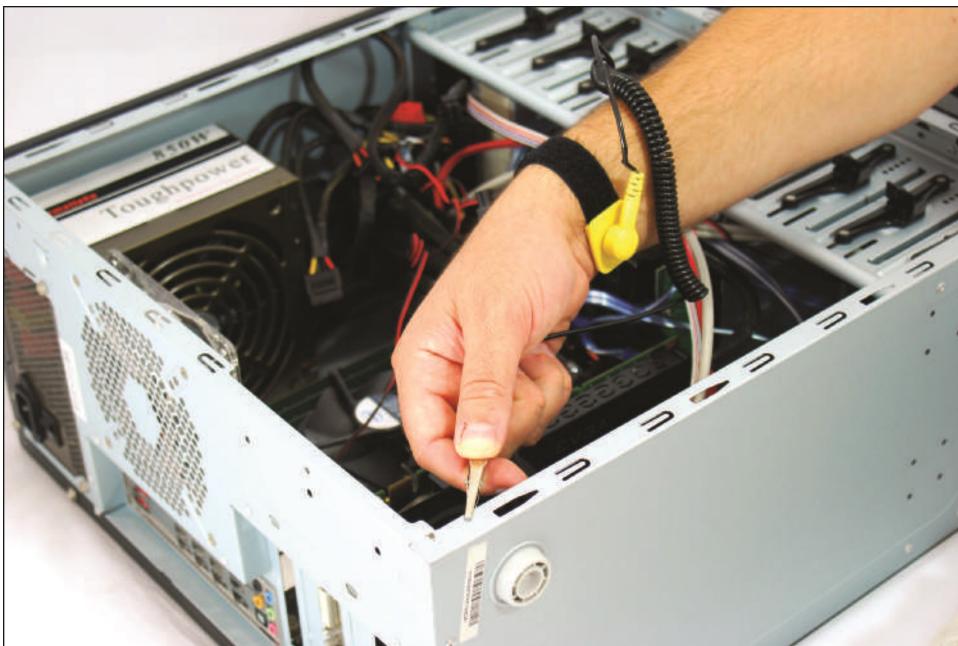


Figure 2-8 Attach the alligator clip of your ground bracelet to the side of the computer case

After you open a computer case, the main components you see inside are the power supply, motherboard, and drives installed in drive bays. You also see a lot of cables and wires connecting various components. These cables are power cables from the power supply to various components, or cables carrying data and instructions between components. The best way to know the purpose of a cable is to follow the cable from its source to its destination.

Hands-On | Project 2-1 Open a Computer Case

Using a desktop or tower computer, identify all the ports on the front or rear of the case. If you need help, see Table 1 in the chapter, “First Look at Computer Parts and Tools.” Look at the rear of the case. On which side is the motherboard? Examine the case and determine how to open it. Shut down the system, and unplug the power cable. Disconnect all other cables. Press the power button on the front of the case to discharge residual power. Carefully open the case. Remember to not touch anything inside the case unless you are using an ESD strap or antistatic gloves to protect components against ESD.

Draw a diagram of the inside of the case and label all drives, the motherboard, the cooler, DIMM memory modules, the power supply, and any expansion cards installed. Leave the case open so you’ll be ready for Hands-On Project 2-2 coming up later.

STEP 3: REMOVE EXPANSION CARDS

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If you plan to remove several components, draw a diagram of all cable connections to the motherboard, expansion cards, and drives. You might need this cable connection diagram to help you reassemble. Note where each cable begins and ends, and pay particular attention to the small wires and connectors that connect the lights, switches, and ports on the front of the case to the motherboard front panel connectors. It’s important to be careful about diagramming these because it is so easy to connect them in the wrong position later when you reassemble. If you want, use

a felt-tip marker to make a mark across components, to indicate a cable connection, board placement, motherboard orientation, speaker connection, brackets, and so on, so that you can simply line up the marks when you reassemble. This method, however, probably won't work for the front case wires because they are so small. For these, consider writing down the color of the wires and their position on the pins or taking a photo of the wires in their positions with a digital camera (see Figure 2-9).

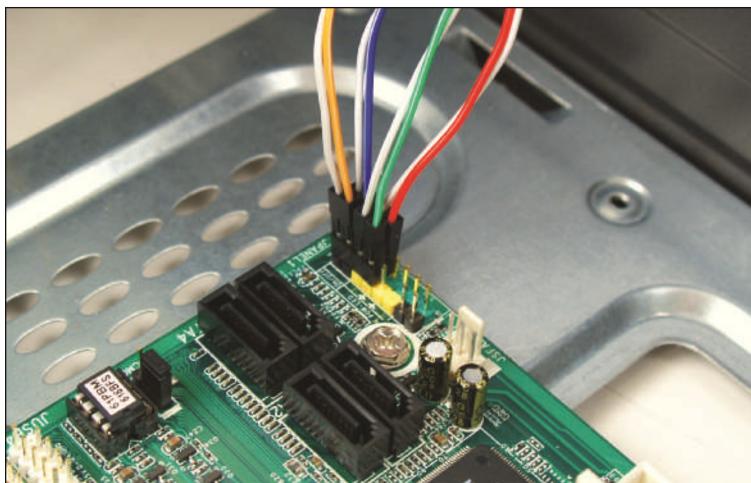


Figure 2-9 Diagram the pin locations of the color-coded wires that connect to the front of the case



Notes A connector on a motherboard that consists of pins that stick up from the board is called a header. For example, the group of pins shown in Figure 2-9 is called the **front panel header**.

Computer systems vary in so many ways, it's impossible to list the exact order to disassemble one. Most likely, however, you need to remove the expansion cards first. Do the following to remove the expansion cards:

1. Remove any wire or cable connected to the card.
2. Remove the screw holding the card to the case (see Figure 2-10).

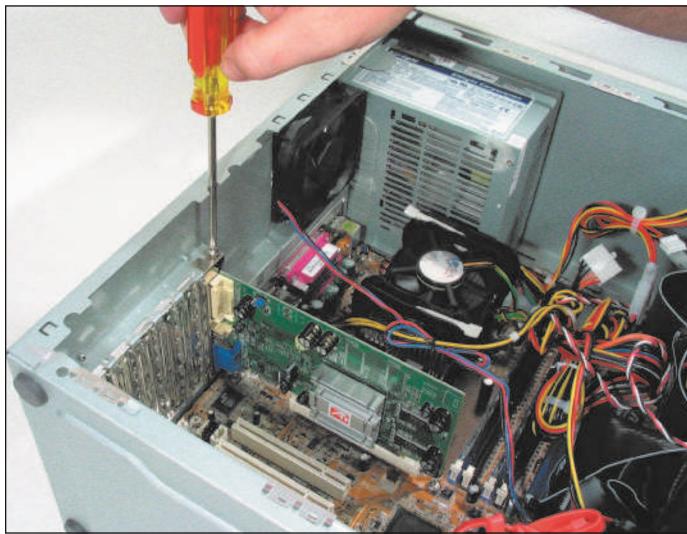


Figure 2-10 Remove the screw holding an expansion card to the case

3. Grasp the card with both hands and remove it by lifting straight up. If you have trouble removing it from the expansion slot, you can *very slightly* rock the card from end to end (*not* side to side). Rocking the card from side to side might spread the slot opening and weaken the connection.
4. As you remove the card, don't put your fingers on the edge connectors or touch a chip, and don't stack the cards on top of one another. Lay each card aside on a flat surface, preferably in an antistatic bag.



Notes Cards installed in PCI Express × 16 slots use a latch that helps to hold the card securely in the slot. To remove these cards, use one finger to hold the latch back from the slot, as shown in Figure 2-11, as you pull the card up and out of the slot.

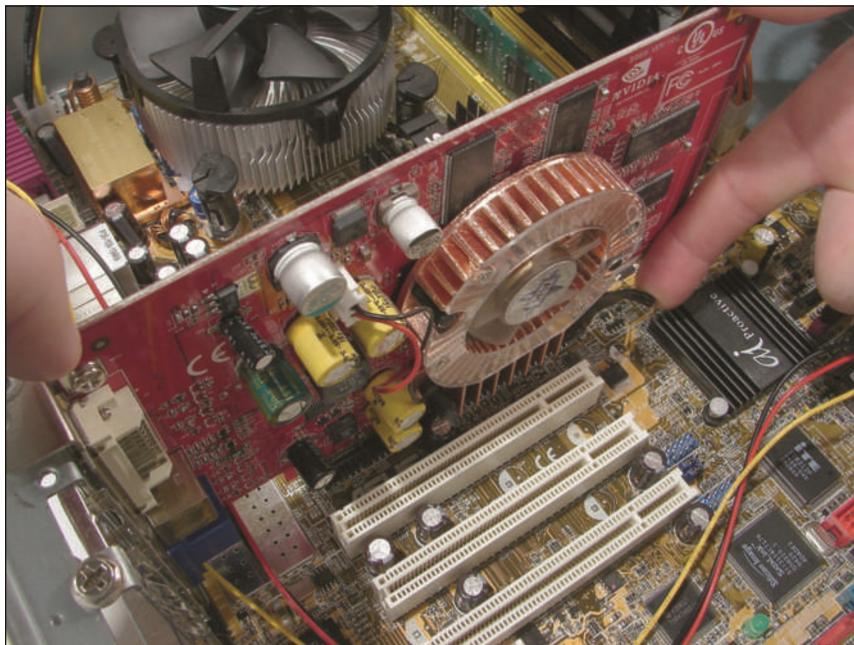


Figure 2-11 Hold the retention mechanism back as you remove a video card from its expansion slot

Hands-On | Project 2-2 Identify Connectors Used on an Installed Motherboard

If necessary, remove the case cover to your desktop computer. Next, remove the expansion cards from your system. With the expansion cards out of the way, you can more clearly see the power cables and other cables and cords connected to the motherboard. Diagrams and notes are extremely useful when disassembling and reassembling a system. To practice this skill, draw a large rectangle that represents the motherboard. On the rectangle, label every header or connector that is used on the board. Include on the label the type of cable that is used and where the other end of the cable connects.

STEP 4: REMOVE THE MOTHERBOARD, POWER SUPPLY, AND DRIVES

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Depending on the system, you might need to remove the motherboard next or remove the drives next. My choice is to first remove the motherboard. It and the processor are the most expensive and easily damaged parts in the system. I like to get them out of harm's way before working with the drives. However, in some cases, you must remove the drives or the power supply before you can get to the motherboard. Study your situation and decide which to do first. To remove the motherboard, do the following:

1. Unplug the power supply lines to the motherboard.
2. Unplug SATA cables connected to the motherboard.
3. The next step is to disconnect wires leading from the front or top of the computer case to the motherboard, which are called the **front panel connectors**. If you don't have the motherboard manual handy, be very careful to diagram how these wires connect because they are rarely labeled well on a motherboard. Make a careful diagram and then disconnect the wires. Figure 2-12 shows five leads and the pins on the motherboard front panel header that receive these leads. The pins are color-coded and cryptically labeled on the board.

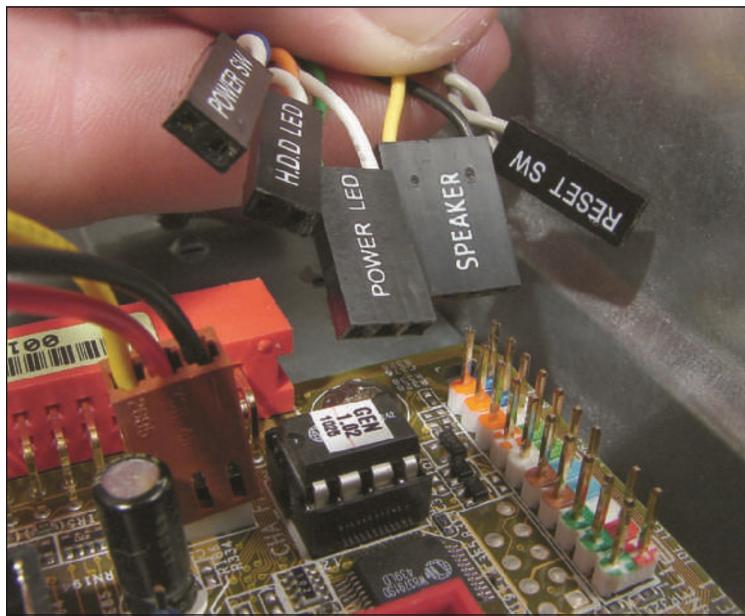


Figure 2-12 Five leads from the front panel connect to two rows of pins on the motherboard front panel header

4. Disconnect any other cables or wires connected to the motherboard. A case fan might be getting power by a small wire connected to the motherboard. In addition, USB ports on the front of the computer case might be connected by a cable to the motherboard.
5. You're now ready to remove the screws that hold the motherboard to the case. A motherboard is installed so that the bottom of the board does not touch the case. If the fine traces or lines on the bottom of the board were to touch the case, a short would result when the system is running. To keep the board from touching the case, screw holes are elevated, or you'll see **spacers**, also called **standoffs**, which are round plastic or metal pegs that separate the board from the case. Carefully pop off these spacers and/or remove the screws (up to nine) that hold the board to the case (see Figure 2-13) and then remove the board. Set it aside in a safe place. Figure 2-14 shows a motherboard sitting to the side of these spacers. One spacer is in place and the other is lying beside its case holes. Also notice in the photo the two holes in the motherboard where screws are used to connect the board to the spacers.

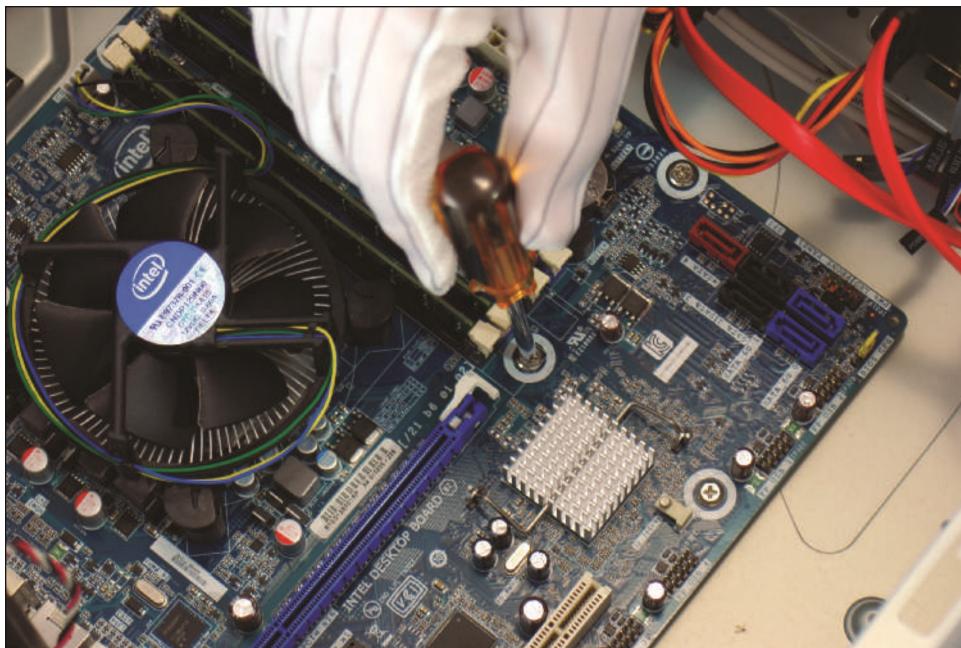


Figure 2-13 Remove up to nine screws that hold the motherboard to the case

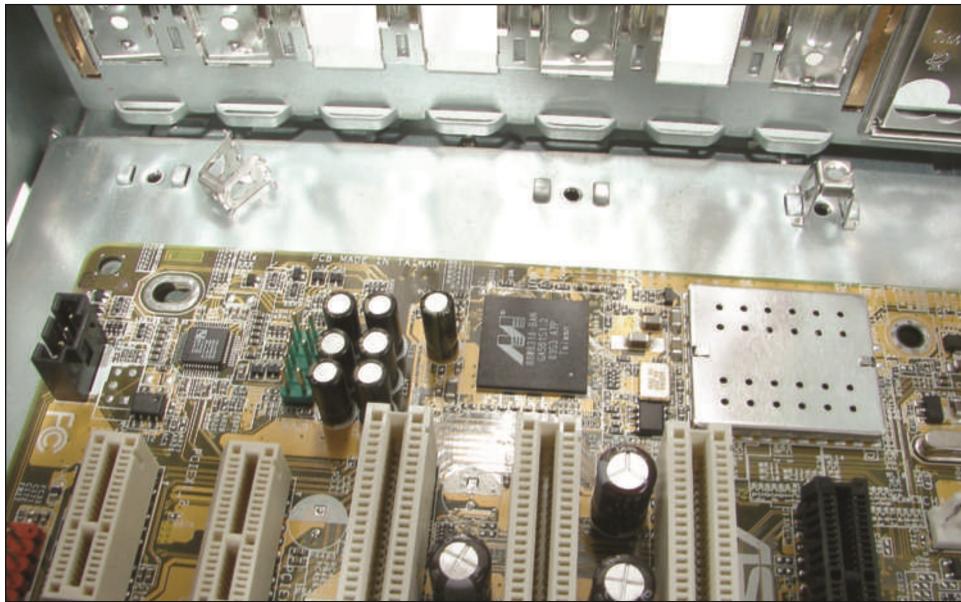


Figure 2-14 This motherboard connects to a case using screws and spacers that keep the board from touching the case



Notes When you're replacing a motherboard in a case that is not the same size as the original board, you can use needle-nose pliers to unplug a standoff so you can move it to a new hole.

6. The motherboard should now be free and you can carefully remove it from the case, as shown in Figure 2-15. Lift the board by its edges, as shown in the figure.



Caution Never lift a motherboard by the cooler because doing so might create an air gap between the cooler and the processor, which can cause the processor to later overheat.

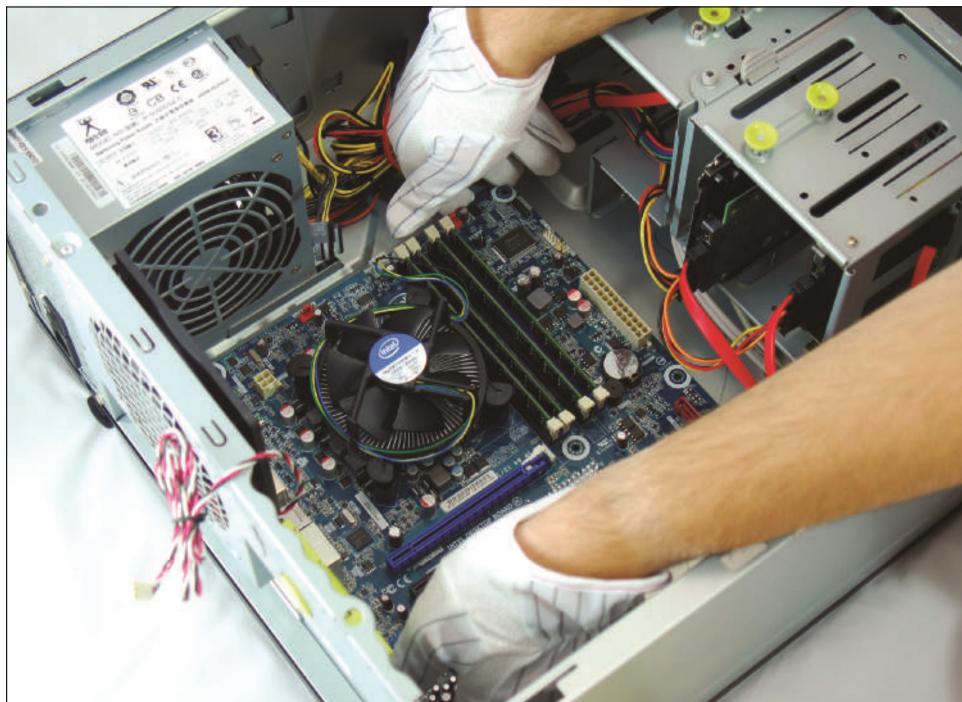


Figure 2-15 Remove the motherboard from the case



Caution Some processors have heavy cooling assemblies installed on top of them. For these systems, it is best to remove the cooler before you take the motherboard out of the case because the motherboard is not designed to support this heavy cooler when the motherboard is not securely seated in the case. How to remove the cooler is covered in the chapter, “Supporting Processors and Upgrading Memory.”

7. To remove the power supply from the case, look for screws that attach the power supply to the computer case, as shown in Figure 2-16. Be careful not to remove any screws that hold the power supply housing together. You do not want to take the housing apart. After you have removed the screws, the power supply still might not be free. Sometimes, it is attached to the case on the underside by recessed slots. Turn the case over and look on the bottom for these slots. If they are present, determine in which direction you need to slide the power supply to free it from the case.



Figure 2-16 Removing the power supply mounting screws

8. Remove each drive next, handling the drives with care. Here are some tips:

- ▲ Some drives have one or two screws on each side of the drive attaching the drive to the drive bay. After you remove the screws, the drive slides to the front or to the rear and then out of the case.
- ▲ Sometimes, there is a catch underneath the drive that you must lift up as you slide the drive forward.
- ▲ Some drive bays have a clipping mechanism to hold the drive in the bay. First release the clip and then pull the drive forward and out of the bay (see Figure 2-17). Handle the drives with care. Some drives have an exposed circuit board on the bottom of the drive. Don't touch this board.



Figure 2-17 To remove this CD drive, first pull the clip forward to release the drive from the bay

- Some cases have a removable bay for small drives (see Figure 2-18). These bays can hold narrow drives such as hard drives and tape drives. The bay is removed first and then the drives are removed from the bay. To remove the bay, first remove the screws or release the clip holding the bay in place and then slide the bay out of the case. The drives are usually installed in the bay with two screws on each side of each drive. Remove the screws and then the drives (see Figure 2-19).

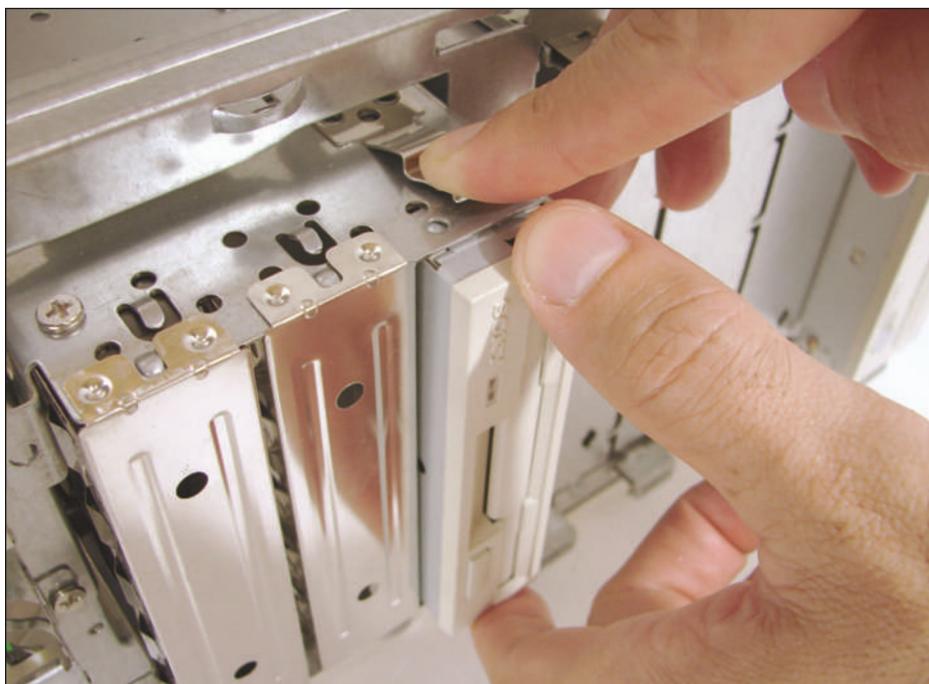


Figure 2-18 Push down on the clip and then slide the removable bay forward and out of the case

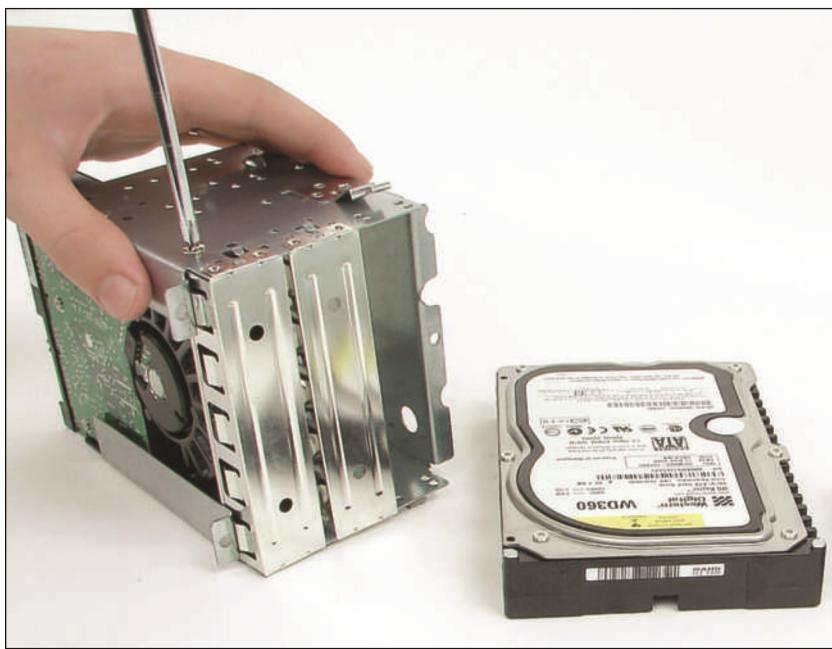


Figure 2-19 Drives in this removable bay are held in place with screws on each side of the bay

STEPS TO PUT A COMPUTER BACK TOGETHER

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To reassemble a computer, reverse the process of disassembling. Here is where your diagrams will be really useful and having the screws and cables organized will also help. In the directions that follow, we're also considering the possibility that you are installing a replacement part as you reassemble the system. Do the following:

1. Install components in the case in this order: power supply, drives, motherboard, and cards. When installing drives, know that for some systems, it's easier to connect data cables to the drives and then slide the drives into the bay. If the drive is anchored to the bay with screws or latches, be careful to align the front of the drive flush with the front of the case before installing screws or pushing in the latches (see Figure 2-20).



Figure 2-20 Align the front of the drive flush with the case front and then anchor with a screw

2. Place the motherboard inside the case. Make sure the ports stick out of the I/O shield at the rear of the case and the screw holes line up with screw holes on the bottom of the case. Figure 2-21 shows how you must align the screw holes on the motherboard with those in the case. There should be at least six screw sets, and there might be as many as nine. Use as many screws as there are holes in the motherboard. Figure 2-22 shows one screw being put in place.

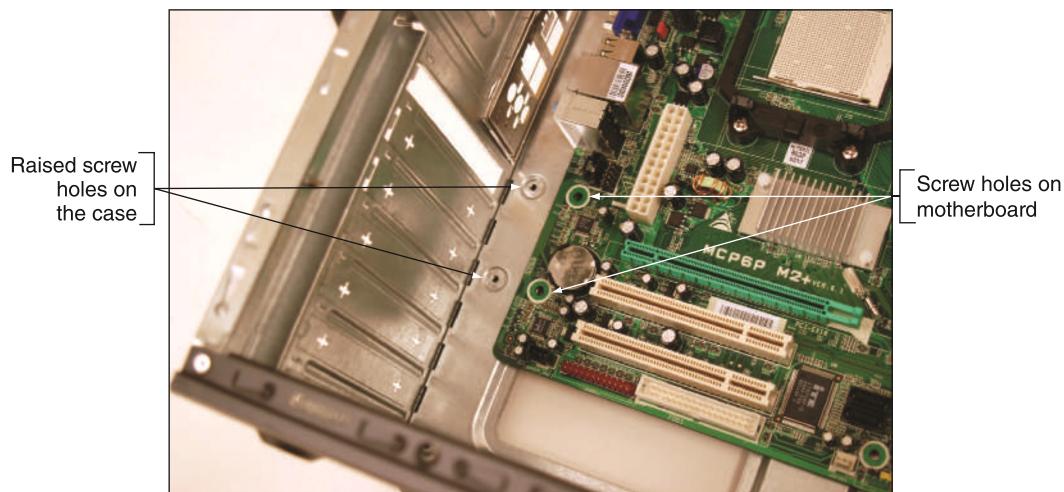


Figure 2-21 Align screw holes in the case with those on the motherboard

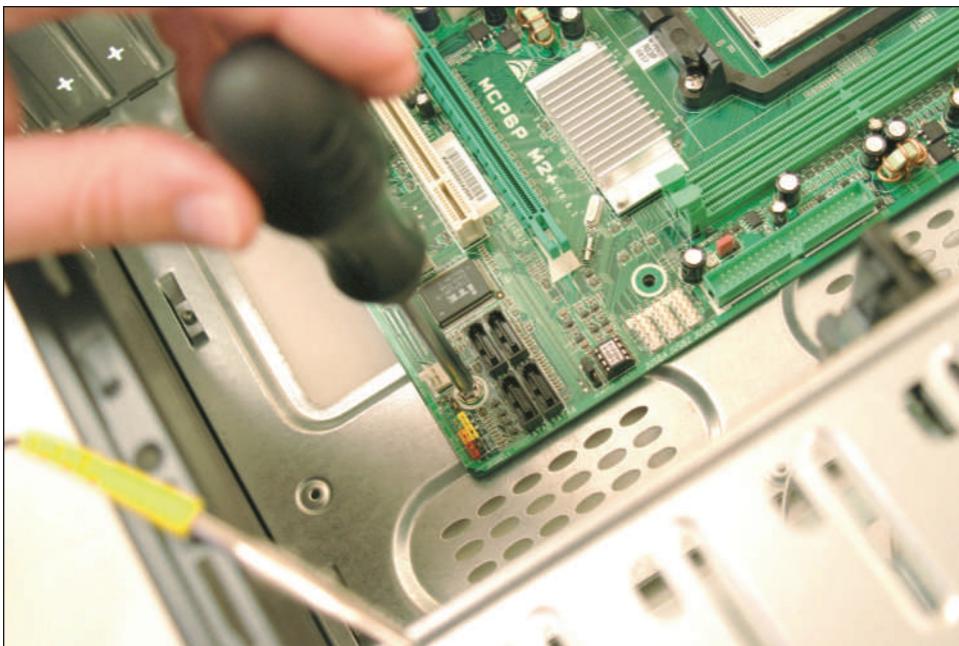


Figure 2-22 Use one screw in each screw hole on the motherboard

3. Connect the power cords from the power supply to the motherboard. A system will always need the main P1 power connector and most likely will need the 4-pin auxiliary connector for the processor. Other power connectors might be needed depending on the devices you later install in the system. Here are the details:

- ▲ Connect the P1 power connector from the power supply to the motherboard (see Figure 2-23).

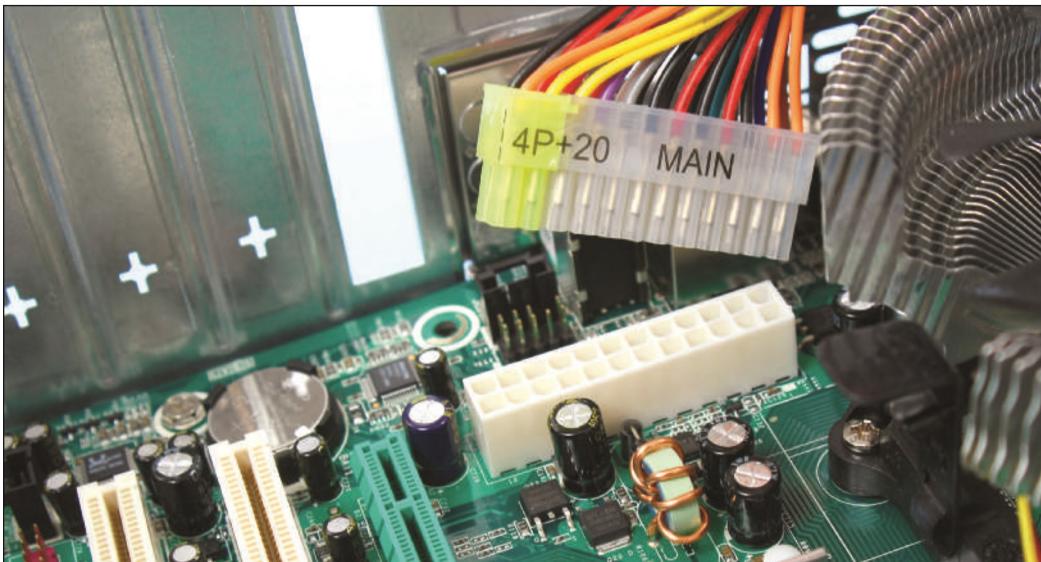


Figure 2-23 The 24-pin connector supplies power to the motherboard

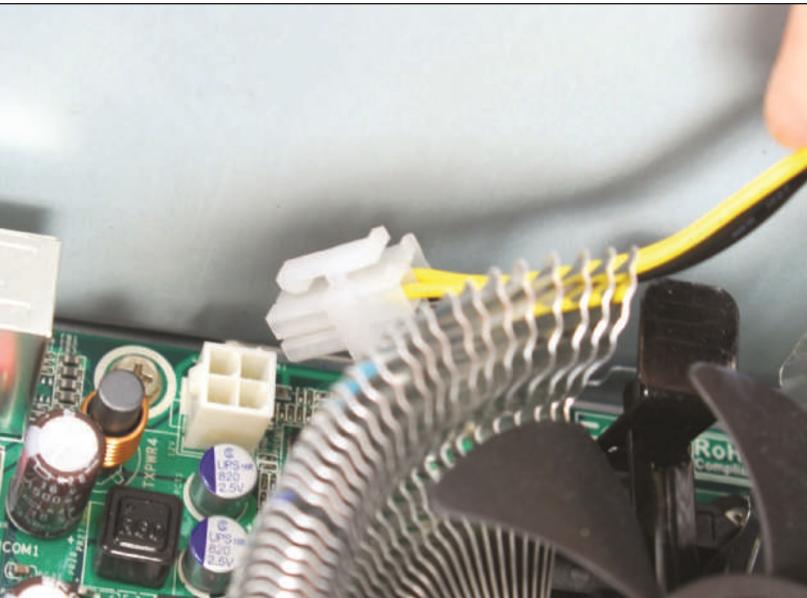


Figure 2-24 The auxiliary 4-pin power cord provides power to the processor

- ▲ Connect the 4-pin auxiliary power cord coming from the power supply to the motherboard, as shown in Figure 2-24. This cord supplies the supplemental power required for the processor.

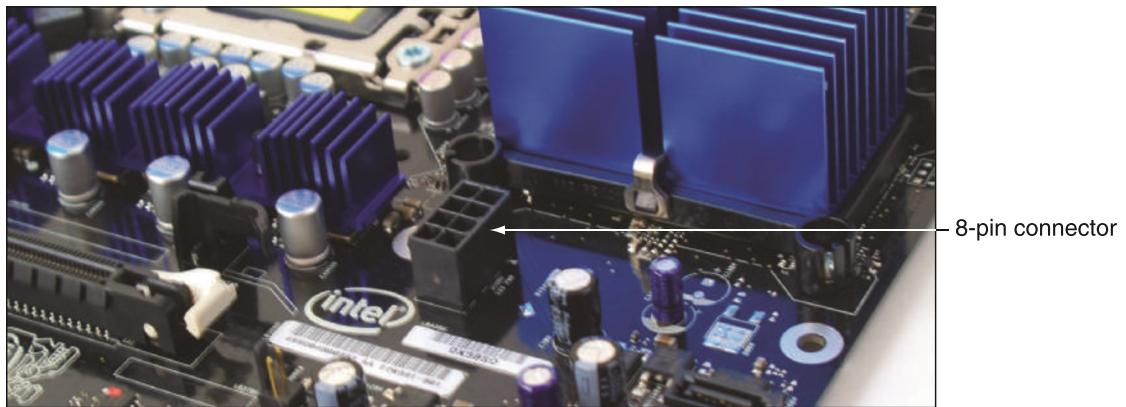


Figure 2-25 8-pin PCIe Version 2.0 power connector

- ▲ Some boards designed to support multiple PCIe video cards will have additional power connectors on the board to power these wattage-hungry cards. For example, Figure 2-26(a) shows a Molex-style connector on one board that provides auxiliary power to PCIe graphics cards. This same board offers a SATA-style connector, shown in Figure 2-26(b). The motherboard documentation says to use just one of these auxiliary power connectors to provide additional wattage for PCIe video cards.

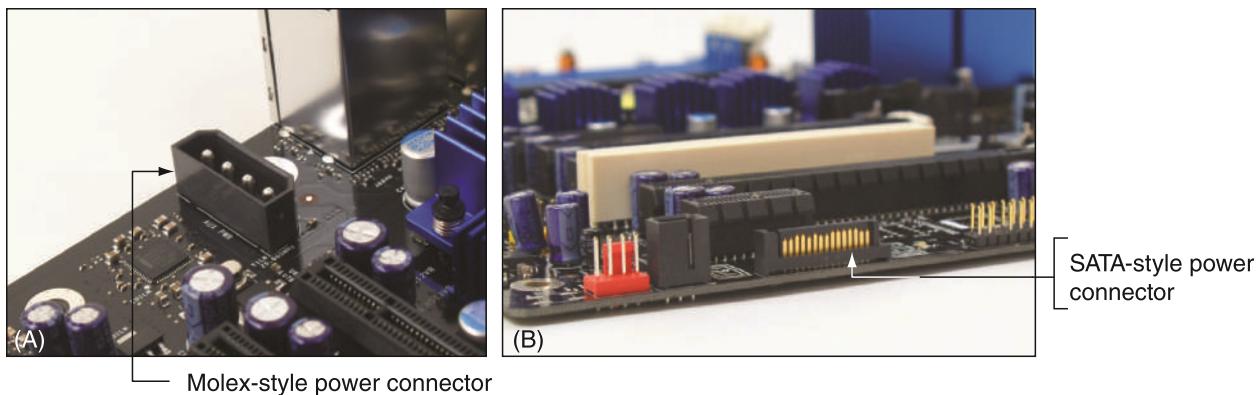


Figure 2-26 Auxiliary power connectors to support PCIe

- ▲ To power the case fan, connect the power cord from the fan to pins on the motherboard labeled Fan Header. Alternately, some case fans use a 4-pin Molex connector that connects to a power cable coming directly from the power supply.
 - ▲ If a CPU and cooler are already installed on the motherboard, connect the power cord from the CPU fan to the pins on the motherboard labeled CPU Fan Header.
4. Connect the wire leads from the front panel of the case to the front panel header on the motherboard. These are the wires for the switches, lights, and ports on the front or top of the computer. Because your case and your motherboard might not have been made by the same manufacturer, you need to pay close attention to the source of the wires to determine where they connect on the motherboard. For example, Figure 2-27 shows a computer case that has seven connectors from the front panel that connect to the motherboard. Figure 2-28 shows the front panel header on the motherboard for these lights and switches. If you look closely at the board in Figure 2-28, you can see labels identifying the pins.

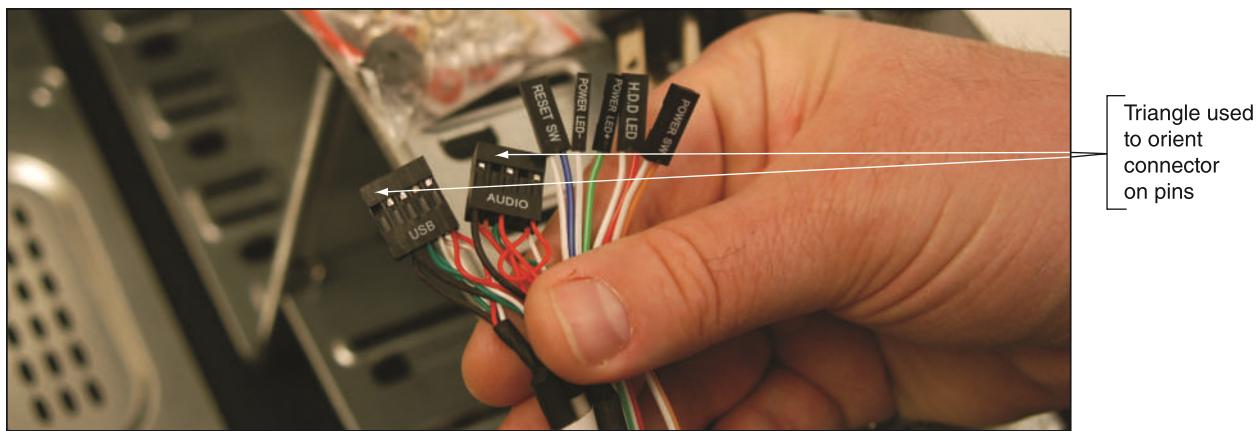


Figure 2-27 Seven connectors from the front panel connect to the motherboard

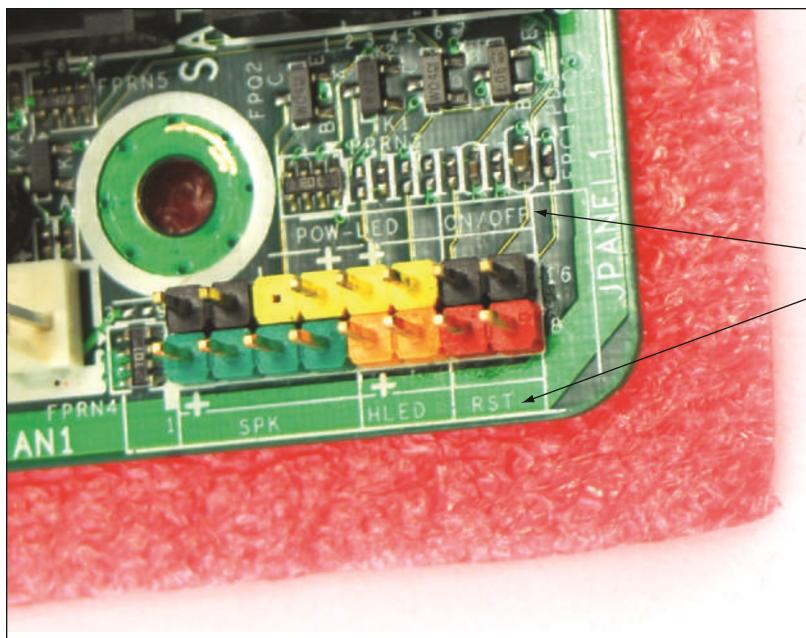


Figure 2-28 Front panel header uses color-coded pins and labels

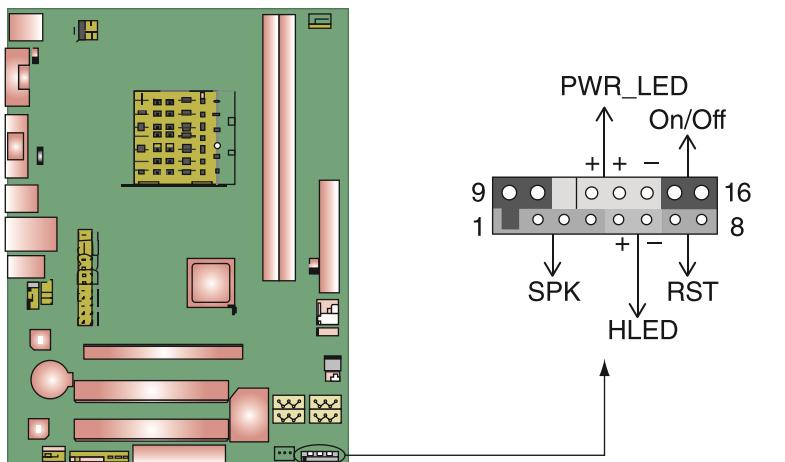
The five smaller connectors on the right side of Figure 2-27 from right to left are labeled as follows:

- ▲ **Power SW.** Controls power to the motherboard; must be connected for the PC to power up
- ▲ **HDD LED.** Controls the drive activity light on the front panel that lights up when any SATA or IDE device is in use (HDD stands for hard disk drive; LED stands for light-emitting diode; and an LED is a light on the front panel.)
- ▲ **Power LED+.** Positive LED controls the power light and indicates that power is on
- ▲ **Power LED-.** Negative LED controls the power light; the two positive and negative leads indicate that power is on
- ▲ **Reset SW.** Switch used to reboot the computer



Notes Positive wires connecting the front panel to the motherboard are usually a solid color, and negative wires are usually white or striped.

To help orient the larger connectors on the motherboard pins, look for a small triangle embedded on the connector that marks one of the outside wires as pin 1 (see Figure 2-27). Look for pin 1 to be labeled on the motherboard as a small 1 embedded to either the right or the left of the group of pins. If the labels on the board are not clear, turn to the motherboard user guide for help. The diagram in Figure 2-29 shows what you can expect from one motherboard user guide. Notice pin 1 is identified as a square pin in the diagram, rather than round like the other pins.



Pin	Assignment	Function	Pin	Assignment	Function
1	+5 V	Speaker connector	9	N/A	N/A
2	N/A		10	N/A	
3	N/A		11	N/A	
4	Speaker		12	Power LED (+)	Power LED
5	HDD LED (+)	Hard drive LED	13	Power LED (+)	
6	HDD LED (-)		14	Power LED (-)	
7	Ground	Reset button	15	Power button	Power-on button
8	Reset control		16	Ground	

Figure 2-29 Documentation for front panel header connections

 **Notes** If the user guide is not handy, you can download it from the motherboard manufacturer's website. Search on the brand and model number of the board, which is imprinted somewhere on the board.

Sometimes the motherboard documentation is not clear, but guessing is okay when connecting a wire to a front panel header connection. If it doesn't work, no harm is done. Figure 2-30 shows all front panel wires in place and the little speaker also connected to the front panel pins.

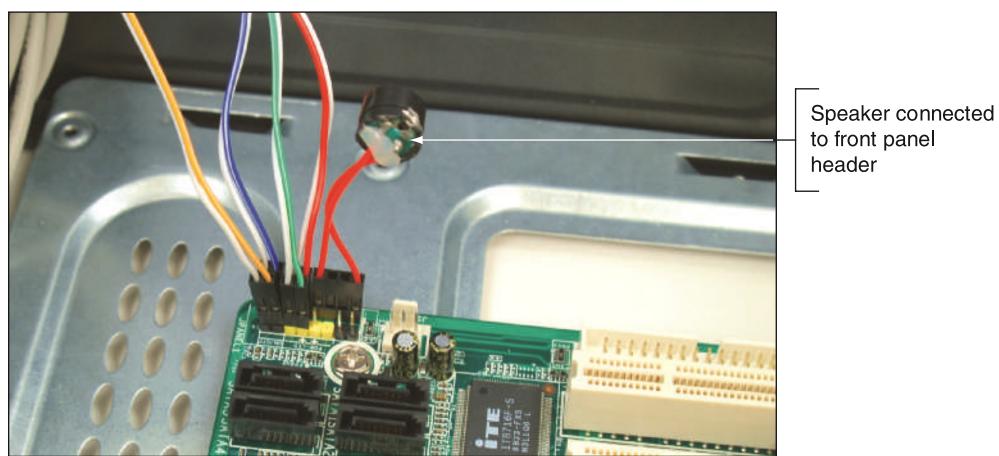


Figure 2-30 Front panel header with all connectors in place

5. Connect wires to ports on the front panel of the case. Depending on your motherboard and case, there might be cables to connect audio ports or USB ports on the front of the case to headers on the motherboard. Audio and USB connectors are the two left connectors shown in Figure 2-27. You can see these ports for audio and USB on the front of the case in Figure 2-31. Look in the motherboard documentation for the location of these connectors. The audio and USB connectors are labeled for one board in Figures 2-32(a) and (b).



Figure 2-31 Ports on the front of the computer case

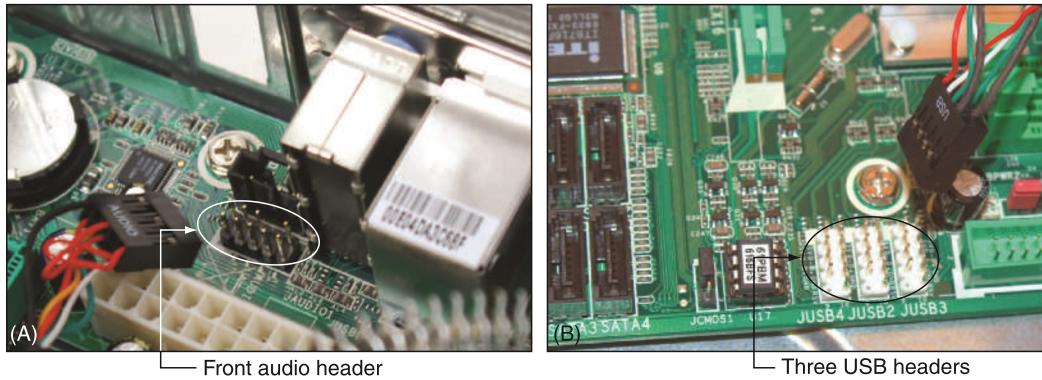


Figure 2-32 Connectors for front panel ports

6. Install the video card and any other expansion cards. Push the card straight down into the slot, being careful to not rock side to side, and install the screw to secure the card to the case.
7. Take a few minutes to double-check each connection to make sure it is correct and snug. Verify all required power cords are connected correctly and the video card is seated solidly in its slot. Also verify that no wires or cables are obstructing fans. You can use cable ties to tie wires up and out of the way.
8. Plug in the keyboard, monitor, and mouse.
9. In a classroom environment, have the instructor check your work before you close the case and power up.

- Turn on the power and check that the PC is working properly. If the PC does not work, most likely the problem is a loose connection. Just turn off the power and go back and check each cable connection and each expansion card. You probably have not solidly seated a card in the slot. After you have double-checked, try again.

Now step back and congratulate yourself on a job well done! By taking a computer apart and putting it back together, you've learned much about how computer parts interconnect and work.

Hands-On | Project 2-3 Close the Case

The case cover to your desktop computer is off from doing the previous exercises. Before you close your case, it's always a good idea to quickly clean it first. Using a can of compressed air, blow the dust away from fans and other components inside the case. Be careful to not touch components unless you are properly grounded. When you're done, close the case cover.

Now we turn our attention to laptops.

SPECIAL CONSIDERATIONS WHEN SUPPORTING LAPTOPS

A+
220-901
3.1, 4.5

Laptops and their replacement parts cost more than desktop computers with similar features because their components are designed to be more compact and stand up to travel. They use compact hard drives, small memory modules, and CPUs that require less power than regular components. Whereas a desktop computer is often assembled from parts made by a variety of manufacturers, laptop computers are almost always sold by a vendor that either manufactured the laptop or had it manufactured as a consolidated system. Factors to consider that generally apply more to laptop than desktop computers are the original equipment manufacturer's warranty, the service manuals and diagnostic software provided by the manufacturer, the customized installation of the OS that is unique to laptops, and the advantage of ordering replacement parts directly from the laptop manufacturer or other source authorized by the manufacturer.

In many situations, the tasks of maintaining, upgrading, and troubleshooting a laptop require the same skills, knowledge, and procedures as when servicing a desktop computer. However, you should take some special considerations into account when caring for, supporting, upgrading, and troubleshooting laptops. These same concerns apply to netbooks and all-in-one computers. Let's begin with warranty concerns.

WARRANTY CONCERNs

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Most manufacturers or retailers of laptops offer at least a one-year warranty and the option to purchase an extended warranty. Therefore, when problems arise while the laptop is under warranty, you are dealing with a single manufacturer or retailer to get support or parts. After the laptop is out of warranty, this manufacturer or retailer can still be your one-stop shop for support and parts.



Caution The warranty often applies to all components in the system, but it can be voided if someone other than an authorized service center services the laptop. Therefore, you, as a service technician, must be very careful not to void a warranty that the customer has purchased. Warranties can be voided by opening the case, removing part labels, installing other-vendor parts, upgrading the OS, or disassembling the system unless directly instructed to do so by the authorized service center help desk personnel.

Before you begin servicing a laptop, to avoid problems with a warranty, always ask the customer, “Is the laptop under warranty?” If the laptop is under warranty, look at the documentation to find out how to get technical support. Options are chat sessions on the web, phone numbers, and email. Use the most appropriate option. Before you contact technical support, have the laptop model and serial number ready (see Figure 2-33). You’ll also need the name, phone number, and address of the person or company that made the purchase. Consider asking the customer for a copy of the receipt and warranty so that you’ll have the information you need to talk with support personnel.

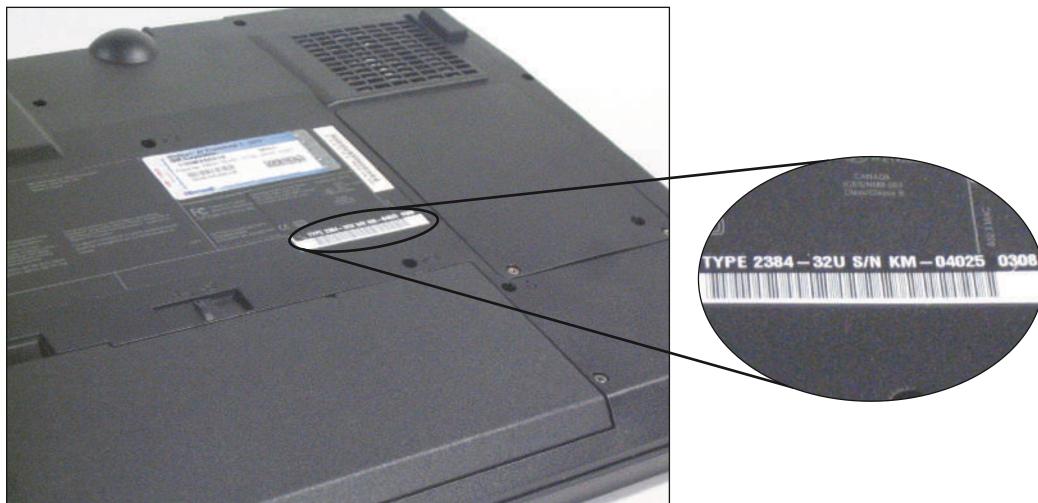


Figure 2-33 The model and serial number stamped on the bottom of a laptop are used to identify the laptop to service desk personnel

Based on the type of warranty purchased by the laptop’s owner, the manufacturer might send an on-site service technician, ask you to ship or take the laptop to an authorized service center, or help you solve the problem by an online chat session or over the phone. Table 2-1 lists some popular manufacturers of laptops, netbooks, and all-in-ones. Manufacturers of laptops typically also produce all-in-ones because of the features they have in common.

Manufacturer	Website
Acer	us.acer.com and us.acer.com/ac/en/US/content/support
Apple Computer	www.apple.com and www.apple.com/support
ASUS	usa.asus.com and www.asus.com/us/support/
Dell Computer	www.dell.com and support.dell.com
Fujitsu/Fuji	www.fujitsu.com and www.fujitsu.com/support
Gateway	www.gateway.com and support.gateway.com
Hewlett Packard (HP)	www.hp.com and www8.hp.com/us/en/support.html
Lenovo (formerly IBM ThinkPad)	www.lenovo.com and support.lenovo.com
Microsoft	www.microsoft.com
Samsung	www.samsung.com and www.samsung.com/support
Sony (VAIO)	store.sony.com and esupport.sony.com
Toshiba America	www.toshiba.com/tai/ and www.toshiba.com/tai/support.jsp

Table 2-1 Laptop, netbook, and all-in-one manufacturers

SERVICE MANUALS AND OTHER SOURCES OF INFORMATION

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3.1, 4.5

Desktop computer cases tend to be similar to one another, and components in desktop systems are usually interchangeable among manufacturers. Not so with laptops. Laptop manufacturers typically take great liberty in creating their own unique computer cases, buses, cables, connectors, drives, circuit boards, fans, and even screws, all of which are likely to be proprietary in design.

Every laptop model has a unique case. Components are installed in unique ways and opening the case for each laptop model is done differently. Because of these differences, servicing laptops can be very complicated and time consuming. For example, a hard drive on one laptop is accessed by popping open a side panel and sliding the drive out of its bay. However, to access the hard drive on another model laptop, you must remove the keyboard. If you are not familiar with a particular laptop model, you can damage the case frame or plastics as you pry and push trying to open it. Trial and error is likely to damage a case. Even though you might successfully replace a broken component, the damaged case will result in an unhappy customer.

Fortunately, a laptop service manual can save you much time and effort—if you can locate one (see Figure 2-34). Most laptop manufacturers closely guard these service manuals and release them only to authorized service centers. Two laptop manufacturers, Lenovo (formerly IBM ThinkPad) and Dell, provide their service manuals online free of charge. HP also does an excellent job of offering online support. For example, in Figure 2-35, you can see a video in progress showing you the steps to replace the optical drive in an HP laptop. I applaud Lenovo, Dell, and HP for the generous documentation about how their laptops are disassembled and the options to purchase proprietary parts without first being an authorized service center.

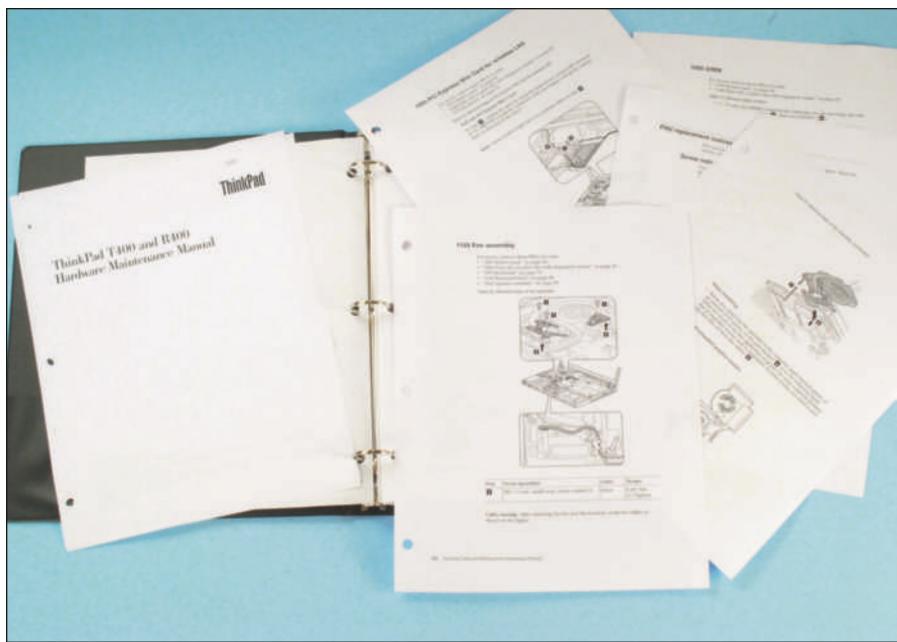
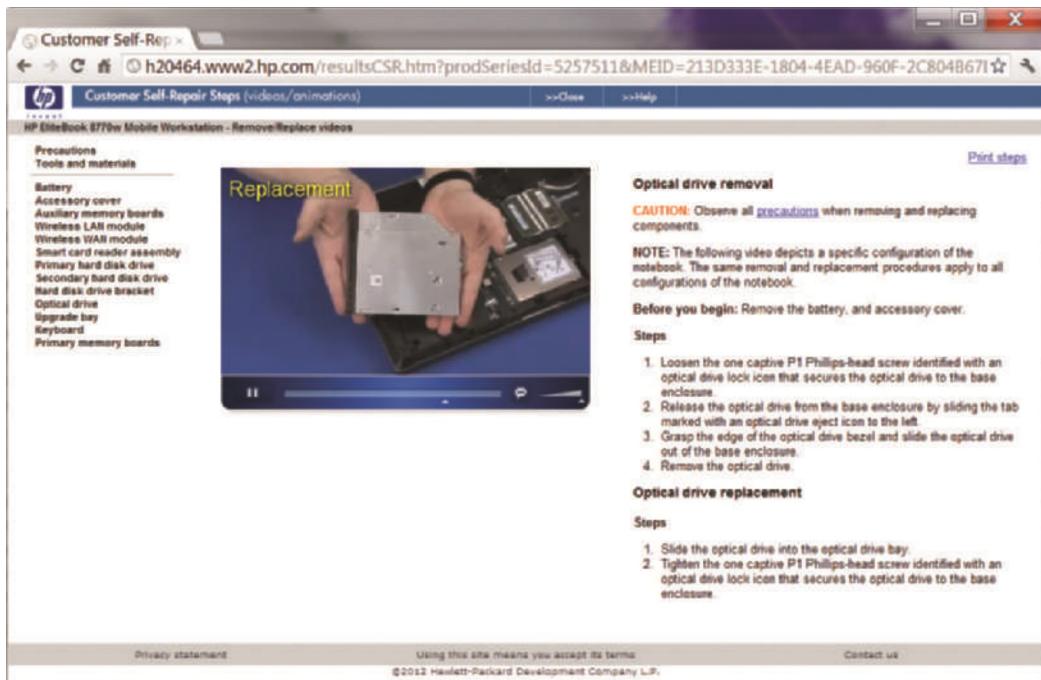


Figure 2-34 A laptop service manual tells you how to use diagnostic tools, troubleshoot a laptop, and replace components



Source: hp.com

Figure 2-35 The HP website (www.hp.com) provides detailed instructions and videos for troubleshooting and replacing components



Notes The wiki-type website ifixit.com does an excellent job of providing its own teardown and reassemble instructions for many brands and models of laptops.

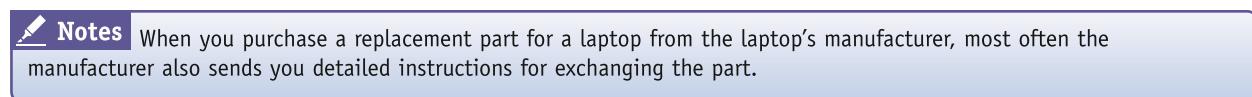
For all laptop manufacturers, check the Support or FAQ pages of their websites for help in tasks such as opening a case without damaging it and locating and replacing a component. Be aware that some manufacturers offer almost no help at all. Sometimes, you can find service manuals on the web. To find your manual, search on the model of laptop, for example, search on “Sony VGN-CR120E laptop service manual”.

Don’t forget about the user manuals. They might contain directions for upgrading and replacing components that do not require disassembling the case, such as how to upgrade memory or install a new hard drive. User manuals also include troubleshooting tips and procedures and possibly descriptions of UEFI/BIOS settings. In addition, you can use a web search engine to search on the computer model, component, or error message, which might give you information about the problem and solution.

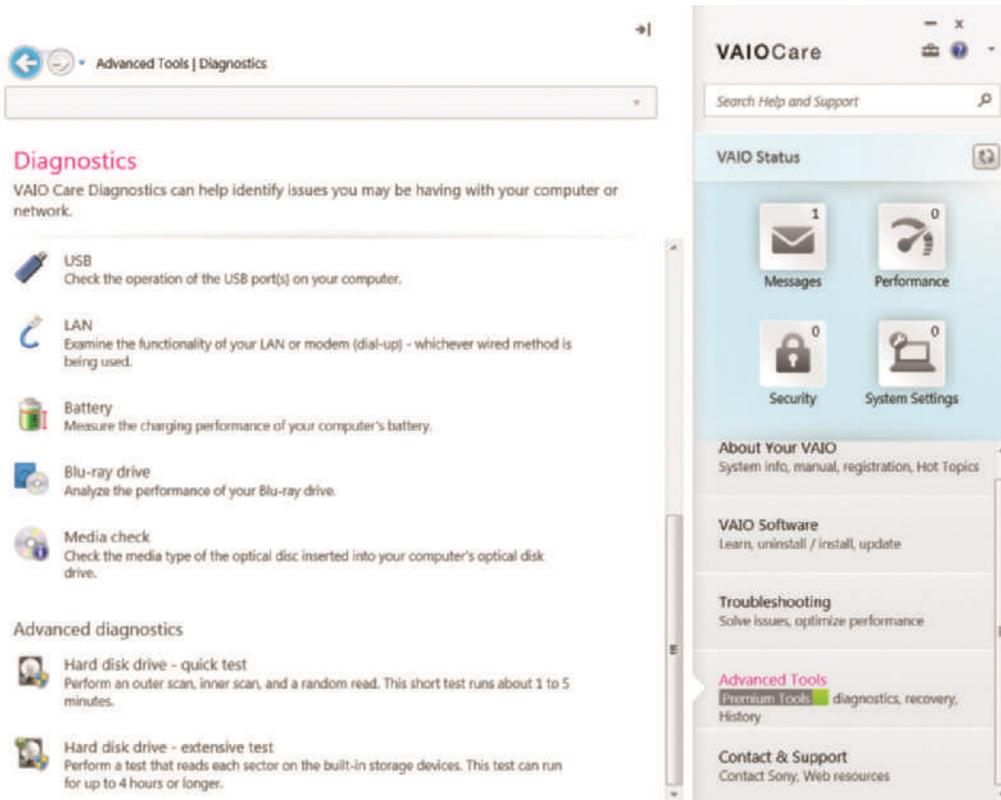
DIAGNOSTIC TOOLS PROVIDED BY MANUFACTURERS

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Most laptop manufacturers provide diagnostic software that can help you test components to determine which component needs replacing. As one of the first steps when servicing a laptop, check the user manual, service manual, or manufacturer’s website to determine if diagnostic software exists and how to use it. Use the software to pinpoint the problem component, which can then be replaced.



Check the manufacturer's website for diagnostics software that can be downloaded for a particular model laptop or stored on the hard drive or on CDs bundled with the laptop. Figure 2-36 shows a window provided by the diagnostics program installed on the hard drive of one laptop.



Source: Sony

Figure 2-36 Use diagnostics software provided by a laptop manufacturer to troubleshoot hardware problems

One example of diagnostic software is PC-Doctor, which is used by several manufacturers, including Lenovo, Fujitsu, and HP laptops. The diagnostic software is stored on the hard drive or on CD. If stored on CD, you can boot from the CD to run the tests. If the software is stored on the hard drive, you can run it from the Windows Start menu or by pressing a function key at startup before Windows loads. Either way, PC-Doctor can run tests on the keyboard, video, speakers, touch pad, optical drive, wireless LAN, motherboard, processor, ports, hard drive, and memory. To learn how to use the software, see the laptop's service manual or user manual.

Lenovo offers PC-Doctor for DOS that you can download from their website at www.lenovo.com/support and burn to a CD. Boot from the CD and use the command-line interface of the older DOS operating system to run the tests. You can also find a stand-alone version of PC-Doctor for DOS and PC-Doctor for Windows at www.pc-doctor.com. You can purchase it at this site; it's expensive but might be worth it if you plan to service many laptops.

Hands-On | Project 2-4 Research Laptop Service Manuals

2

Do the following to find a service manual for a laptop that you have access to, such as one belonging to you or a friend:

1. What are the brand, model, and serial number of the laptop?
2. What is the website of the laptop manufacturer? Print a webpage on that site that shows the documentation and/or drivers available for this laptop.
3. If the website provides a service manual for disassembling the laptop, download the manual. Print two or three pages from the manual showing the title page and table of contents for the manual.
4. If the website does not provide a service manual, search the Internet for the manual. If you find it, download it and print the title page and table of contents.

Now let's turn our attention to how to disassemble and reassemble a laptop.

HOW TO WORK INSIDE A LAPTOP COMPUTER

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3.1, 4.5

Sometimes it is necessary to open a laptop case so you can upgrade memory, exchange a hard drive, or replace a failed component such as the LCD panel, video inverter, keyboard, touch pad, processor, optical drive, DC jack, fan, motherboard, CMOS battery, Mini-PCIe card, wireless card, or speaker. Most laptops sold today are designed so that you can easily purchase and exchange memory modules or hard drives. However, replacing a broken LCD panel or motherboard can be a complex process, taking several hours. Most likely, you will choose to replace the entire laptop rather than doing these labor-intensive and costly repairs.

Screws and nuts on a laptop are smaller than a desktop system and therefore require smaller tools. Figure 2-37 shows a display of several tools used to disassemble a laptop, although you can get by without several of them. Here's the list:



Figure 2-37 Tools for disassembling a laptop

- ▲ ESD strap
- ▲ Small flathead screwdriver
- ▲ Number 1 Phillips-head screwdriver
- ▲ Dental pick (useful for prying without damaging plastic cases, connectors, and screw covers such as the one in Figure 2-38)



Figure 2-38 Use a small screwdriver or dental pick to pry up the plastic cover hiding a screw

- ▲ Torx screwdriver set, particularly size T5
- ▲ Something such as a pillbox to keep screws and small parts organized
- ▲ Notepad for note taking or digital camera (optional)
- ▲ Flashlight (optional)
- ▲ Three-prong extractor to pick up tiny screws (optional)

Working on laptops requires extra patience. Just as when you are working with desktop systems, before opening the case of a laptop or touching sensitive components, you should always wear an ESD strap to protect the system against ESD. You can attach the alligator clip end of the strap to an unpainted metallic surface on the laptop. This surface could be, for instance, a port on the back of the laptop (see Figure 2-39). If a ground strap is not available, first dissipate any ESD between you and the laptop by touching a metallic unpainted part of the laptop, such as a port on the back, before you touch a component inside the case.

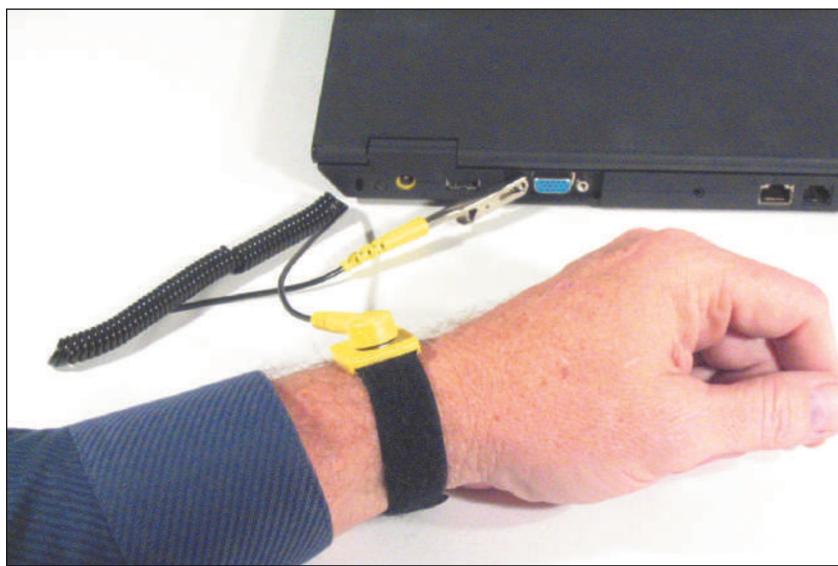


Figure 2-39 To protect the system against ESD, attach the alligator clip of a ground strap to an I/O port on the back of the laptop

Laptops contain many small screws of various sizes and lengths. When reassembling, put screws back where they came from so that when you reassemble the system, you won't use screws that are too long and that can protrude into a sensitive component and damage it. As you remove a screw, store or label it so you know where it goes when reassembling. One way to do that is to place screws in a pillbox with each compartment labeled. Another way is to place screws on a soft padded work surface and use white labeling tape to label each set of screws. A third way to organize screws is to put them on notebook paper and write beside them where the screw belongs (see Figure 2-40). My favorite method of keeping up with all those screws is to tape the screw beside the manufacturer documentation that I'm following to disassemble the laptop (see Figure 2-41). Whatever method you use, work methodically to keep screws and components organized so you know what goes where when reassembling.

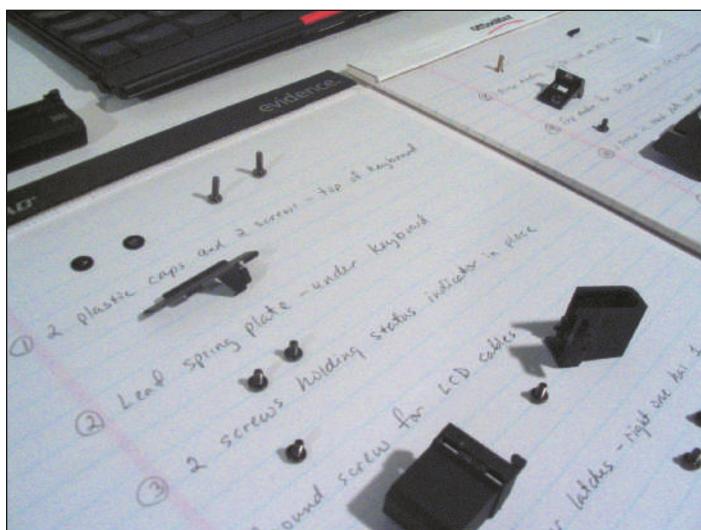


Figure 2-40 Using a notepad can help you organize screws so you know which screw goes where when reassembling

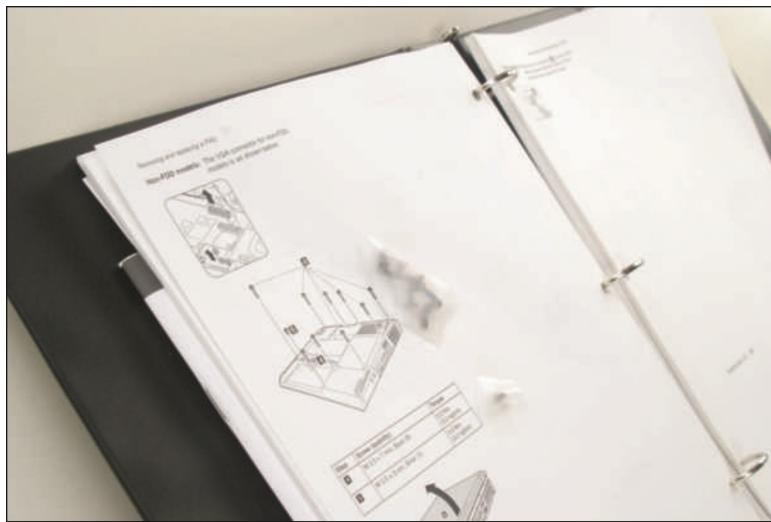


Figure 2-41 Tape screws beside the step in the manufacturer documentation that told you to remove the screw

★ A+ Exam Tip The A+ 220-901 exam expects you to know the importance of keeping parts organized when disassembling a laptop as well as the importance of having manufacturer documentation to know the steps to disassembly.

As you disassemble the computer, if you are not following directions from a service manual, keep notes as you work to help you reassemble later. Draw diagrams and label things carefully. Include in your drawings cable orientations and screw locations. You might consider using a digital camera. Photos that you take at each step in the disassembly process will be a great help when it's time to put the laptop back together.

When disassembling a laptop, consider the following tips:

- ▲ Make your best effort to find the hardware service manual for the particular laptop model you are servicing. The manual should include all the detailed steps to disassemble the laptop and a parts list of components that can be ordered from the laptop manufacturer. If you don't have this manual, your chances of successfully replacing an internal component are greatly reduced! And, if you don't have much experience disassembling a laptop, it is not wise to attempt to do so without this manual.
- ▲ Consider the warranty that might still apply to the laptop. Remember that opening the case of a laptop under warranty most likely will void the warranty. Make certain that any component you have purchased to replace an internal component will work in the model of laptop you are servicing.
- ▲ Take your time. Patience is needed to keep from scratching or marring plastic screw covers, hinges, and the case.
- ▲ As you work, don't force anything. If you find yourself forcing something, you're likely to break it.
- ▲ Always wear an ESD strap or use other protection against ESD.
- ▲ When removing cables, know that sometimes cable connectors are **ZIF connectors**. To disconnect a cable from a ZIF connector, first pull up on the connector and then remove the cable, as shown in Figure 2-42. Figure 2-43 shows a laptop using three ZIF connectors that hold the three keyboard cables in place.

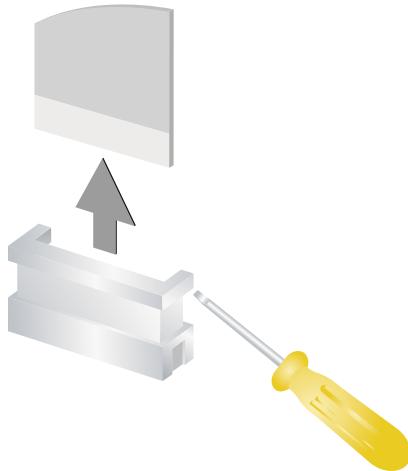


Figure 2-42 To disconnect a ZIF connector, first push up on the connector to release the latch, and then remove the cable



Figure 2-43 Three ZIF connectors hold the three keyboard cables in place

- ▲ Again, use a dental pick or very small screwdriver to pry up the plastic cover hiding a screw.
- ▲ Some laptops use plastic screws that are intended to be used only once. The service manual will tell you to be careful to not overtighten these screws and to always use new screws when reassembling a laptop.

- ▲ Disassemble the laptop by removing each field replaceable unit (FRU) in the order given by the service manual for your laptop. For example, one manufacturer says that to replace the motherboard for a laptop, remove components in this order: battery pack, RAM door, keyboard, middle cover, hinge cover, DVD drive and bracket, mini PCIe adapter, keyboard bezel assembly, fan assembly, CPU, CPU fixture, and DVD drive bracket. After all these components are removed, you can then remove the motherboard. Follow the steps to remove each component in the right order.

When reassembling a laptop, consider these general tips:

- ▲ Reassemble the laptop in the reverse order of the way you disassembled it. Follow each step carefully.
- ▲ Be sure to tighten, but not overtighten, all screws. Loose screws or metal fragments in a laptop can be dangerous; they might cause a short as they shift about inside the laptop.
- ▲ Before you install the battery or AC adapter, verify that there are no loose parts inside the laptop. Pick it up and gently shake it. If you hear anything loose, open the case and find the loose component, screw, spring, or metal flake, and fix the problem.

>> CHAPTER SUMMARY

How to Work Inside a Desktop Computer Case

- ▲ When a hardware support technician is disassembling or reassembling a computer, it is important to stay organized, keep careful notes, and follow all the safety procedures to protect the computer equipment.
- ▲ Before opening a computer case, shut down the system, unplug it, disconnect all cables, and press the power button to drain residual power.
- ▲ An expansion card fits in a slot on the motherboard and is anchored to the case by a single screw or clip.

Special Considerations When Supporting Laptops

- ▲ Laptop computers are designed for travel. They use the same technology as desktop computers, with modifications for space, portability, and power conservation. A laptop generally costs more than a desktop with comparable power and features. Special concerns when supporting a laptop also apply to supporting a netbook or all-in-one computer.
- ▲ When supporting laptops, pay careful attention to what the warranty allows you to change on the computer.
- ▲ The laptop manufacturer documentation, including the service manual, diagnostic software, and recovery media, is useful when disassembling, troubleshooting, and repairing a laptop.

How to Work Inside a Laptop Computer

- ▲ Field replaceable units in a laptop can include the memory modules, hard drive, LCD panel, video inverter, keyboard, touch pad, processor, optical drive, DC jack, fan, motherboard, CMOS battery, Mini-PCIe card, wireless card, or speakers.
- ▲ When an internal component needs replacing, consider the possibility of disabling the component and using an external peripheral device in its place. Don't jeopardize the warranty on a laptop by opening the case or using components not authorized by the manufacturer.
- ▲ Replacing the laptop might be more cost effective than performing labor-intensive repairs, such as replacing the motherboard.

- ▲ When disassembling a laptop, the manufacturer's service manual is essential.
- ▲ When upgrading components on a laptop, including memory, use components that are the same brand as the laptop, or use only components recommended by the laptop's manufacturer.
- ▲ Follow the directions in a service manual to disassemble a laptop. Keep small screws organized as you disassemble a laptop because the laptop will have a variety of sizes and lengths of screws. Some manufacturers use plastic screws and recommend you use new screws rather than reuse the old ones.

>> KEY TERMS

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

front panel connector
front panel header
spacer
standoff
ZIF connector

>> REVIEWING THE BASICS

1. When taking a computer apart, why is it important to not stack boards on top of each other?
2. Why is it important to remove loose jewelry before working inside a computer case?
3. When assembling a desktop computer, which do you install first, the drives or the motherboard?
4. What is the purpose of raised screw holes or standoffs installed between the motherboard and desktop case?
5. When installing the front panel wires to the motherboard front panel header, how do you know which pins to use for each wire if the pins on the header are not labeled?
6. How many pins does the CPU auxiliary power connector on a motherboard have?
7. Why are laptops usually more expensive than desktop computers with comparable power and features?
8. Why is the service manual so important to have when you disassemble a laptop?
9. When a laptop internal device fails, what three options can you use to deal with the problem?
10. After you have removed the AC adapter and all peripherals, what is the next component you should always remove before servicing any internal laptop components?

>> THINKING CRITICALLY

1. You disassemble and reassemble a desktop computer. When you first turn it on, you see no lights and hear no sounds. Nothing appears on the monitor screen. What is the most likely cause of the problem? Explain your answer.
 - a. A memory module is not seated properly in a memory slot.
 - b. You forgot to plug up the monitor's external power cord.
 - c. A wire in the case is obstructing a fan.
 - d. Power cords to the motherboard are not connected.

2. You are looking to buy a laptop on a budget and want to save money by not purchasing an extended service agreement with the manufacturer beyond the first year. What should you consider when choosing manufacturers to limit your search? Which manufacturers would you choose and why?
3. A four-year-old laptop will not boot and presents error messages on screen. You have verified with the laptop technical support that these error messages indicate the motherboard has failed and needs replacing. What is the first question you should ask yourself before performing the repair?
 - a. Will replacing the motherboard be more costly than purchasing a new laptop?
 - b. Can you find a replacement motherboard?
 - c. Can you find the service manual to show you how to replace the motherboard?
 - d. Is the laptop still under warranty?

>> REAL PROBLEMS, REAL SOLUTIONS

REAL PROBLEM 2-1 Taking a Lab Computer Apart and Putting It Back Together

A PC technician needs to be comfortable with taking apart a computer and putting it back together. In most situations, the essential tools you'll need for the job are an ESD strap, a Phillips-head screwdriver, a flathead screwdriver, paper, and pen.

Working with a partner and using a lab computer designated to be disassembled, take a computer apart. It is not necessary to remove the processor or memory modules from the motherboard, but be very careful to properly support the motherboard and processor as you remove them from the case. Then reassemble the system. Don't replace the computer case panel until your instructor has inspected all cable connections. Then turn on the computer and verify that all is working.

REAL PROBLEM 2-2 Setting Up a Service Center for Laptops

If you intend to set up your own computer repair shop, you might want to consider becoming a service center for a few brands of the more popular laptops. Reasons to become an authorized service center are that you have access to service manuals, parts lists, and wholesale parts for laptops. Do the following to research becoming an authorized service center:

1. Select a brand of laptops that you think you would like to service.
2. Research the website of this manufacturer and answer these questions:
 - a. Where is the closest authorized service center for this brand of laptops?
 - b. What are the requirements to become an authorized service center? Print the webpage showing the requirements.
 - c. Is A+ certification one of those requirements?
 - d. Some laptop manufacturers offer a program that falls short of becoming an authorized service center but does provide support for IT professionals so that repair technicians can order laptop parts. Does the manufacturer offer this service? If so, what must you do to qualify?

If you try one brand of laptop and can't find the information you need, try another brand. Sometimes this information can only be obtained by contacting the manufacturer directly. And one more hint: To use www.google.com to search a particular site, begin the search string with *site:hostname.com*.

REAL PROBLEM 2-3 Taking Apart a Laptop

If you enjoy putting together a thousand-piece jigsaw puzzle, you'll probably enjoy working on laptop computers. With desktop systems, replacing a component is not a time-consuming task, but with laptops, the job could take half a day. If you take the time to carefully examine the laptop's case before attempting to open it, you will probably find markings provided by the manufacturer to assist you in locating components that are commonly upgraded. If you have a service manual, your work will be much easier than without one.

The best way to learn to disassemble a laptop is to practice on an old one that you can afford to break. Find an old Dell or Lenovo or IBM ThinkPad for which you can download the service manual from the Dell or Lenovo website. Carefully and patiently follow the disassembly instructions and then reassemble it. When done, you can congratulate yourself and move on to newer laptops.