CHAPTER 2

The Visible PC

In this chapter, you will learn how to

- Describe how the PC works
- Identify the essential tools of the trade and avoid electrostatic discharge
- Identify the different connectors on a typical PC system unit
- Identify the major internal and external components of a PC

Mastering the craft of a PC technician requires you to learn a lot of details about the many pieces of hardware in the typical PC. Even the most basic PC contains hundreds of discrete hardware components, each with its own set of characteristics, shapes, sizes, colors, connections, and so on. By the end of this book, you will be able to discuss all of these components in detail.

This chapter takes you inside a typical PC, starting with an overview of how computers work. Because it's always good to follow the physician's rule, "First, do no harm," the second section of the chapter gives you the scoop on how to avoid damaging anything when you open up the computer.

Remember the children's song that goes, "Oh, the leg bone connects to the thigh bone...."? Well, think of the rest of the chapter in that manner, showing you what the parts look like and giving you a rough idea as to how they work and connect. In later chapters, you'll dissect all these PC "leg bones" and "thigh bones" and get to the level of detail you need to install, configure, maintain, and fix computers. Even if you are an expert, do not skip this chapter! It introduces a large number of terms that will be used throughout the rest of the book. Many of these terms you will know, but some you will not, so take some time and read it.

It is handy, although certainly not required, to have a PC that you can take the lid off of and inspect as you progress. Almost any old PC will help—it doesn't even need to work. So get thee a screwdriver, grab your PC, and see if you can recognize the various components as you read about them.

Historical/Conceptual

How the PC Works

You've undoubtedly seen a PC in action—a nice, glossy monitor displaying a picture that changes according to the actions of the person sitting in front of it, typing away on a keyboard, clicking a mouse, or twisting a joystick. Sound pours out of tiny speakers that flank the screen, and a box whirs happily beneath the table. The PC is a computer: a machine that enables you to do work, produce documents, play games, balance your checkbook, and check up on the latest sports scores on the Internet.

Although the computer is certainly a machine, it's also *programming:* the commands that tell the computer what to do to get work done. These commands are just ones and zeroes that the computer's hardware understands, enabling it to do amazing actions, such as perform powerful mathematic functions, move data (also ones and zeroes), realize the mouse has moved, and put pretty icons on the screen. So a computer is a complex interaction between hardware and computer programming, created by your fellow humans.

Ever heard of Morse code? Morse code is nothing more than dots and dashes to those who do not understand it, but if you send dots and dashes (in the right order) to a guy who understands Morse code, you can tell him a joke. Think of programming as Morse code for the computer. You may not understand those ones and zeroes, but your computer certainly does! (See Figure 2-1.)

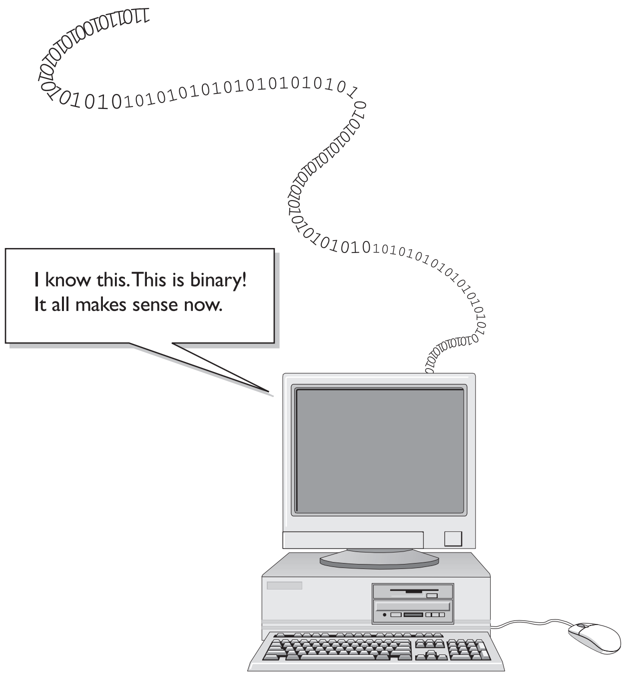


Figure 2-1 Computer musing that a string of ones and zeroes makes perfect sense to him

There's more to the ones and zeroes than just programming. All of the data on the computer—the Web pages, your documents, your e-mail—is also stored as ones and zeroes. Programs know how to translate these ones and zeroes into a form humans understand.

Programming comes in two forms. First are the applications—the programs that get work done. Word processing programs, Web browsers, and e-mail programs are all considered applications. But applications need a main program to support them. They need a program that enables you to start and stop applications, copy/move/delete data, talk to the hardware, and perform lots of other jobs. This program is called the *operating system (OS)*. Microsoft Windows is the most popular OS today, but there are other computer operating systems, such as Apple Macintosh OS X (Figure 2-2) and the popular (and free) Linux. Computer people lump operating systems and applications into the term *software* to differentiate them from the hardware of the computer.

Understanding the computer at this broad conceptual level—in terms of hardware, OS, and programs—can help you explain things to customers, but good techs have a much more fundamental appreciation and understanding of the complex interplay of all the software and the individual pieces of hardware. In short, techs need to know the processes going on behind the scenes.

NOTE The CompTIA A+ certification exams focus on hardware and operating systems; other certifications cover many of the programs in common use today. Two examples are the Microsoft Office Specialist (MOS) and Macromedia Certified Professional certifications.

Figure 2-2 OS X interface

From the CompTIA A+ tech's perspective, the computer functions through four stages: input, processing, output, and storage. Knowing which parts participate in a particular stage of the computing process enables you to troubleshoot on a fundamental and decisive level.

Input

To illustrate this four-step process, let's walk through the steps involved in a fairly common computer task: preparing your taxes. [Insert collective groan here.] February has rolled around and, at least in the United States, millions of people install their favorite tax software, TurboTax from Intuit, onto their computers to help them prepare their taxes (Figure 2-3). After starting TurboTax, your first job is to provide the computer with data—essential information, such as your name, where you live, how much you earned, and how many dollars you gave to federal and state governments.

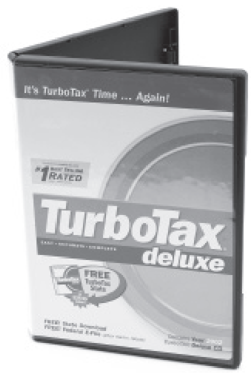


Figure 2-3 Turbo Tax glamour shot

Various pieces of hardware enable you to input data, the most common of which are the keyboard and mouse. Most computers won't react when you say, "Hey you!"—at least anywhere outside of a Star Trek set. Although that day will come, for now you must use something decidedly more mechanical: a keyboard to type in your data. The OS provides a fundamental service in this process as well. You can bang on a keyboard all day and accomplish nothing without the OS translating your keystrokes into code that the hardware can understand.

Processing

Next, the computer processes your data. It places information in various appropriate "boxes" in TurboTax, and then it does the math for you. Processing takes place inside the computer case and happens almost completely at a hardware level, although that hardware functions according to rules laid out in the OS. Thus, again you have a complex interaction between hardware and software.

The processing portion is the magical part—you can't see it happen. The first half of this book demystifies this stage because good techs understand all the pieces of the process. I won't go through the specific hardware involved in the processing stage here because the pieces change according to the type of process.

Output

Simply adding up your total tax for the year is useless unless the computer shows you the result. That's where the third step—output—comes into play. Once the computer finishes processing data, it must put the information somewhere for you to inspect it. Often it places data on the monitor so you can see what you've just typed. It might send the data over to the printer if you tell it so you can print out copies of your tax return to mail to the Internal Revenue Service (or whatever the Tax Man is called where you live). A hardware device does the actual printing, but the OS controls the printing process. Again, it's a fundamental interaction of hardware and software.

Storage

Once you've sent in your tax return, you most likely do not want all that work simply to disappear. What happens if the IRS comes back a couple of months later with a question about your return? Yikes! You need to keep permanent records; plus, you need to keep a copy of the tax program. The fourth stage in the computing process is storage. A lot of devices are used in the storage process, the most visible of which are the external storage parts, such as floppy diskettes and CD-R discs (Figure 2-4).

Figure 2-4 Typical storage (CD-R discs)

The Art of the PC Technician

Using the four stages of the computing process—input, processing, output, and storage—to master how the PC works and, in turn, become a great technician, requires that you understand all the pieces of hardware and software involved **and** the interactions between them that make up the various stages. You have to know what the parts do, in other words, and how they work together. The best place to start is with a real computer. Let's go through the process of inspecting a typical, complete PC, including opening up a few important pieces to see the components inside. Hopefully, you've got a real computer in front of you right now that you may dismantle a bit. No two computers are exactly the same, so you'll see differences between your PC and the one in this chapter—and that's okay. You'll gain an appreciation of the fact that all computers have the same main parts that do the same jobs even though they differ in size, shape, and color.

By the time you reach the end of this book, you'll have a deeper, more nuanced understanding of the interaction of hardware and software in the four-stage computing process. Just as great artists have mastered fundamental skills of their trade before creating a masterpiece, you'll have the fundamentals of the art of the computer technician and be on your road to mastery.

Tools of the Trade and ESD Avoidance

Before we dive into the PC, you need two pieces of information: an overview of the most common tools you'll find in a tech's toolkit and how *not* to destroy hardware inadvertently through electrostatic discharge.

Tools of the Trade

The basic technician toolkit consists of a Phillips-head screwdriver and not much else—seriously—but a half dozen tools round out a fully-functional toolkit. Most kits have a star-headed Torx wrench, a nut driver or two, a pair of tweezers, a little grabber tool, and a hemostat to go along with Phillips-head and flat-head screwdrivers (Figure 2-5).

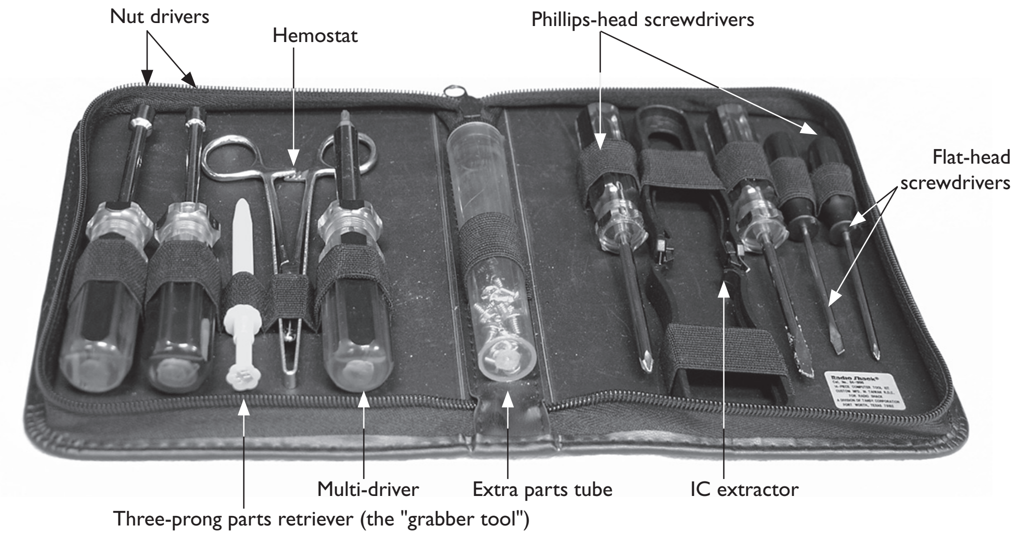


Figure 2-5 Typical technician toolkit

A lot of techs will throw in a magnifying glass and a flashlight for those hard-to-read numbers and text on the printed circuit boards (PCBs) that make up a large percentage of devices inside the system unit (Figure 2-6). Contrary to what you might think, techs rarely need a hammer.

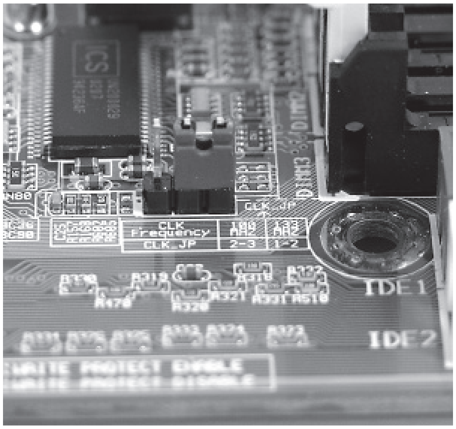


Figure 2-6 Close-up of a printed circuit board (PCB)

Essentials

Avoiding Electrostatic Discharge

If you decide to open a PC while reading this chapter, as I encourage you to do, you must take proper steps to avoid the greatest killer of PCs—*electrostatic discharge (ESD)*. ESD simply means the passage of a static electrical charge. Have you ever rubbed a balloon against your shirt, making the balloon stick to you? That's a classic example of static electricity. When that static charge discharges, you may not notice it happening—although on a cool, dry day, I've been shocked so hard by touching a doorknob that I could see a big, blue spark! I've never heard of a human being getting anything worse than a rather nasty shock from ESD, but I can't say the same thing about computers. ESD will destroy the sensitive parts of your PC, so it is essential that you take steps to avoid ESD when working on your PC.

NOTE All PCs are well protected against ESD on the outside—unless you take a screwdriver and actually open up your PC, you really don't need to concern yourself with ESD.

Anti-static Tools

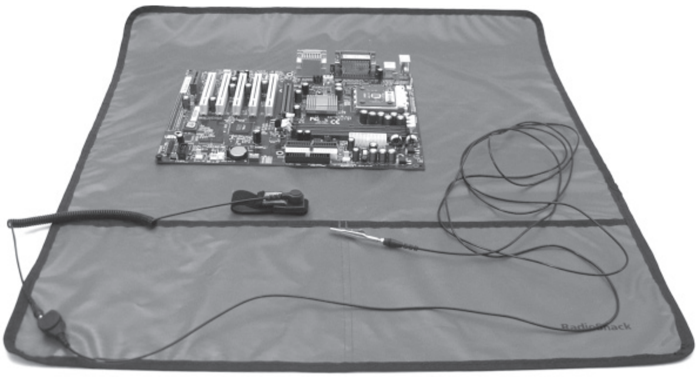
ESD only takes place when two objects that store different amounts (the hip electrical term to use is *potential*) of static electricity come in contact. The secret to avoiding ESD is to keep you and the parts of the PC you touch at the same electrical potential. You can accomplish this by connecting yourself to the PC via a handy little device called an *anti-static wrist strap*. This simple device consists of a wire that connects on one end to an alligator clip and on the other end to a small metal plate that secures to your wrist with an elastic strap. You snap the alligator clip onto any handy metal part of the PC and place the wrist strap on either wrist. Figure 2-7 shows a typical anti-static wrist strap in use.

Figure 2-7 Anti-static wrist strap in use

EXAM TIP Static electricity, and therefore the risk of ESD, is much more prevalent in dry, cool environments.

Anti-static wrist straps are standard equipment for anyone working on a PC, but other tools might come in handy. One of the big issues when working with a PC stems from the fact that in many situations you find yourself pulling out parts from the PC and setting them aside. The moment you take a piece out of the PC, it no longer has contact with the systems and may pick up static from other sources. Techs use *anti-static mats* to eliminate this risk. An anti-static mat acts as a point of common potential—it's very common to purchase a combination anti-static wrist strap and mat that all connect together to keep you, the PC, and any loose components at the same electrical potential (Figure 2-8).

Figure 2-8 Anti-static wrist strap and mat combination



Anti-static wrist straps and mats use tiny *resistors*—devices that stop or *resist* the flow of electricity—to prevent anti-static charge from racing through the device. These resistors can fail over time, so it's always a good idea to read the documentation that comes with your anti-static tools to see how to test those small resistors properly.

Any electrical component not in a PC needs to be stored in an *anti-static bag,* a specially designed bag that sheds whatever static electricity you have when you touch it, thus preventing any damage to components stored within (Figure 2-9). Almost all PC components come in an anti-static bag when purchased. Experienced techs never throw these bags away, as you never know when you'll want to pull a part out and place it on a shelf for a while!

Figure 2-9
Anti-static bag

Although it would be ideal to have an anti-static wrist strap with you at all times, the reality is that from time to time you'll find yourself in situations where you lack the proper anti-static tools. This shouldn't keep you from working on the PC—if you're careful! Before working on a PC in such a situation, take a moment to touch the power supply—I'll show you where it is in this chapter—every once in a while as you work to keep yourself at the same electrical potential as the PC. Although this isn't as good as a wrist strap, it's better than nothing at all!

The last issue when it comes to preventing ESD is that never-ending question—should you work with the PC plugged in or unplugged? The answer is simple—do you really want to be physically connected to a PC that is plugged into an electrical outlet? Granted, the chances of electrocution are slim, but why take the risk?

EXAM TIP Always unplug a PC when working inside it.

Have I convinced you that ESD is a problem? Good! So now it's safe to start looking at the components of the PC.

The Complete PC

Sometimes I hate the term "personal computer." That term implies a single device, like a toaster. A typical PC is more than one device, and you need all the parts (or at least most) to make the PC work. The most important part of the PC is the box that usually sits underneath your desk—the one that all the other parts connect to, called the *system unit.* All of the processing and storage takes place in the system unit. All of the other parts of the PC—the printer, the keyboard, the monitor—connect to the system unit and are known collectively as *peripherals.* Figure 2-10 shows a typical desktop PC, with the system unit and peripherals as separate pieces.

Figure 2-10 Typical desktop computer with peripherals

Most computers have a standard set of peripherals to provide input and output. You'll see some variation in color, bells, and whistles, but here's the standard set:

- **Monitor** The big television thing that provides a visual output for the computer.
- **Keyboard** Keypad for providing keyed input. Based on a typewriter.
- **Mouse** Pointing device used to control a graphical pointer on the monitor for input.
- **Speakers/headphone** Speakers provide sound output.
- **Printer** Provides printed paper output.

A typical PC has all of these peripherals, but there's no law that requires a PC to have them. Plenty of PCs may not have a printer. Some PCs won't have speakers. Some computers don't even have a keyboard, mouse, or monitor—but they tend to hide in unlikely places, such as the inside of a jet fighter or next to the engine in an automobile. Other PCs may have many more peripherals. It's easy to install four or five printers on a single PC if you so desire. There are also hundreds of other types of peripherals, such as Web cameras and microphones, that you'll find on many PCs. You add or remove peripherals depending on what you need from the system. The only limit is the number of connections for peripherals available on the system unit.

External Connections

Every peripheral connects to the system unit through one of the many types of ports. The back of a typical system unit (Figure 2-11) has lots of cables running from the system unit to the different peripherals. You may even have a few connectors in the front. All these connectors and ports have their own naming conventions, and a good tech knows all of them. It's not acceptable to go around saying things like "that's a printer port" or "that's a *little-type* keyboard connector." You need to be comfortable with the more commonly used naming conventions so you can say "that's a female DB-25" or "that's a USB connector."

Figure 2-11 Connections on the back of a PC

Plugs, Ports, Jacks, and Connectors

Although PCs use close to 50 different types of connections, almost all fit into one of six major types: DIN, USB, FireWire, DB, RJ, and audio. Read the next paragraph to get your terminology straight, and then you can jump into the various connectors with gusto.

No one seems to use the terms *plug, port, jack,* or *connector* correctly, so let's get this right from the start. To connect one device to another, you need a cable containing the wires that make the connection. On each device, as well as on each end of the connecting cable, you need standardized parts to make that connection. Because these are usually electrical connections, you need one part to fit inside another to make a snug, safe connection.

A *plug* is a part with some type of projection that goes into a *port*. A port is a part that has some type of matching hole or slot that accepts the plug. You never put a port into a plug; it's always the other way around. The term *jack* is used as an alternative to port, so you may also put a plug into a jack. The term *connector* describes either a port or a plug. (See Figure 2-12.) As you progress through this chapter and see the different plugs and ports, this will become clearer.

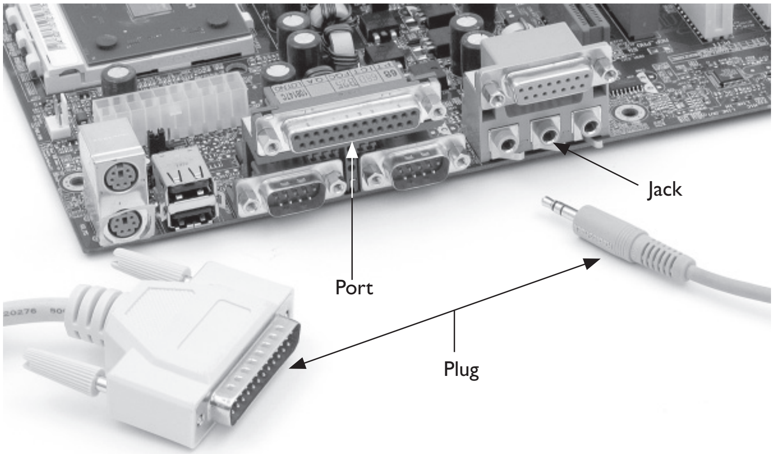


Figure 2-12 Plug, port, and jack

Mini-DIN Connectors

Most PCs sport the European-designed *mini-DIN* connectors. The original DIN connector was replaced by mini-DIN a long time ago, so you'll only see mini-DIN connectors on your PC (see Figure 2-13). Older-style keyboards and mice plug into mini-DIN ports.

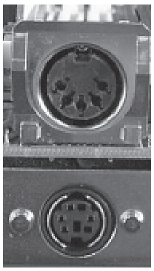
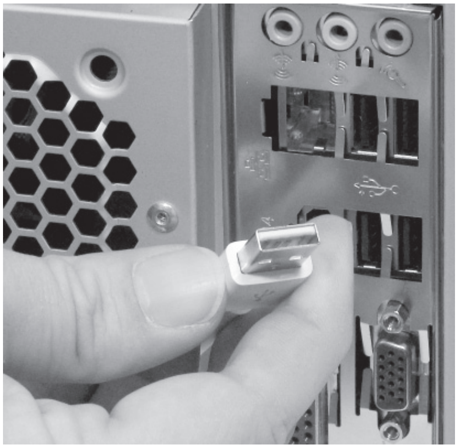


Figure 2-13 DIN (top) and mini-DIN connectors

USB Connectors

Universal serial bus (USB) provides the most common general-purpose connection for PCs. You'll find USB versions of many different devices, such as mice, keyboards, scanners, cameras, and printers. USB connections come in three different sizes: *A* (very common), *B*, and *mini-B* (less common). The USB A connector's distinctive rectangular shape makes it easily recognizable (Figure 2-14).

Figure 2-14
USB A connector and port



You never see a USB B connector on your computer. USB B connectors are for the other end of the USB cable where it attaches to the USB device (Figure 2-15).

Figure 2-15
USB B connector

NOTE You'll sometimes hear USB ports and plugs described as *upstream* or *downstream*, terms that create rather amusing conversation and confusion. It's all about whether you refer to the plug or the port, so here's the scoop. The USB A plugs go upstream to USB A ports on the host or hub. USB A ports provide downstream output from the host or hub. So, the plug is upstream and the port is downstream. Just to add more fun to the mix, USB B plugs go downstream to devices. USB B ports provide upstream output from the device to the host or hub. My advice? Stick with A or B and nobody will get confused.

The USB B connector's relatively large size makes it less than optimal for small devices such as cameras, so the USB folks also make the smaller mini-B–style connector, as shown in Figure 2-16.

Figure 2-16
USB mini-B connector

USB has a number of features that make it particularly popular on PCs. First, USB devices are *hot-swappable,* which means you can insert or remove them without restarting your PC. Almost every other type of connector requires you to turn the system off, insert or remove the connector, and then turn the system back on. Hot-swapping completely eliminates this process.

Second, many USB devices get their electrical power through the USB connection, so they don't need batteries or a plug for an electrical outlet. You can even recharge some devices, such as cellular telephones, by plugging them into a USB port (Figure 2-17).

Figure 2-17 Cell phone charging via a USB connection

FireWire Connectors

FireWire, also known as *IEEE 1394*, moves data at incredibly high speeds, making it the perfect connection for highly specialized applications, such as streaming video from a digital video camera onto a hard drive. FireWire consists of a special 6-wire connector, as shown in Figure 2-18. There's also a smaller, 4-pin version, usually seen on peripherals. Like USB, FireWire devices are hot-swappable.

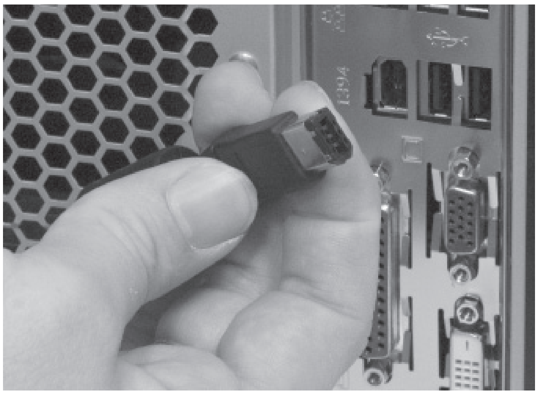


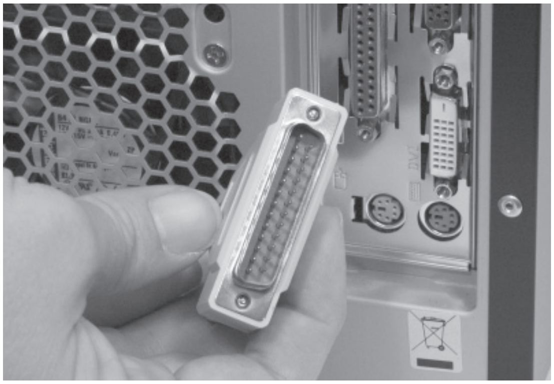
Figure 2-18 FireWire connector and port

DB Connectors

Over the years, *DB connectors* have been used for almost any type of peripheral you can think of, with the exception of keyboards. They have a slight *D* shape, which allows only one proper way to insert a plug into the socket and makes it easier to remember what they're called. Technically, they're known as *D-sub* or *D-subminiature* connectors, but most techs call them DB.

Each male DB plug has a group of small pins that connect to DB ports. Female DB plugs connect to male DB ports on the system unit. DB connectors in the PC world can have from 9 to 37 pins or sockets, although you rarely see a DB connector with more than 25 pins or sockets. Figure 2-19 shows an example. DB-type connectors are some of the oldest and most common connectors used in the back of PCs.

Figure 2-19
DB-25 connector and port



NOTE Each size D-sub connector—called the *shell size*—has a specific name in the D-sub manufacturing world. A two-row, nine-pin connector, for example, is officially a DE-9 connector, rather than a DB-9. The E refers to the 9-pin shell size. Why all the DA, DB, DC, DD, and DE connectors became DB-*x* in the world of personal computers is a mystery, but most techs simply call them DB connectors.

It wasn't that long ago that a typical PC used at least three or more different DB connectors. Over the past few years, the PC world has moved away from DB connectors. A typical modern system might only have one or two, usually for a printer or video.

RJ Connectors

You have more than likely seen an *RJ connector,* whether or not you knew it by that name. The little plastic plug used to connect your telephone cord to the jack (techs don't use the word "port" to describe RJ connectors) is a classic example of an RJ plug. Modern PCs use only two types of RJ jacks: the RJ-11 and the RJ-45. The phone jack is an RJ-11. It is used

Figure 2-20
RJ-11 (top) and RJ-45 (bottom)

almost exclusively for modems. The slightly wider RJ-45 jack is used for your network connection. Figure 2-20 shows an RJ-11 jack (top) and an RJ-45 jack (bottom).

Audio Connectors

Speakers and microphones connect to audio jacks on the system unit. The most common type of sound connector in popular use is the *mini-audio connector.* These small connectors have been around for years; they're just like the plug you use to insert headphones into an iPod or similar device (Figure 2-21). Traditionally, you'd find the audio jacks on the back of the PC, but many newer models sport front audio connections as well.

Figure 2-21
Mini-audio jacks and plug

NOTE Keep in mind that the variety of connectors is virtually endless. The preceding types of connectors cover the vast majority, but many others exist in the PC world. No law or standard requires device makers to use a particular connector, especially if they have no interest in making that device interchangeable with similar devices from other manufacturers.

Devices and Their Connectors

Now that you have a sense of the connectors, let's turn to the devices common to almost every PC to learn which connectors go with which device.

NOTE Almost all connectors are now color coordinated to help users plug the right device into the right port. These color codes are not required, and not all PCs and devices use them.

Cards Versus Onboard

All of the connectors on the back of the PC are just that—connectors. Behind those connectors are the actual devices that support whatever peripherals plug into those connectors. These devices might be built into the computer, such as a keyboard port. Others might be add-on expansion cards that a tech installed into the PC.

Most PCs have special expansion slots inside the system unit that enable you to add more devices on expansion cards. Figure 2-22 shows a typical card. If you want some new device and your system unit doesn't have that device built into the PC, you just go to the store, buy a card version of that device, and snap it in! Later chapters of the book go into great detail on how to do this, but for now just appreciate that a device might be built in or it might come on a card.

Figure 2-22 Typical expansion card

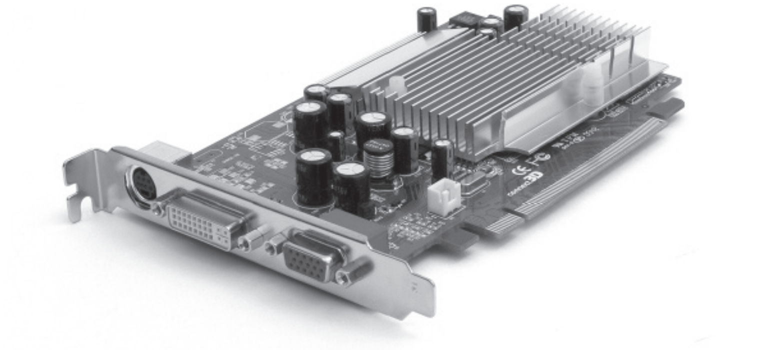
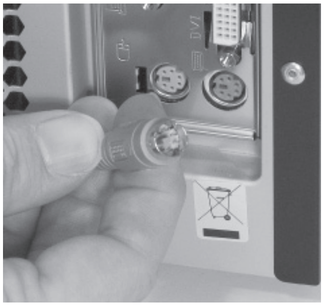


Figure 2-23 Keyboard plug and port



Keyboard

Today's keyboards come in many shapes and sizes, but connect into either a dedicated mini-DIN keyboard port or a USB port. Many keyboards ship with an adapter so you can use either port. Most keyboard plugs and mini-DIN ports are colored purple (see Figure 2-23).

Monitor

A monitor connects to the video connector on the system unit. You'll usually see one of two types of video connectors: the older 15-pin female DB *video graphics array (VGA)* connector or the unique *digital video interface* (DVI) connector. VGA connectors are colored blue, whereas DVI connectors are white. Many video cards have both types of connectors (Figure 2-24), or two VGA or two DVI connectors. Video cards with two connectors support two monitors, a very cool thing to do!

Occasionally you'll run into a video card with a mini-DIN connector, such as the S-Video connector you can see at the left in Figure 2-24. These mini-DIN connectors support all sorts of interesting video jobs, such as connecting to output to a television or input from a video camera.

Figure 2-24 Video card with three ports. From left to right, S-Video, DVI, and VGA.

The newest video connector is called *High-Definition Multimedia Interface (HDMI)*, shown in Figure 2-25. HDMI is still very new to the video scene, but brings a number of enhancements, such as the ability to carry both video and sound on the same cable. Primarily designed for home theater, you'll see video cards with HDMI connectors growing more common over the next few years.

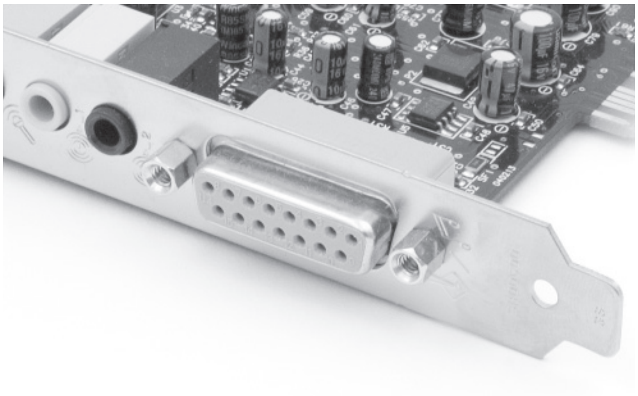
Figure 2-25
HDMI connector

Sound

The sound device on your card performs two functions. First, it takes digital information and turns it into sound, outputting the sound through speakers. Second, it takes sound that is input through a microphone and turns it into digital data.

To play and record sounds, your sound device needs to connect to at least a set of speakers and a microphone. All PCs have at least two miniature audio jacks: one for a microphone and another for stereo speakers. Better cards provide extra miniature audio jacks for surround sound. A few sound cards provide a female 15-pin DB port that enables you to attach an electronic musical instrument interface or add a joystick to your PC (see Figure 2-26).

Figure 2-26
Legacy joystick/MIDI port



Adding more and more audio jacks to sound cards made the back of a typical sound card a busy place. In an effort to consolidate all of the different sound signals, the industry invented the *Sony/Philips Digital Interface Format (S/PDIF)* connection (Figure 2-27). One S/PDIF connection replaces all of the mini-audio connections, assuming your surround speaker system also comes with an S/PDIF connection.

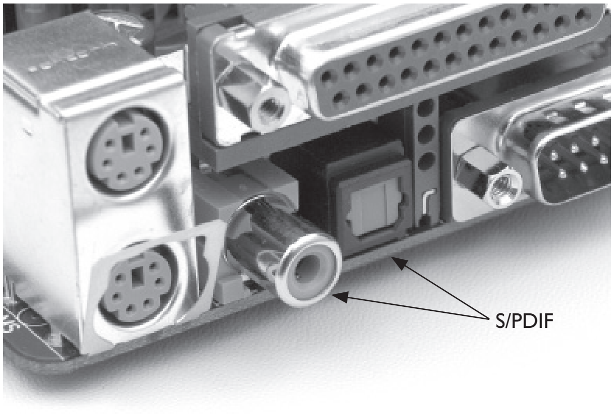


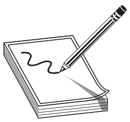
Figure 2-27 S/PDIF connection

The color scheme for sound connections is complex, but for now remember one color—green. That's the one you need to connect a standard pair of stereo speakers.

Network

Networks are groups of connected PCs that share information. The PCs most commonly connect via some type of cabling that usually looks like an extra-think phone cable. A modern PC uses an RJ-45 connection to connect to the network. Figure 2-28 shows a typical RJ-45 network connector. Network connectors do not have a standard color.

Figure 2-28 Typical network connection



NOTE Modern PCs have built-in network connections, but this is a fairly recent development. For many years, network devices only came on an expansion card, called a *network interface card (NIC)*. The term is so common that even built-in network connections—which most certainly are not cards—are still called NICs.

Mouse

Most folks are pretty comfortable with the function of a mouse (Figure 2-29)—it enables you to select graphical items on a graphical screen. A PC mouse has at least two buttons (as opposed to the famous one-button mouse that came with Apple Macintosh computers until recently), while a better mouse provides a scroll wheel and extra buttons. A mouse uses either a USB port or a dedicated, light-green mini-DIN connector (see Figure 2-30).

Figure 2-29
Mouse

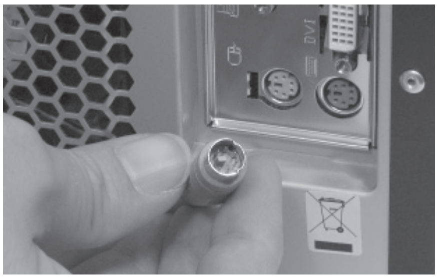


Figure 2-30
Typical mouse mini-DIN connection

A variation of the mouse is a *trackball* (Figure 2-31). A trackball does the same job as a mouse, but instead of being pushed around like a mouse, the trackball stays in one place as you roll a ball with your fingers or thumb.

Figure 2-31
Trackball

Modem

A *modem* enables you to connect your PC to a telephone. A modem is another easily identifiable device in PCs. Most modems have two RJ-11 sockets. One connects the modem to the telephone jack on the wall, and the other is for an optional telephone so that you can use the phone line when the modem is not in use (see Figure 2-32).

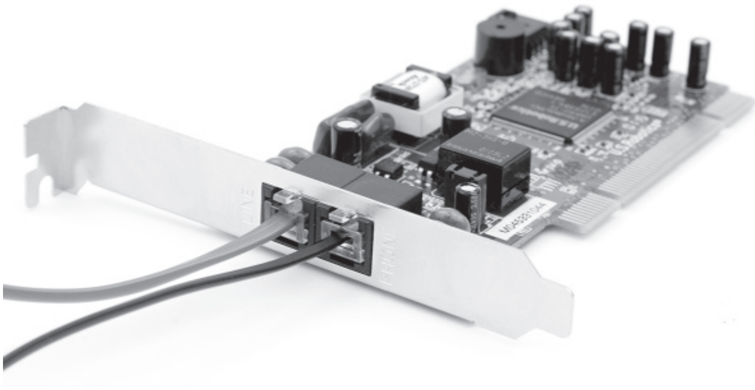
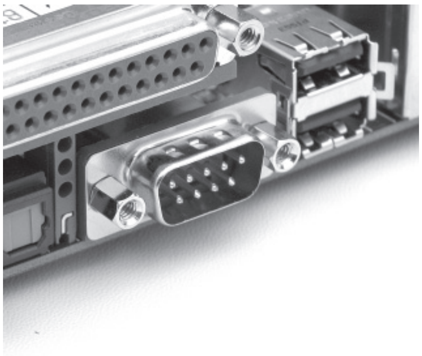


Figure 2-32 Internal modem

External modems traditionally connected to a male 9-pin or 25-pin D-subminiature port on the system unit called a *serial port* (Figure 2-33). Although just about every external modem today connects to USB, most computers come with a serial port for legacy devices. Serial ports are one of the few connectors on modern systems that were also used in the first PCs more than 20 years ago!

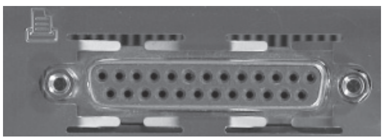
Figure 2-33
Serial port



Printer

For many years, printers only used a special connector called a *parallel port.* Parallel ports use a 25-pin female DB connector that's usually colored fuchsia (see Figure 2-34).

Figure 2-34
Parallel port



After almost 20 years of domination by parallel ports, almost all printers now come with USB ports. Some better models even offer FireWire connections.

Figure 2-35
Joystick

Joystick

Joysticks (Figure 2-35) weren't supposed to be used just for games. When the folks at IBM added the 15-pin female DB joystick connector to PCs, they envisioned joysticks as hard-working input devices, just as the mouse is today. Except in the most rare circumstances, however, the only thing a joystick does today is enable you to turn your PC into a rather expensive game machine! But is there a more gratifying feeling than easing that joystick over, pressing the Fire button, and watching an enemy fighter jet get blasted by a well-placed Sidewinder missile? I think not. Traditional joystick connectors are colored orange, but most joysticks today connect to USB ports.

Plenty More!

Keep in mind that there are lots more devices and connectors out there! These are only the most common and the ones you're most likely to see. As we progress through this book, you'll see these less common connectors and where they are used.

Inside the System Unit

Now that you've seen the devices that connect to the PC, let's open up the system unit to inspect the major internal components of a typical PC. A single PC is composed of thousands of discrete components. Although no one can name every tiny bit of electronics in a PC, a good technician should be able to name the major internal components that make up the typical PC. Let's open and inspect a system unit to see these components and gain at least a concept of what they do. In later chapters, you'll see all of these components in much more detail.

Case

The system unit's case is both the internal framework of the PC and the external skin that protects the internal components from the environment. Cases come in an amazing variety of styles, sizes, and colors. Figure 2-36 shows the front and back of a typical PC case. The front of the case holds the buttons used to turn the system on and off, lights to tell you the status of the system, and access doors to removable media drives such as floppy, CD-ROM, and DVD drives. This system also provides USB, FireWire, and audio connections in the front for easy access if you want to use a device that needs these connections.

Figure 2-36 Front and back of a typical PC case showing various buttons and ports

NOTE Front connections are most commonly used for temporary devices, such as headphones. If you have a device you don't intend to remove very often, you should install it in one of the back connections.

The back of the case holds the vast majority of the system unit connections. You will also notice the power supply—almost always at the top of the case—distinguished by its cooling fan and power plug. Note that one area of the back of the case holds all the onboard connections, while another area contains slots for cards. The onboard ports need holes so you can plug devices into them (see Figure 2-37). Similarly, the case uses slots to enable access to the external connectors on cards installed in the system unit.

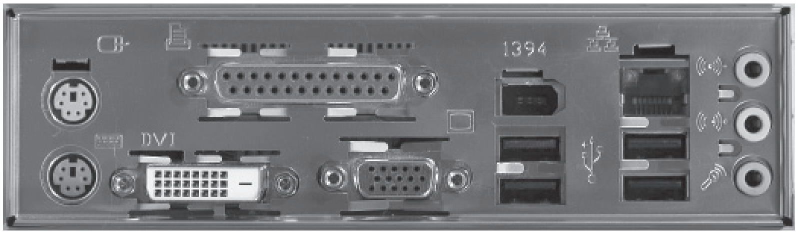


Figure 2-37 Onboard devices

NOTE You'll hear the PC case called the *enclosure*, especially at the more expensive end of the spectrum. Case, enclosure, and system unit are interchangeable terms.

Opening a case is always … interesting. There's no standard way to open a case, and I'm convinced that the folks making system units enjoy some sick humor inventing new and complex ways to open them. In general, you detach the sides of a case by removing a few screws in the back of the system unit, as shown in Figure 2-38. Use common sense and you won't have too many problems. Just don't lose track of your screws or where each one was inserted!

Figure 2-38
Opening a system unit

Once you've opened the case, take a look inside. You see metal framework, all kinds of cables, and a number of devices. As you inspect the devices, you may gently push cables to the side to get a better view. Don't forget to wear an anti-static wrist strap or touch the metal case occasionally to prevent ESD.

CPU

The *central processing unit (CPU)*, also called the *microprocessor*, performs all the calculations that take place inside a PC. CPUs come in a variety of shapes and sizes, as shown in Figure 2-39.

Figure 2-39
Typical CPUs

Modern CPUs generate a lot of heat and thus require a cooling fan and heat sink assembly to avoid overheating (see Figure 2-40). A heat sink is a big slab of copper or aluminum that helps draw heat away from the processor. The fan then blows the heat out into the case. You can usually remove this cooling device if you need to replace it, although some CPU manufacturers have sold CPUs with a fan permanently attached.

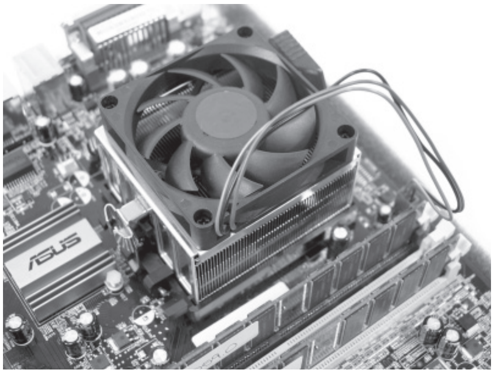


Figure 2-40
CPU with fan in PC

CPUs have a make and model, just like automobiles do. When talking about a particular car, for example, most people speak in terms of a Ford Taurus or a Toyota Camry. When they talk about CPUs, people say Intel Pentium 4 or AMD Athlon. Over the years, there have been only a few major CPU manufacturers, just as there are only a few major auto manufacturers. The two most common makes of CPUs used in PCs are AMD and Intel.

Although only a few manufacturers of CPUs have existed, those manufacturers have made hundreds of models of CPUs. Some of the more common models made over the last few years have names such as Celeron, Athlon, Sempron, Pentium III, and Pentium 4.

Finally, CPUs come in different packages. The package defines how the CPU looks physically and how it connects to the computer. The predominant package type is called *pin grid array (PGA)*. Every package type has lots of variations.

Chapter 3, "Microprocessors," goes into great detail on CPUs, but for now remember that every CPU has a make, a model, and a package type.

RAM

Random access memory (RAM) stores programs and data currently being used by the CPU. The maximum amount of programs and data that a piece of RAM can store is measured in units called *bytes.* Modern PCs have many millions, even billions, of bytes of RAM, so RAM is measured in units called *megabytes (MB)* or *gigabytes (GB)*. An average PC will have from 256 MB to 2 GB of RAM, although you may see PCs with far more or far less RAM. Each piece of RAM is called a *stick.* One common type of stick found in today's PC is called a *dual inline memory module (DIMM)*. Figure 2-41 shows two examples of DIMMs used in PCs.

Figure 2-41
Two DIMMs

Your PC takes only one type of DIMM, and you must know the type so you can add or replace RAM when needed. Chapter 4, "RAM," covers everything you need to know to work comfortably with RAM.

CAUTION Some parts of your PC are much more sensitive to ESD than others. Your CPU and RAM are very sensitive to ESD. If you touch the metal parts of your CPU or RAM and you have even the tiniest amount of charge, it can destroy them.

Motherboard

You can compare a motherboard to the chassis of an automobile. In a car, everything connects to the chassis either directly or indirectly. In a PC, everything connects to the motherboard either directly or indirectly. A motherboard is a thin, flat piece of circuit board, usually green or gold, and often slightly larger than a typical piece of notebook paper (see Figure 2-42).

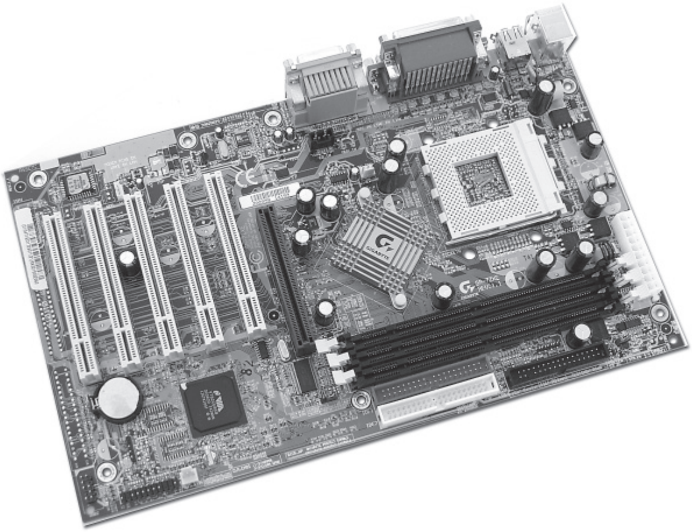


Figure 2-42 Typical motherboard

A motherboard contains a number of special sockets that accept various PC components. The CPU and RAM, for example, plug directly into the motherboard. Other devices, such as floppy drives, hard drives, CD and DVD drives, connect to the motherboard sockets through short cables. Motherboards also provide onboard connectors for external devices such as mice, printers, joysticks, and keyboards.

All motherboards use multipurpose expansion slots that enable you to add adapter cards. Different types of expansion slots exist for different types of cards (see Figure 2-43).

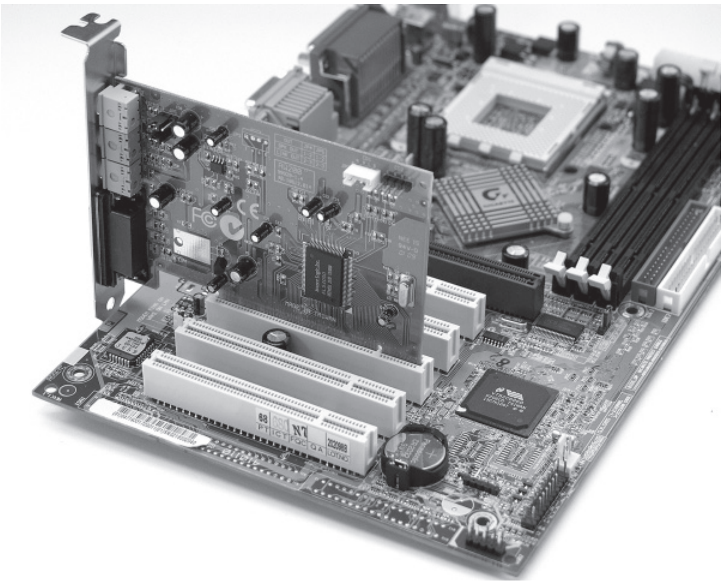


Figure 2-43 Expansion slots

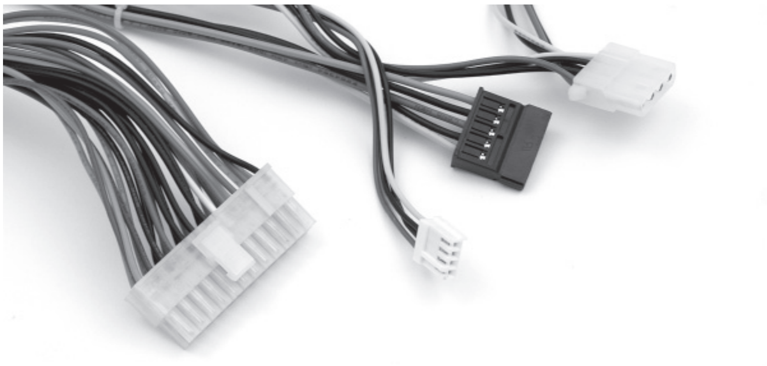
Power Supply

The *power supply,* as its name implies, provides the necessary electrical power to make the PC operate. The power supply takes standard (in the United States) 110-volt AC power and converts it into 12-volt, 5-volt, and 3.3-volt DC power. Most power supplies are about the size of a shoebox cut in half and are usually a gray or metallic color (see Figure 2-44).

Figure 2-44
Power supply

A number of connectors lead out of the power supply. Every power supply provides special connectors to power the motherboard and a number of other general-use connectors that provide power to any device that needs electricity. Figure 2-45 shows both the motherboard power and typical general-use connectors. Check out Chapter 8, "Power Supplies," for more information.

Figure 2-45
Power connectors



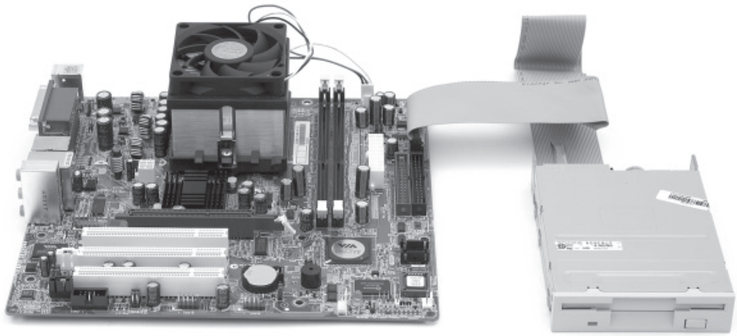
Floppy Drive

The *floppy drive* enables you to access removable floppy disks (diskettes). The floppy drive used in PCs today is called a 3.5″ floppy drive (Figure 2-46). Floppy drives only store a tiny amount of data and are disappearing from many PCs.

The floppy drive connects to the computer via a *ribbon cable,* which in turn connects to the motherboard. The connection to the motherboard is known as the *floppy drive controller* (Figure 2-47).

Figure 2-46
Floppy drive

Figure 2-47
Floppy drive connected to motherboard



Hard Drive

Hard drives store programs and data that are not currently being used by the CPU (Figure 2-48). Even though both hard drives and RAM use the same storage units (megabytes and gigabytes), a PC's hard drive stores much more data than a typical PC's RAM—up to hundreds of gigabytes.

Figure 2-48
Typical hard drive

An average PC has one hard drive, although most PCs accept more. Special PCs that need to store large amounts of data, such as a large corporation's main file storage computer, can contain many hard drives—8 to 16 drives in some cases.

By far the most common type of hard drive seen in today's PC fall under the *AT Attachment (ATA)* standard. These drives come in two types: the older *parallel ATA (PATA)* or the more modern *serial ATA (SATA)*. PATA drives use a ribbon cable very similar to the one used by floppy drives, whereas SATA drives use a very narrow cable. Figure 2-49 shows a SATA drive (left) next to a PATA drive (right). Most motherboards come with connections for both types of drives.

Figure 2-49
SATA and PATA drives

NOTE A very few PCs use *small computer system interface (SCSI)* drives. SCSI drives are generally faster and more expensive, so they usually show up only in high-end PCs such as network servers or graphics workstations.

Almost all CD-ROM and DVD drives are actually PATA drives and connect via a ribbon cable just like a PATA hard drive. Figure 2-50 shows a DVD drive connected to a ribbon cable with a PATA hard drive—a very common sight inside a PC.

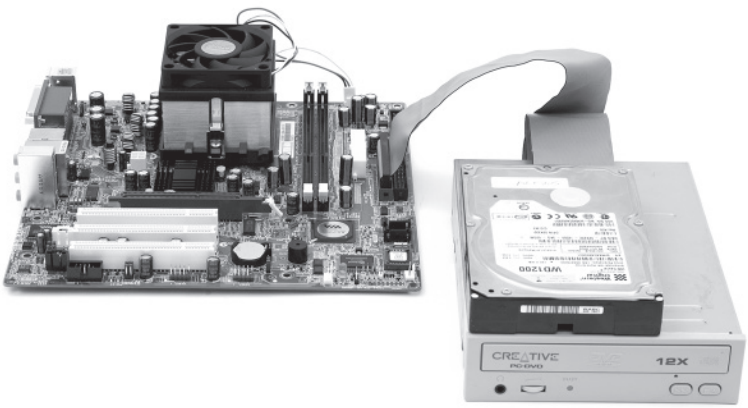


Figure 2-50
Hard drive and DVD drive

Optical Media

CDs, DVDs—there are so many types of those shiny discs to put in computers (Figure 2-51)! The term *optical media* describes all of them. Generally, you may break optical media into two groups: CDs and DVDs. CDs store around 700 MB and come in three varieties: CD-ROM (*read only memory:* you can't change the data on them), CD-R (*recordable:* you can change the data once), and CD-RW (*rewritable:* you can change the data on them over and over). DVDs store much more data—around 4 GB, enough for a Hollywood movie—and come in even more varieties: DVD-ROM, DVD+R, DVD-R, DVD+RW, and DVD-RW, just to name the more famous ones.

Figure 2-51
Assorted optical media discs

All of these different optical-media discs require an optical drive that knows how to read them. If you want to do anything with a CD-RW disc, for example, you need a CD-RW drive. If you want to use a DVD+R disc, you need a DVD+R drive. Luckily, most optical drives support many different types of discs, and some support every common type of optical media available! Figure 2-52 shows typical optical drives. Note that some of them advertise the types of media they use. Others give no clue whatsoever.

NOTE Chapter 11, "Removable Media," goes into great detail on the assorted disc and drive types.

Figure 2-52
Optical drives

Know Your Parts

The entire goal of this chapter was to get you to appreciate the names and functions of the different parts of the PC: peripherals, connectors, and components. You also learned about ESD and other issues that come into play when working with a PC. By starting with the Big Picture view, you may now begin breaking down the individual components on a chapter-by-chapter basis and truly understand at great depth how each component works and how they interconnect with the PC system as a whole.

Chapter Review Questions

1. What do you call the commands that tell the computer what to do?
   - **A.** Data
   - **B.** Morse code
   - **C.** Programming
   - **D.** Output
2. What is the essential tool for computer techs?
   - **A.** File
   - **B.** Phillips-head screwdriver
   - **C.** Pliers
   - **D.** Flat-head screwdriver
3. Where do you connect an anti-static wrist strap? (Select the best answer.)
   - **A.** To an anti-static plate on the computer
   - **B.** To an electrical outlet
   - **C.** To a handy metal part of the case
   - **D.** Non-static wrist strap
4. What sort of connector does a typical network card have?
   - **A.** DB-9
   - **B.** Mini-DIN
   - **C.** RJ-11
   - **D.** RJ-45
5. Modern keyboards connect to which of the following ports? (Select all that apply.)
   - **A.** DIN
   - **B.** FireWire
   - **C.** Mini-DIN
   - **D.** USB

6. Which end of the USB cable plugs into the PC?
   - A. A
   - B. B
   - C. Mini-A
   - D. Mini-B
7. A printer usually plugs into which of the following ports? (Select two.)
   - A. DB-9
   - B. DB-25
   - C. Mini-DIN
   - D. USB
8. What do you plug into a three-row, 15-pin port?
   - A. Joystick
   - B. Keyboard
   - C. Monitor
   - D. Mouse
9. What connector was designed to connect your PC to a high-end television set?
   - A. DB-HD
   - B. DVI
   - C. HDMI
   - D. VGA
10. What connector was designed to connect your PC to a high-end audio system?
    - A. DB-HA
    - B. DVI
    - C. Mini-audio
    - D. S/PDIF

Answers

1. **C.** Programming is the general term for commands that tell the computer what to do.
2. **B.** A Phillips-head screwdriver is the essential tool for computer techs.
3. **C.** Connect an anti-static wrist strap to any handy metal part of the computer. The metal plate, by the way, is the section on the strap where you connect the cable from the PC.

4. **D.** A typical network card sports an RJ-45 port.
5. **C, D.** Modern keyboards connect to either mini-DIN or USB ports.
6. **A.** Plug the USB A connector into the PC.
7. **B, D.** A printer usually plugs into either DB-25 or USB (although some can use FireWire, it's not as common).
8. **C.** You plug a monitor into a three-row, 15-pin port.
9. **C.** HDMI was designed to connect your PC to a high-end television set.
10. **D.** S/PDIF was designed to connect your PC to a high-end audio system.