
# PC Architecture

**THE FOLLOWING OBJECTIVES ARE COVERED IN THIS CHAPTER:**

- ✓ **1.1 Identify the names, purpose, and characteristics, of system modules. Recognize these modules by sight or definition.**
- ✓ **1.5 Identify the names, purposes, and performance characteristics, of standardized/common peripheral ports, associated cabling, and their connectors. Recognize ports, cabling, and connectors, by sight.**

A *personal computer (PC)* is a computing device made up of many distinct electronic components that all function together in order to accomplish some useful task (such as adding up the numbers in a spreadsheet or helping you write a letter). By this definition, note that we're describing a computer as having many distinct parts that work together. Most computers today are modular. That is, they have components that can be removed and replaced with a component of similar function in order to improve performance. Each component has a very specific function. In this chapter, you will learn about the components that make up a typical PC, what their function is, and how they work together inside the PC.

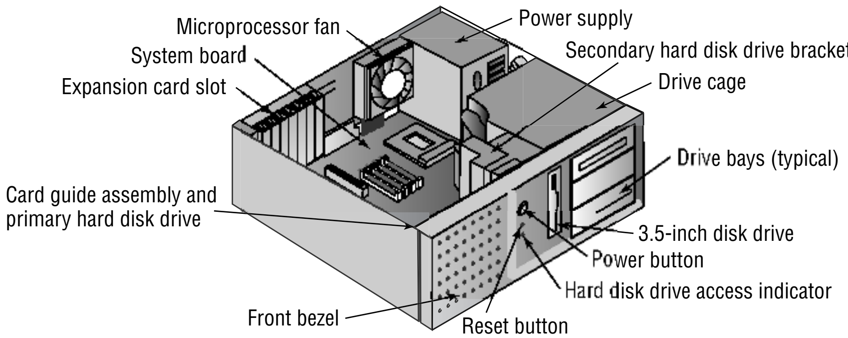
> Unless specifically mentioned otherwise, throughout this book the terms *PC* and *computer* can be used interchangeably.

The components in most computers include:

- The case
- The power supply
- The motherboard
- The processor /CPU
- Memory
- Storage devices
- The adapter cards
- Display devices
- Ports and cables

As you read this chapter, please keep in mind that many of these parts will be covered in more detail in later chapters. Figure 1.1 shows an example of a typical PC and illustrates how some of these parts fit together.

**FIGURE 1.1** The components of a typical PC




# The Case

A *computer case* is the enclosure that encases all the components of a computer. All the computer's components mount to the inside of the case—the case is essentially the mounting platform for all the electronic devices that make up the computer. Typically, cases are square or rectangular boxes, usually beige in color (although the current trend is for all-black cases and matching peripherals), and made of steel, aluminum, or plastic. Figure 1.2 shows an example of a typical computer case.

**FIGURE 1.2** A typical computer case

NOTE

To see some examples of many different styles and colors of computer cases, visit `www.pimprig.com`.

Cases are primarily categorized in two ways: by their physical size (full tower, mini tower, and so on) and by the type of motherboard they are designed for (such as AT, ATX, or Mini-ATX). We'll talk more about motherboard designs in a later chapter. For now, just remember that in addition to their type, cases must also be designed for the motherboard type. You could have two cases with the same physical dimensions and look, but with completely different internal layouts suitable for their motherboards.

Case styles vary in the way they normally sit (vertically or horizontally) as well as the number of device bays they support. A *device bay* (or *bay* for short) is a large slot into which an expansion device fits (usually a disk drive of some sort). There are two bay sizes: 5 1/4-inch (typically used for CD-ROM and similar drives) and 3 1/2-inch (used for floppy, Zip, and hard disk drives).

Several common PC case styles are in use today. Let's take a quick look at each of these and how they differ. These styles include:

- Full tower
- Mid tower
- Mini tower
- Midi tower
- Desktop
- Slimline
- Proprietary

NOTE

It is important to note that these are general guidelines. What one manufacturer calls a tower, another may call a mid tower. When you're determining whether a particular case will fit your needs, it is more important to note its physical size and specifications than its labels.

## Full Tower

A *full tower case* is a computer case that stands approximately 20–25 inches tall, has at least five 5 1/4-inch drive bays, and is designed to stand vertically on the floor next to a desk (instead of on the desk). This type of case usually has wheels so you can move it easily when you need to unplug a cable or do other work on the computer. Often, because of its sheer size, it will have stabilizing feet to prevent it from tipping over. Figure 1.3 shows an example of a full tower case.

Full tower cases are often used for server computers because of the number of disk drives a server needs to hold. If a computer you are building or buying needs lots of drives, you may want to look into a full tower case.

**FIGURE 1.3** A full tower case

Such a case also has a lot of room inside. This space allows components to be separated and provides good airflow around them. People who need many different components inside their computer and need to keep temperatures in check for reliability might also consider a full tower case.

### You Get What You Pay For

As with any other product, there are varying degrees of quality and design among full tower cases. You could find two cases that look exactly the same outwardly but are built completely differently. They might differ in metal type and thickness, fastener type, and whether the motherboard mounting plate can be removed to make motherboard mounting easier. As you look at the various types of available cases, remember that generally speaking, you get what you pay for. Cheaper cases are made of thinner gauge metal, use inferior fastening mechanisms, and generally don't have the fit and finish of the more expensive cases. The quality of the case is especially important when you are building the computer yourself.

The full tower case has a couple of drawbacks. The most obvious is sheer size. The case's large size makes it awkward to place anywhere but on the floor next to your desk (which may not always be possible). Also, because full towers are the largest type of case, they are usually the most expensive you can buy.

## Mid Tower

A *mid tower case* is a computer case that stands between 16 and 19 inches tall, has at least three $5\frac{1}{4}$-inch drive bays, and is designed to stand vertically either on the floor or on a computer user's desk next to the monitor. This type of case doesn't have quite as much room inside as a full tower case, but it still has significant room for airflow and component layout. And, these cases are less expensive than full tower cases. At the time of this writing (early 2003), the mid tower case is probably the most popular case being sold for computers. Figure 1.4 shows an example of a mid tower case.

**FIGURE 1.4** A mid tower case

About the only drawback to a mid tower case is that it doesn't quite fit well on either the floor or a desk. It's a bit too big for a desk and a bit too small for the floor. But, because it is more convenient, most people make room for the case on their desk.

## Mini Tower

A *mini tower case* is a computer case that stands about 12 to 15 inches tall, has one or two $5\frac{1}{4}$-inch drive bays, and is designed to stand next to a computer monitor. It was designed to keep the small form factor of a desktop case but also keep the look of a tower, which is more visually appealing. Mini towers are often used in low-end or entry-level computer systems to keep the price down. They are the cheapest possible tower-style case you can buy. Figure 1.5 shows an example of a mini tower case.

**FIGURE 1.5** A mini tower case


The main drawback to mini tower cases is their relatively small size. Most components are packed inside these cases with relatively little room for airflow, so the cases tend to be used for computer configurations that don't have many components (housing all-in-one motherboards, for example).

## Midi Tower

*Midi tower case* is a term used to describe a computer case that's between a mid tower and a mini tower in size. The term is used (mostly in Europe) interchangeably with the term *mid tower*. It's primarily a marketing term, and not really a case type. (This case type has nothing to do with Musical Instrument Digital Interface [MIDI], the technology used to interface computers with digital musical instruments.)

## Desktop

A *desktop case* is designed to lie horizontally, with at least three $5\frac{1}{4}$-inch bays oriented horizontally and the $3\frac{1}{2}$-inch bays oriented vertically. The original IBM PC used this style of case (although the case for the original PC was much bigger). Currently, the dimensions for a typical full size desktop case are about 15 to 17 inches wide and 5 to 7 inches high. Figure 1.6 shows an example of a desktop case.

**FIGURE 1.6** A desktop case


This case design usually saves floor and desktop space and was the design of choice for corporate America for several years for this reason. However, this case costs about the same as a similarly configured mini tower case and has less internal space. Desktop cases also don't necessarily cool as well as their vertically oriented cousins (and it didn't help that people were putting monitors on top, adding to the internal heat level). For these reasons, sales of desktop systems today are much slower compared to similarly configured mini tower versions.

## Slimline

Because desktop space is always at a premium, case designers continually develop new designs that hold the most components in the least amount of space. Toward that end, designers have come up with the *slimline case*. A slimline computer case usually has only one $5\frac{1}{4}$-inch drive bay, mounted horizontally (or possibly two, side by side). It's designed to take up the least amount of desktop space, and is the smallest standardized form factor. Figure 1.7 shows an example of one type of slimline case.

**FIGURE 1.7** A slimline case


The only advantage of the slimline case is its small size. However, this small size leads to one major disadvantage: heat. Heat shortens the life of computer components, and due to the small size of slimline cases, they require specialized cooling design (and they still do a poor job of cooling). Even so, sales of slimline cases continue to rise as people try to make their PC as unobtrusive on their desk as their pencil cup.

## Proprietary Case Designs

The cases we have listed so far are only some of the styles available. Many PC manufacturers (such as Dell and Gateway) don't use standardized cases, but rather manufacture their motherboards and cases together to keep costs down. This results in what are known as proprietary case designs. A *proprietary case* is a computer case that is designed to work with only one particular motherboard and set of components and is typically designed for a specific purpose.

Dell's computers are a perfect example of PCs that use proprietary cases. Although Dell's cases could be classified as mid tower or mini tower, they only work with Dell motherboards designed for the particular case and are therefore usually classified as proprietary.

NOTE

You can check out some of Dell's computers at `www.dell.com`.

## Comparison of Case Designs

Now that we've discussed the styles of cases, let's take a quick look at the different designs available. Table 1.1 compares the case designs you have read about in this chapter.

**TABLE 1.1** Case Design Comparison

| Case Design | Number of 5 $^{1}/_{4}$" Bays | Footprint Size | Cooling | Cost |
|---|---|---|---|---|
| Full tower | 5 or more | Largest | Excellent | $$$$ |
| Mid tower | 3 or more | Large | Good to excellent | $$$ |
| Mini tower | 1 or 2 | Medium | Good | $$ |
| Desktop | 3 or more | Medium | Poor to good | $$ |
| Slimline | 1 | Smallest | Poor | $ |
| Proprietary | Varies | Varies | Varies | Varies |

# The Power Supply

The computer's components would not be able to operate without power. The device in the computer that provides this power is the *power supply* (Figure 1.8). A power supply converts 110 volt or 220 volt AC current into the DC voltages that a computer needs to operate. These are +3.3 volts DC, +5 volts DC, –5 volts DC (ground), +12 volts DC, –12 volts DC (ground), and +5 volts DC standby. The 3.3 volts DC and +5 volts DC standby voltages are used only by ATX motherboards, not AT motherboards.

NOTE You may frequently see *volts DC* abbreviated as *VDC*.

**FIGURE 1.8** A power supply

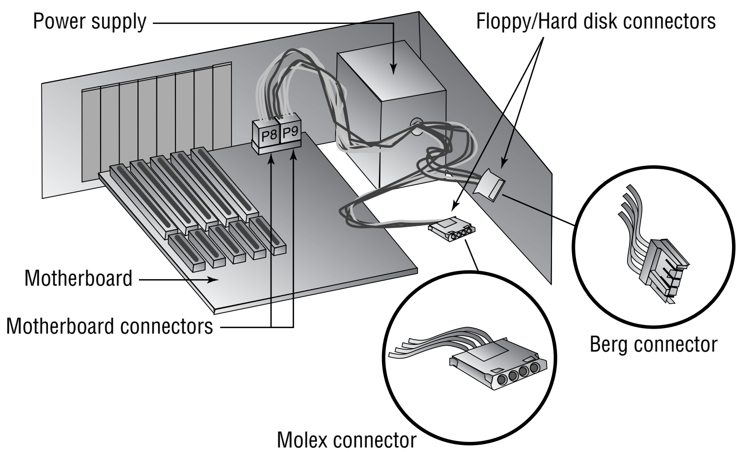
**WARNING** Power supplies contain transformers and capacitors that carry *lethal* amounts of current. They are not meant to be serviced. *Do not* attempt to open them or do any work on them.

Power supplies are rated in watts. A *watt* is a unit of power. The higher the number, the more power the power supply (and thus your computer) will use. Most computers use power supplies in the 250- to 400-watt range.

## Power Supply Connectors

Power supplies use four types of connectors to power the various devices within the computer (Figure 1.9): floppy drive power connectors, AT system connectors, ATX power connectors, and standard peripheral power connectors. Each has a different appearance and way of connecting to the device. Additionally, each type is used for a specific purpose.

**FIGURE 1.9** Standard power supply connectors

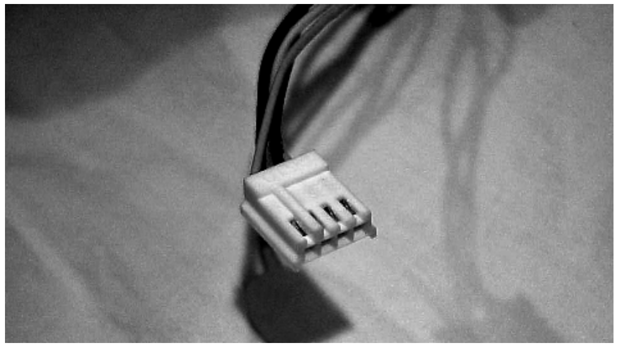



Let's take a quick look at each type of power connector and what it is used for.

### Floppy Drive Power Connectors

*Floppy drive power connectors* are most commonly used to power floppy disk drives and other small form factor devices. This type of connector is smaller and flatter (as shown in Figure 1.10) than any of the other types of power connectors. These connectors are also called *Berg connectors*. Notice that there are four wires going to this connector. These wires carry the 2 voltages used by the motors and logic circuits: +5VDC (carried on the red wire) and +12VDC (carried on the yellow wire) plus 2 black ground wires.

**FIGURE 1.10** Floppy drive power connector

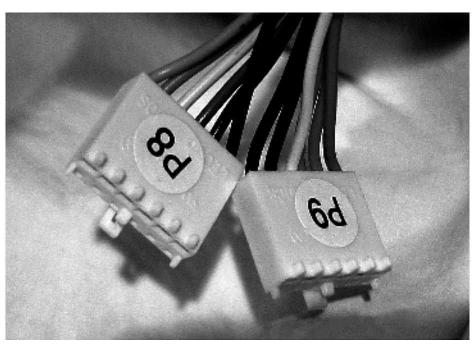


## AT System Connectors

The next type of power connector is called the *AT system connector*. There are two 6-wire connectors, labeled P8 and P9 (as shown in Figure 1.11). They connect to an AT-only motherboard and deliver the power that feeds the electronic components on it. These connectors have small tabs on them that interlock with tabs on the power connector on the motherboard. If there are two connectors, you must install them in the correct fashion. To do this (on most systems), place the connectors side by side with their black wires together, and then push the connectors onto the receptacle on the motherboard.

> **TIP** Although it's easy to remove this type of connector from the motherboard, the tabs on the connector make it difficult to reinstall it. Here's a hint: Place the connector at a right angle to the motherboard's connector, interlocking the tabs in their correct positions. Then tilt the connector to the vertical position. The connector will slide into place easily.

**FIGURE 1.11** AT Power supply system board connectors

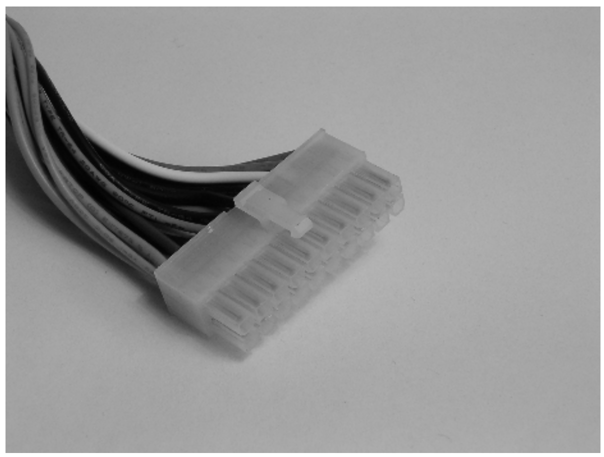



It is important to note that only computers with AT and baby AT motherboards use this type of power connector. Most computers today use the ATX power connector to provide power to the motherboard.

## ATX Power Connector

The *ATX system connector* (also known as the *ATX motherboard power connector*) feeds an ATX motherboard. It provides the six voltages required, plus it delivers them all through one connector: a single 20-pin connector. This connector is much easier to work with than the dual connectors of the AT power supply. Figure 1.12 shows an example of an ATX system connector.

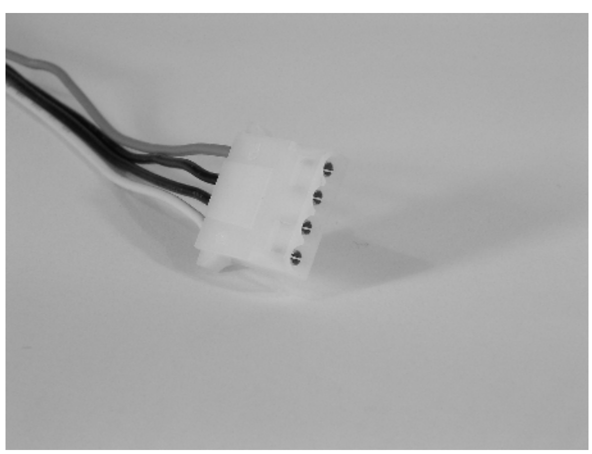
**FIGURE 1.12** ATX power connector



## Standard Peripheral Power Connector

The *standard peripheral power connector* is generally used to power different types of internal disk drives. This type of connector is also called a *Molex connector*. Figure 1.13 shows an example of a standard peripheral power connector. This power connector, though larger than the floppy drive power connector, uses the same wiring color code scheme as the floppy drive connector.

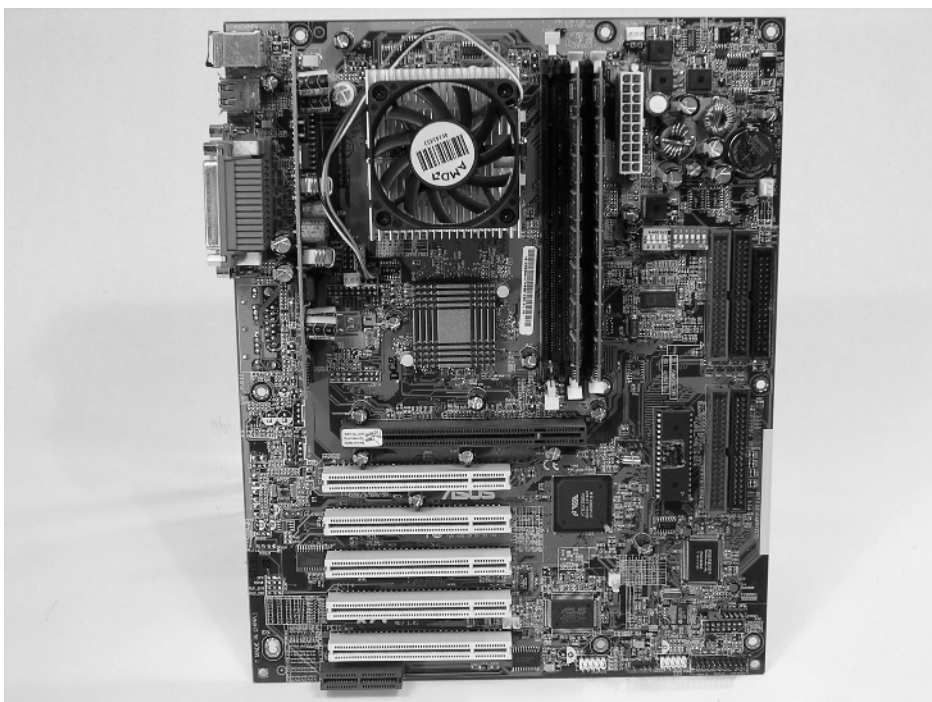
**FIGURE 1.13** A standard peripheral power connector



# The Motherboard

The spine of the computer is the *motherboard*, otherwise known as the *system board* (and less commonly referred to as the *planar board*). This is the olive green or brown circuit board that lines the bottom of the computer. It is the most important component in the computer because it connects all the other components of a PC together. Figure 1.14 shows a typical PC system board, as seen from above. All other components are attached on this sheet. On the system board, you will find the Central Processing Unit (CPU), underlying circuitry, expansion slots, video components, random access memory (RAM) slots, and a variety of other chips.

**FIGURE 1.14** A typical system board



## Types of System Boards

There are two major types of system boards: integrated and nonintegrated:

***Nonintegrated system board*** Each major assembly is installed in the computer as an expansion card. The major assemblies we're talking about are items like the video circuitry, disk controllers, and accessories. Nonintegrated boards can be easily identified because each expansion slot is usually occupied by one of these components.

***Integrated system board*** Most of the components that would otherwise be installed as expansion cards are integrated into the motherboard circuitry. Integrated system boards were designed for simplicity. Of course, there's a drawback to this simplicity: When one component breaks, you can't just replace the component that's broken; the whole motherboard must be replaced. Although these boards are cheaper to produce, they are more expensive to repair.

NOTE With integrated system boards, there is a way around having to replace the whole motherboard when a single component breaks. On some motherboards, you can disable the malfunctioning onboard component (e.g., the sound circuitry) and simply add an expansion card to replace its functions.

## System Board Form Factors

Nonintegrated system boards are also classified by their form factor (design): AT, ATX, or NLX (and variants of these). AT system boards are similar to the motherboards found in the original IBM AT. The processor, memory, and expansion slots are all in line with each other. Because of advances in technology, the same number of components that were on the original AT motherboard (now called a *full AT* board) were later compressed into a smaller area. This configuration is known as the *baby AT* configuration.

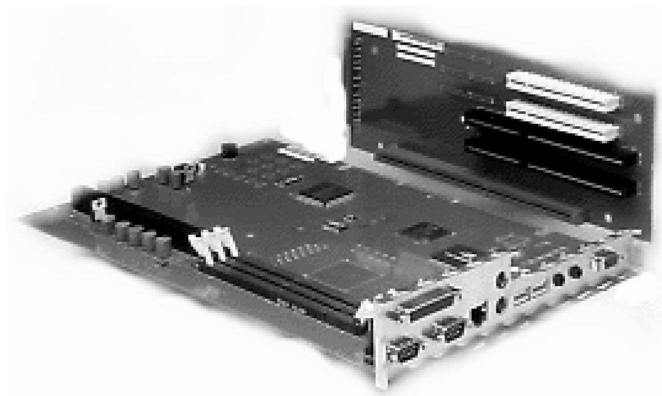
The baby AT used to be the most commonly used design, but it has some fundamental problems. Because the processor and memory were in line with the expansion slots, only one or two full-length cards could be used. Also, the processor was far from the power supply's cooling fan and therefore tended to overheat unless a heatsink or processor fan was directly attached to it. To overcome the limitations of the baby AT design, the ATX motherboard was designed. The *ATX motherboard* has the processor and memory slots at right angles to the expansion cards. This arrangement puts the processor and memory in line with the fan output of the power supply, allowing the processor to run cooler. And, because those components are not in line with the expansion cards, you can install full-length expansion cards in an ATX motherboard machine. AT motherboards are rarely found for sale because ATX (and its derivatives) are the primary motherboards sold today.

Also, because the AT and ATX have different board layouts for their components and expansion slots, they will have different case layouts for the cutouts where expansion ports and slots go at the back of the case. Therefore, an ATX motherboard will not fit into a case designed for an AT motherboard (and vice versa).

NOTE The line between integrated and nonintegrated system boards is quickly becoming blurred. Many of what would normally be called nonintegrated system boards now incorporate the most commonly used circuitry (such as IDE and floppy controllers, serial controllers, and sound cards) onto the motherboard itself.

A fairly new motherboard form factor that has been gaining popularity in the last couple of years is *NLX*. This form factor is used in low-profile case types. NLX motherboards are unique because the expansion slots are placed sideways on a special *riser card* (as shown in Figure 1.15) to use the space optimally.

**FIGURE 1.15** An NLX motherboard with riser card



These motherboard form factors are usually found in what are known as *clone* computers (those not manufactured by a Fortune 500 PC company). Some manufacturers (such as Compaq and IBM) design and manufacture their own motherboards, which don't conform to either the AT or ATX standard. This style of motherboard is known as a *proprietary design* motherboard.

NOTE: There are other motherboard designs, but these are the most popular and also the ones that are covered on the exam.

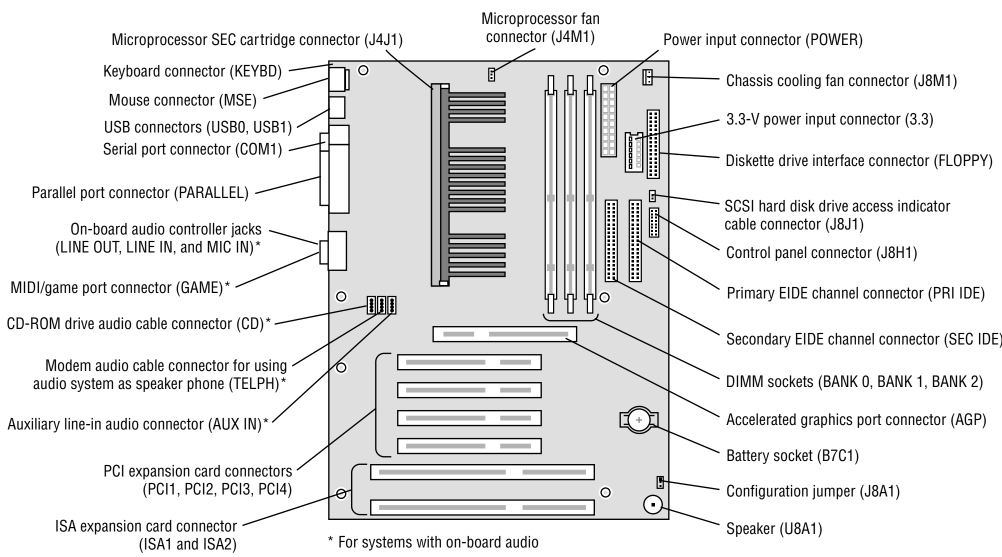
## System Board Components

Now that you understand the basic types of motherboards and their form factors, it's time to look at the components found on the motherboard and their locations relative to each other. Figure 1.16 illustrates many of the following components found on a typical motherboard:

- Expansion slots
- Memory slots
- CPU and processor slots or sockets
- Power connectors
- On-board disk drive connectors
- Keyboard connectors
- Peripheral port and connectors
- BIOS chip

- CMOS battery
- Jumpers and DIP switches
- Firmware

**FIGURE 1.16** Components on a motherboard




In this subsection, you will learn about the most-used components of a motherboard, what they do, and where they are located on the motherboard. We'll show what each component looks like so you can identify it on any motherboard you run across. Note, however, that this is just a brief introduction to the insides of a computer. The details of the various devices in the computer and their impact on computer service practices will be covered in later chapters.

## Expansion Slots

The most visible parts of any motherboard are the *expansion slots*. These look like small plastic slots, usually from 3 to 11 inches long and approximately 1/2 inch wide. As their name suggests, these slots are used to install various devices in the computer to expand its capabilities. Some expansion devices that might be installed in these slots include video, network, sound, and disk interface cards.

If you look at the motherboard in your computer, you will more than likely see one of three main types of expansion slots used in computers today:

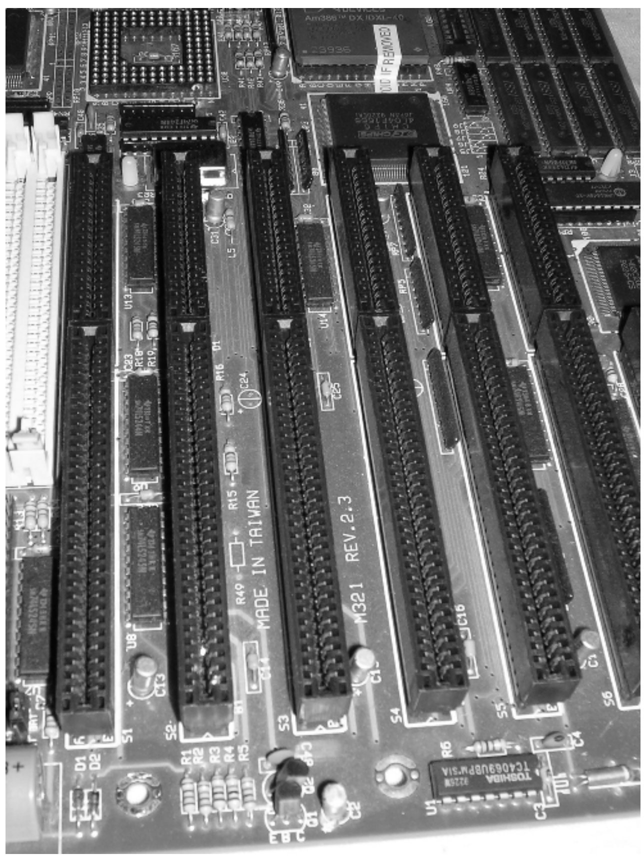
- ISA
- PCI
- AGP

Each type differs in appearance and function, as you'll learn more about in Chapter 2, "Motherboards, CPUs, and RAM." In this chapter, we will cover how to visually identify the different expansion slots on the motherboard.

### ISA Expansion Slots

If you have a computer made before 1997, chances are the motherboard has a few *Industry Standard Architecture (ISA) expansion slots*. They're easily recognizable, because they are usually black and have two parts: one shorter and one longer. Computers made after 1997 generally include a few ISA slots for backward compatibility with old expansion cards (although most computers are phasing them out in favor of PCI). Figure 1.17 shows an example of ISA expansion slots.

**FIGURE 1.17** ISA expansion slots

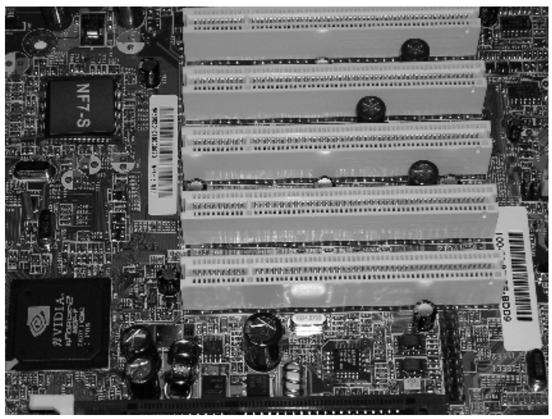



NOTE VL-Bus, an expansion of ISA, was designed to provide 32-bit, processor-direct capabilities to ISA. You will learn more about ISA and VL-Bus in Chapter 2.

### PCI Expansion Slots

Most computers made today contain primarily *Peripheral Component Interconnect* (PCI) slots. They are easily recognizable, because they are short (around 3 inches long) and usually white. PCI slots can usually be found in any computer that has a Pentium-class processor or higher. Figure 1.18 shows an example of several PCI expansion slots.

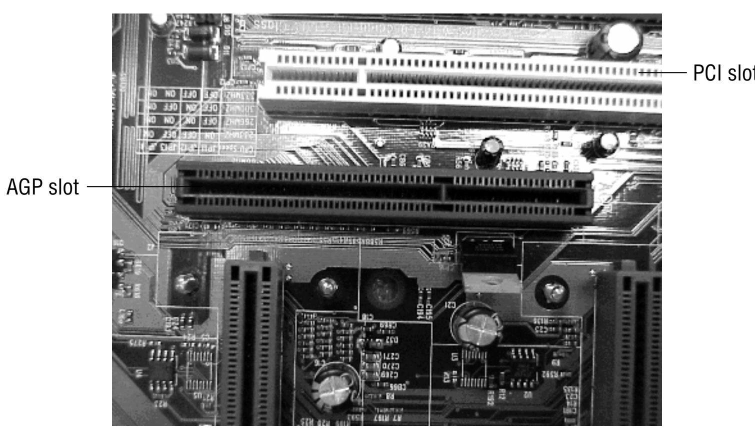
**FIGURE 1.18** PCI expansion slots




### AGP Expansion Slots

*Accelerated Graphics Port (AGP)* slots are becoming more popular. In the past, if you wanted to use a high-speed, accelerated 3D graphics video card, you had to install the card into an existing PCI or ISA slot. AGP slots were designed to be a direct connection between the video circuitry and the PC's memory. They are also easily recognizable, because they are usually brown, are located right next to the PCI slots on the motherboard, and are shorter than the PCI slots. Figure 1.19 shows an example of an AGP slot, along with a PCI slot for comparison. Notice the difference in length between the two.

**FIGURE 1.19** An AGP slot compared to a PCI slot



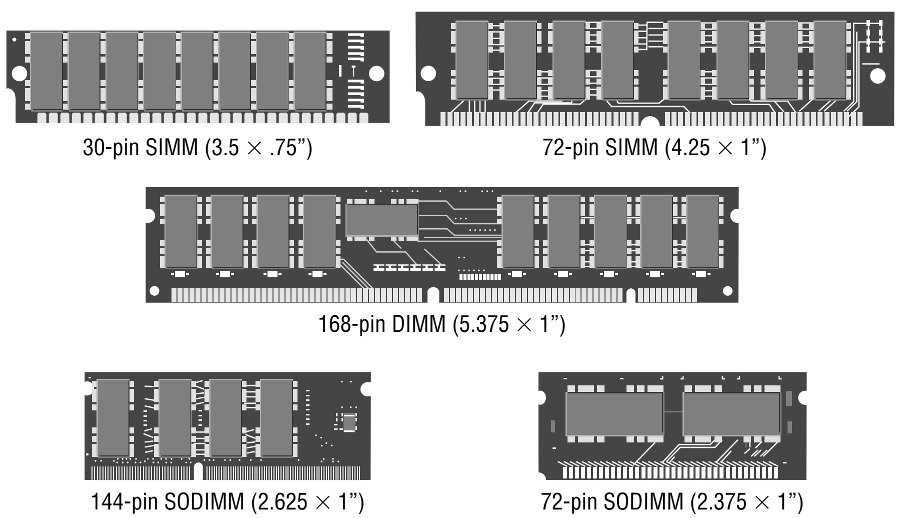
You will learn more about the details of the various expansion bus types and the expansion cards that go in them in Chapter 2.

## Memory Slots

Memory or random access memory (RAM) slots are the next most prolific slots on a motherboard, and they contain the memory chips. Many and varied types of memory are available for PCs today. In this chapter, you will learn the appearance of the slots on the motherboard, so you can identify them. You will learn more about the details of the different types of PC memory in Chapter 2.

For the most part, PCs today use memory chips arranged on a small circuit board. These circuit boards are called *Single Inline Memory Modules (SIMMs)* or *Dual Inline Memory Modules (DIMMs)*, depending on whether there are chips on one side of the circuit board or on both sides, respectively. Aside from the difference in chip placement, memory modules also differ in the number of conductors, or *pins*, that the particular memory module uses. Some common examples include 30-pin, 72-pin, and 168-pin (the 168-pin modules are most often DIMMs). Additionally, laptop memory comes in smaller form factors known as Small Outline DIMMs (SODIMMs). Figure 1.20 shows the popular form factors for the most popular memory chips. Notice how they basically look the same, but the memory module sizes are different.

**FIGURE 1.20** Different memory module form factors



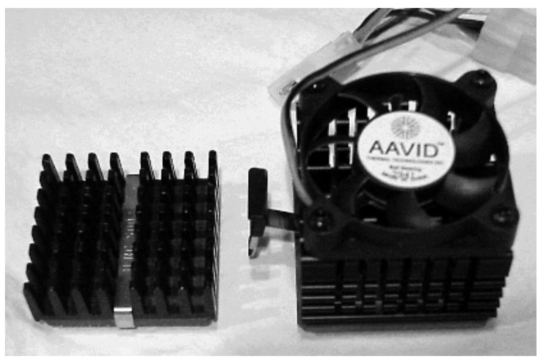

Memory slots are easy to identify on a motherboard. SIMMS are usually white; DIMMS are usually black and placed very close together. The number of memory slots varies from motherboard to motherboard, but the appearance of the different slots is similar. Metal pins in the bottom make contact with the soldered tabs on each memory module. Small metal or plastic tabs on each side of the slot keep the memory module securely in its slot.

## Central Processing Unit (CPU) and Processor Socket or Slot

The "brain" of any computer is the *Central Processing Unit (CPU)*. This component does all the calculations and performs 90 percent of all the functions of a computer. There are many different types of processors for computers—so many, in fact, that you will learn about them later in this chapter in the section "The Processor/CPU."

Typically, in today's computers, the processor is the easiest component to identify on the motherboard. It is usually the component that has either a fan or a heatsink (sometimes both) attached to it (as shown in Figure 1.21). These devices are used to draw away the heat a processor generates. This is done because heat is the enemy of microelectronics. Theoretically, a Pentium (or higher) processor generates enough heat that without the heatsink, it would self-destruct in a matter of hours.

**FIGURE 1.21** A processor with a fan and a processor with a heatsink




Sockets and slots on the motherboard are as plentiful and varied as processors. Sockets are basically flat and have several rows of holes arranged in a square, as shown in Figure 1.22. The processor slot is another method of connecting a processor to a motherboard, but one into which an Intel Pentium II or Pentium III–class processor on a special expansion card can be inserted (as shown in Figure 1.23). To see which socket type is used for which processors, examine Table 1.2.

**FIGURE 1.22** An example of a CPU socket

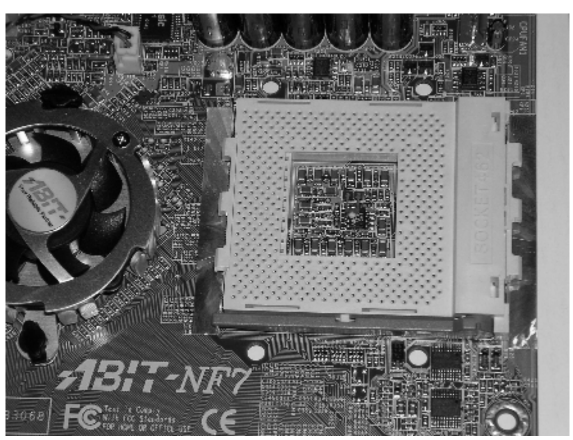


**FIGURE 1.23** A Slot-1 connector slot

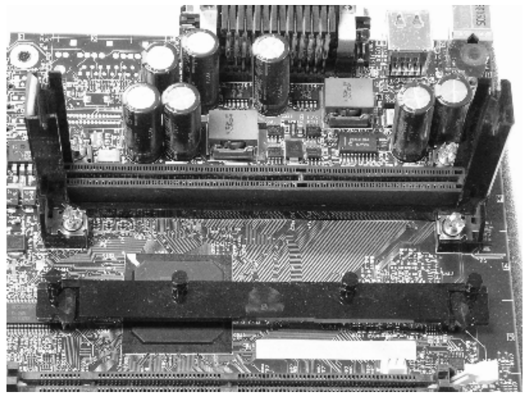


**TABLE 1.2** Socket Types and the Processors They Support

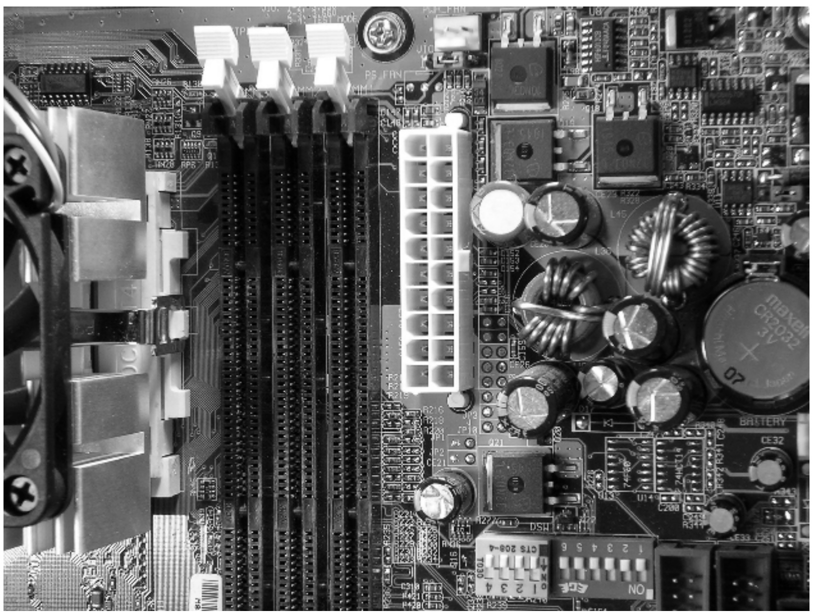
| Connector Type | Processors |
|---|---|
| Socket 4 | Pentium 60/66, Pentium 60/66, OverDrive |
| Socket 5 | Pentium 75-133, Pentium 75+ OverDrive |
| Socket 6* | DX4, 486 Pentium OverDrive |
| Socket 7 | Pentium 75-200, Pentium 75+ OverDrive, AMD K6-2, K6-3 |
| Socket 8 | Pentium Pro |
| Slot 1 | Pentium II, Pentium III, and all SECC and SECC2 |
| Slot 2 | Pentium XEON only |
| Slot A | Early AMD Athlon |
| Socket 370 | PPGA processors, including Celeron |
| Socket A (socket 462) | AMD Athlon/Thunderbird/XP/Duron |
| Socket-423 | Early Pentium IV |
| Socket 478 | Pentium IV |

*Socket 6 was a paper standard only and was never implemented in any systems.

## Power Connectors

In addition to these sockets and slots on the motherboard, a special connector (shown in Figure 1.24) allows the motherboard to be connected to the power supply to receive power. This connector is where the ATX power connector (mentioned earlier in this chapter in the section “The Power Supply”) plugs in.

**FIGURE 1.24** An ATX power connector on a motherboard




## On-Board Floppy and Hard Disk Connectors

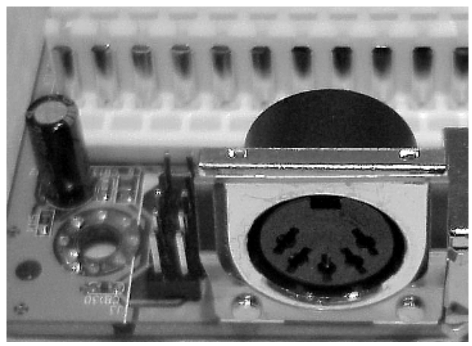
Almost every computer made today uses some type of disk drive to store data and programs until they are needed. You’ll learn the exact details of how they work later in Chapter 3. Most drives need a connection to the motherboard so the computer can “talk” to the disk drive. These connections are known as *drive interfaces*, and there are two main types: *floppy drive interfaces* and *hard disk interfaces*. Floppy disk interfaces allow floppy disk drives to be connected to the motherboard and, similarly, hard disk interfaces do the same for hard disks. When you see them on the motherboard, these interfaces are said to be *on board*, as opposed to being on an expansion card (*off board*). The interfaces consist of circuitry and a port. Most motherboards produced today include both the floppy disk and hard disk interfaces on the motherboard.

**NOTE** The differences and compatibility between the different types of hard disk interfaces will be covered in Chapter 2.

## Keyboard Connectors

The most important input device for a PC is the keyboard. All PC motherboards contain a connector (as shown in Figure 1.25) that allows a keyboard to be connected directly to the motherboard through the case. There are two main types of keyboard connectors: AT and PS/2. The AT connector is round, about 1/2 inch in diameter, and has five sockets in the DIN-5 configuration.

**FIGURE 1.25** An AT connector on a motherboard

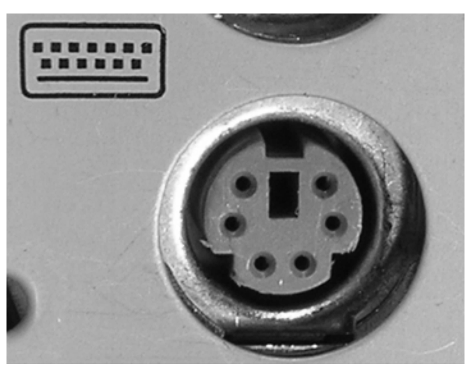


The PS/2 connector (as shown in Figure 1.26) is smaller and more common than the AT connector. Most new PCs you can purchase today contain a PS/2 keyboard connector as well as a PS/2 mouse connector right above it on the motherboard. Compare your PC's keyboard connector with Figures 1.25 and 1.26.

NOTE

The newest motherboards have color coded the PS/2 mouse and keyboard connectors to make connection of keyboards and mice easier. PS/2 mouse connectors are green (to match the standard green connectors on some mice) and the keyboard connectors are purple.

**FIGURE 1.26** A PS/2-style keyboard connector on a motherboard



## Peripheral Ports and Connectors

In order for a computer to be useful and have the most functionality, there must be a way to get the data into and out of it. Many different ports are available for this purpose. We will discuss the different types of ports and how they work later in this chapter.

Briefly, the seven most common types of ports you will see on a computer are serial, parallel, Universal Serial Bus (USB), video, Ethernet, sound in/out, and game ports. Figure 1.27 shows an example of the two different types of *serial ports*: 9-pin male and 25-pin male. Figure 1.28 shows a typical *parallel port* (also called a *printer port*, because the most common peripheral connected to it is a printer). *Universal Serial Bus (USB)* ports look slightly different, as shown in Figure 1.29. *Video (SVGA) ports* (as shown in Figure 1.30) are found on motherboards that have built-in video circuitry to allow the computer to display images on a monitor. The video port is typically a 15-pin, three row, female connector. If your motherboard has an Ethernet network adapter integrated into its circuitry, you may see an *Ethernet port* (Figure 1.31), an RJ-45 port, attached to the motherboard. Finally, Figure 1.32 shows an example of a *game port* (also called a *joystick port* because that's the most common device connected to it). Game ports are used to connect peripheral devices to the computer and use a 15-pin female connector.

**FIGURE 1.27** Typical 9-pin and 25-pin serial ports

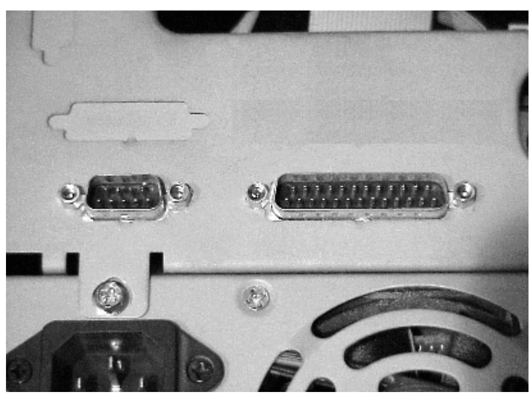


**FIGURE 1.28** A parallel port

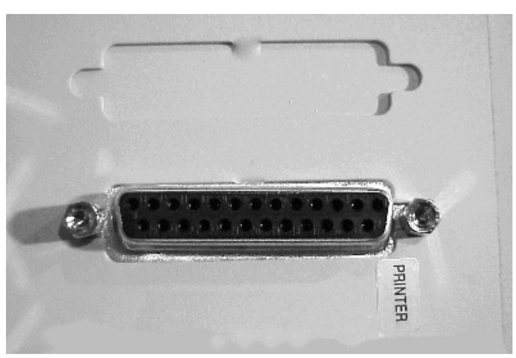


**FIGURE 1.29** A Universal Serial Bus (USB) port

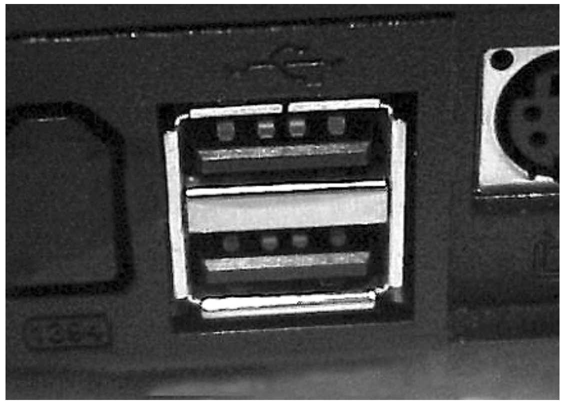


**FIGURE 1.30** A video port

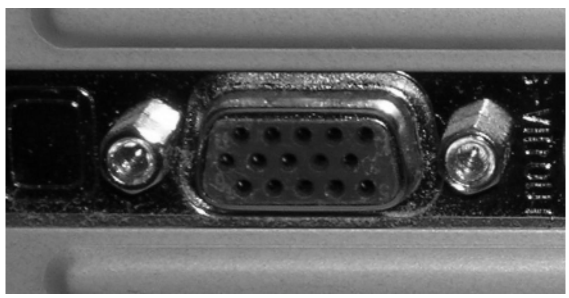


**FIGURE 1.31** An Ethernet port

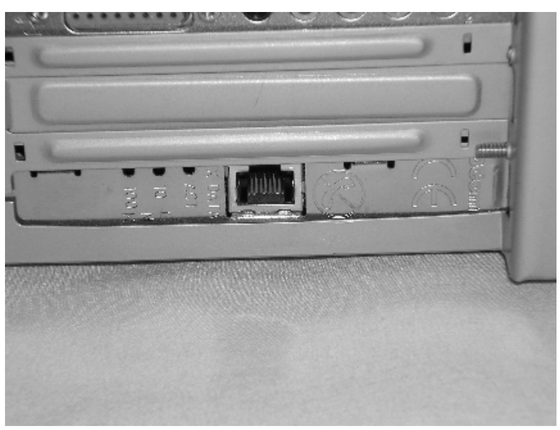
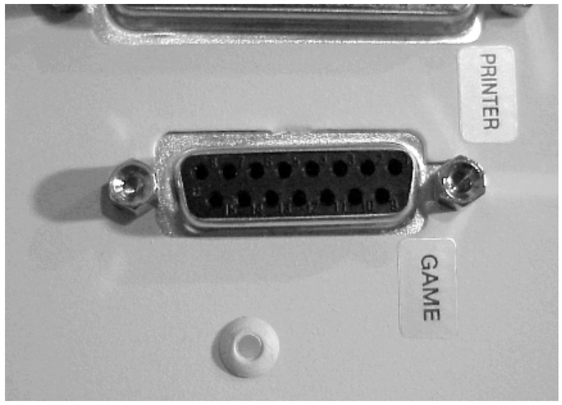
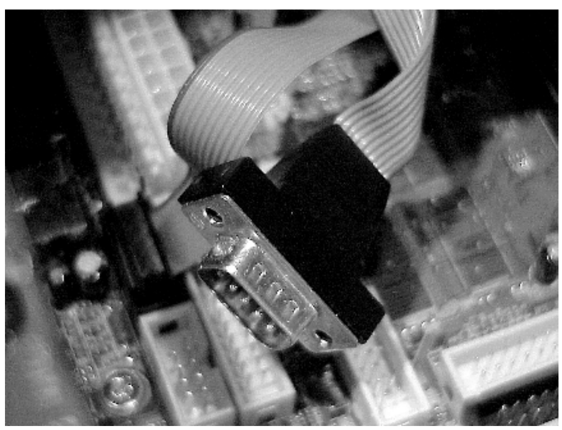


**FIGURE 1.32** A game port



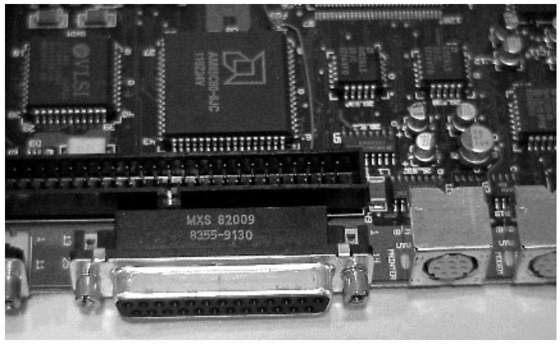

There are two ways of connecting these ports to the motherboard (assuming the circuitry for providing these functions is integrated into the motherboard). The first, called a *dongle connection*, allows you to mount the ports into the computer's case with a special cable (called a *dongle*). The dongle for each port connects to the respective pins on the motherboard for that port (as shown in Figure 1.33).

**FIGURE 1.33** Connecting a port to the motherboard with the dongle method



The second method of connecting a peripheral port is known as the *direct-solder method*. With this method, the individual ports are soldered directly to the motherboard. This method is used mostly in integrated motherboards in non-clone machines. Figure 1.34 shows peripheral ports connected to a motherboard with the direct solder method. Notice that there is no cable between the port and the motherboard and that the port is part of the motherboard. As discussed earlier, these onboard ports can be disabled in the BIOS setup if necessary.

**FIGURE 1.34** Peripheral ports directly soldered to a motherboard




## BIOS Chip

Aside from the processor, the most important chip on the motherboard is the basic input/output system (BIOS) chip. This special memory chip contains the BIOS software that tells the processor how to interact with the rest of the hardware in the computer. The BIOS chip is easily identified: If you have a non-clone computer (Compaq, IBM, HP, and so on), this chip has on it the name of the manufacturer and usually the word *BIOS*. For example, the BIOS chip for a Compaq has something like *Compaq BIOS* printed on it. For clones, the chip usually has a sticker or printing on it from one of the three major BIOS manufacturers (AMI, Phoenix, or Award).

TIP: If you can't find the BIOS chip with these guidelines, look for a fairly large chip close to the CPU.

## CMOS Battery

Your PC has to keep certain settings when it's turned off and its power cord is unplugged. Some of these settings include:

- Date
- Time
- Hard drive configuration
- Memory

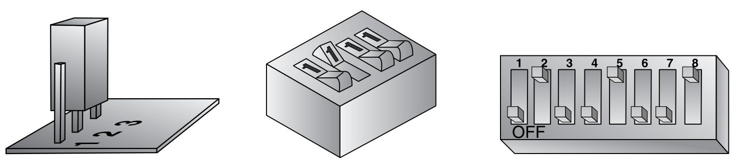
Your PC keeps these settings in a special memory chip called the Complimentary Metal-Oxide Semiconductor (CMOS) chip. Actually, CMOS (usually pronounced *see-moss*) is a type of memory chip; it is the parameter memory for the BIOS. But that doesn't translate into an easy-to-say acronym. So, because it's the most important CMOS chip in the computer, it has come to be called the CMOS.

To keep its settings, the memory must have power constantly. When you shut off a computer, anything that is left in main memory is lost forever. To prevent CMOS from losing its information (and it's rather important that it doesn't), motherboard manufacturers include a small battery called the *CMOS battery* to power the CMOS memory. The batteries come in different shapes and sizes, but they all perform the same function. CMOS batteries come in different styles and sizes, but most look like either large watch batteries or small, cylindrical batteries.

### Jumpers and DIP Switches

The last components of the motherboard we will discuss in this section are jumpers and DIP switches. These two devices are used to configure various hardware options on the motherboard. For example, some processors use different voltages (either 3.3 volts or 5 volts). You must set the motherboard to provide the correct voltage for the processor it is using. You do so by changing a setting on the motherboard with either a jumper or a DIP switch. Figure 1.35 shows both a jumper set and DIP switches. Motherboards often have either several jumpers or one bank of DIP switches. Individual jumpers are often labeled with the moniker JP*x* (where *x* is the number of the jumper).

**FIGURE 1.35** Jumpers and DIP switches




NOTE

Many of the motherboard settings that were set using jumpers and dip switches are now either automatically detected or set manually in the CMOS setup program.

### Firmware

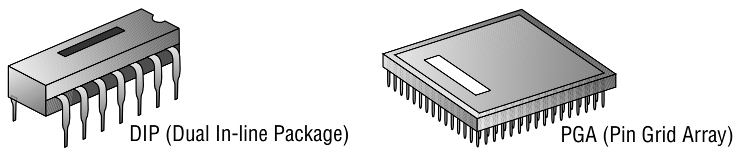
*Firmware* is the name given to any software that is encoded into a read-only memory (ROM) chip and can be run without extra instructions from the operating system. Most computers use firmware in some limited sense. The best example of firmware is a computer's CMOS setup program, which is used to set the options for the computer's BIOS (time/date and boot options, for example). Also, some expansion cards (like Small Computer System Interface [SCSI] cards) use their own firmware utilities for setting up peripherals.

# The Processor/CPU

Now that you've learned the basics of the motherboard, you need to learn about the most important component on the motherboard: the CPU. The role of the CPU, or central processing unit, is to control and direct all the activities of the computer using both external and internal buses. It is a processor chip consisting of an array of *millions* of transistors.

Older CPUs are generally square, with transistors arranged in a Pin Grid Array (PGA). Prior to 1981, chips were found in a rectangle with two rows of 20 pins known as a Dual Inline Package (DIP). See Figure 1.36. There are still integrated circuits that use the DIP form factor. However, the DIP form factor is no longer used for PC CPUs. Most CPUs use either the PGA or the Single Edge Contact Card (SECC) form factor. SECC is essentially a PGA-type socket on a special expansion card.

**FIGURE 1.36** DIP and PGA




You can easily identify which component inside the computer is the CPU, because it is a large square lying flat on the motherboard with a very large heatsink and fan (as shown earlier in Figure 1.21). Or, if the CPU is installed in a Slot 1 motherboard, it is a large 1/2-inch thick expansion card with a large heatsink and fan integrated into the package. It is located away from the expansion cards. Figure 1.37 shows the location of the CPU in relation to the other components on a typical ATX motherboard. Notice how prominent the CPU is.

**FIGURE 1.37** The location of a CPU inside a typical computer


NOTE: CPU chips, their manufacturers, and their specifications will be covered in much more detail in Chapter 2.

**Real World Scenario**

**What's Your CPU?**

The surest way to determine which CPU your computer is using is to open the case and view the numbers stamped on the CPU. However, you may be able to get an idea without opening the case, because many manufacturers indicate the type of processor by using a model number that contains some combination of numbers for the processor type and speed. For example, a Whizbang 466 could be a 486 DX 66MHz computer. Similarly, a 75MHz Pentium computer might be labeled Whizbang 575.

Another way to determine a computer's CPU is to save your work, exit any open programs, and restart the computer. Watch closely as the computer returns to its normal state. You should see a notation that tells you what chip you are using. If you are using MS-DOS, you can also run Microsoft Diagnostics to view the processor type (that is, unless your computer has a Pentium, in which case it will report a very fast 486).

# Memory

"More memory, more memory, I don't have enough memory!" Today, memory is one of the most popular, easy, and inexpensive ways to upgrade a computer. As the computer's CPU works, it stores information in the computer's memory. The rule of thumb is, the more memory a computer has, the faster it will operate. In this brief section we'll outline the four major types of computer memory: DRAM, SRAM, ROM, and CMOS. (Memory will also be covered in more detail in Chapter 2.)

To identify memory within a computer, look for several thin rows of small circuit boards sitting vertically, packed tightly together near the processor. Figure 1.38 shows where memory is located in a system.

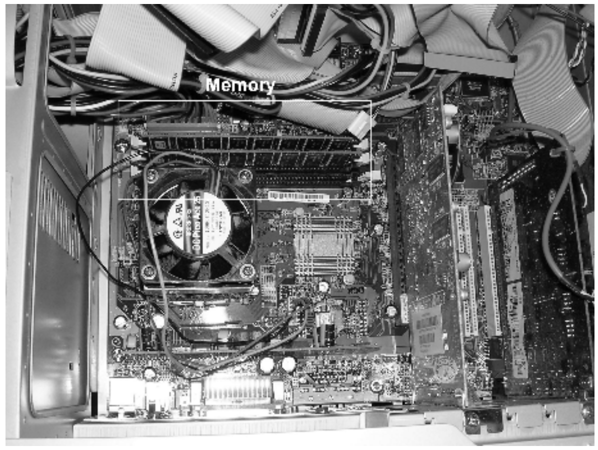
## DRAM

DRAM is dynamic random access memory. (This is what most people are talking about when they mention RAM.) When you expand the memory in a computer, you are adding DRAM chips. You use DRAM to expand the memory in the computer because it's cheaper than any other type of memory. Dynamic RAM chips are cheaper to manufacture than other types because they are less complex. *Dynamic* refers to the memory chips' need for a constant update signal (also called a *refresh* signal) in order to keep the information that is written there. If this signal is not received every so often, the information will cease to exist.

## SRAM

The *S* in SRAM stands for *static*. Static random access memory doesn't require a refresh signal like DRAM. The chips are more complex and are thus more expensive. However, they are faster. DRAM access times come in at 80 nanoseconds (ns) or more; SRAM has access times of 15 to 20 ns. SRAM is often used for cache memory.

**FIGURE 1.38** Location of memory within a system




## ROM

ROM stands for read-only memory. It is called read-only because it can't be written to. Once information has been written to the ROM, it can't be changed. ROM is normally used to store the computer's BIOS, because this information normally does not change.

The system ROM in the original IBM PC contained the Power-On Self Test (POST), basic input/output system (BIOS), and cassette BASIC. Later IBM computers and compatibles include everything but the cassette BASIC. The system ROM enables the computer to "pull itself up by its bootstraps," or *boot* (start the operating system).

## CMOS

CMOS is a special kind of memory that holds the BIOS configuration settings. CMOS memory is powered by a small battery so the settings are retained when the computer is shut off. The BIOS reads information such as which hard drive types are configured for this computer to use, which drive(s) it should search for boot sectors, and so on. CMOS memory is usually *not* upgradeable in terms of its capacity.

# Storage Devices

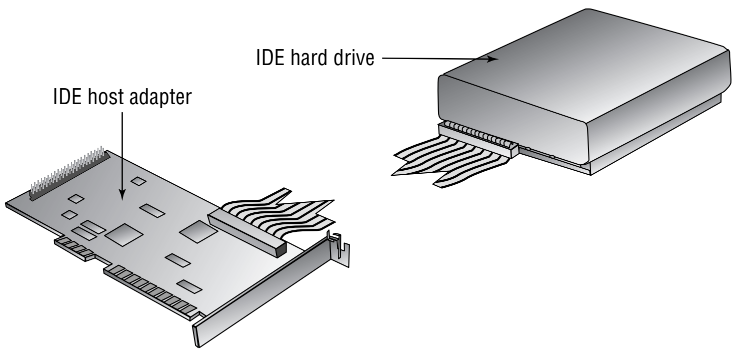
What good is a computer without a place to put everything? Storage media hold the data being accessed, as well as the files the system needs to operate and data that needs to be saved. The many different types of storage differ in terms of their capacity (how much they can store), access time (how fast the computer can access the information), and the physical type of media used.

NOTE These storage devices will be covered in depth in Chapter 3.

## Hard Disk Systems

Hard disk systems are used for permanent storage and quick access (Figure 1.39). Hard disks typically reside inside the computer (although there are external and removable hard drives) and can hold more information than other forms of storage.

**FIGURE 1.39** A hard disk system




The hard disk system contains three critical components:

**Controller** Controls the drive. It understands how the drive operates, sends signals to the various motors in the disk, and receives signals from the sensors inside the drive.

**Hard disk** The physical storage medium. Hard disk systems store information on small disks (between three and five inches in diameter) stacked together and placed in an enclosure.

**Host adapter** The translator, converting signals from the hard drive and controller to signals the computer can understand.

Most of today's hard disk technologies incorporate the controller and drive into one enclosure. (For more information on disk types, see Chapter 3.) In addition, most motherboards incorporate the host adapter into the motherboard's circuitry.

## Floppy Drives

A *floppy disk* is a magnetic storage medium that uses a flexible diskette made of a thin plastic encased in a protective casing. The floppy disk itself enables the information to be transported from one computer to another very easily. There are two main types of floppy disks. The floppy disk, which is 5 1/4 inches square, is the older style; the *diskette* is a disk that is 3 1/2 inches square. Most computers today use diskettes.

NOTE Generally speaking, throughout this book we will use the term *floppy drive* to refer to a 3½-inch diskette drive.

A *floppy drive* (shown in Figure 1.40) is used to read and write information to and from these drives. The advantage of these drives is that they allow portability of data (you can transfer data from one computer to another on a diskette). The downside of a floppy disk drive is its limited storage capacity. Whereas a hard drive can store hundreds of gigabytes of information, most floppy disks were designed to store only about one megabyte. Table 1.3 shows the five different floppy disk drive formats you may run into, with five corresponding diskette sizes supported in PC systems.

**FIGURE 1.40** A floppy disk drive

NOTE Drives that offer anything less than 1.2MB are increasingly rare, because most computers today do not carry the 5¼-inch size. Some are even eliminating floppy drives altogether in favor of larger capacity CD-R and CD-RW drives (as well as other larger capacity removable media drive like the ZIP drive).

**TABLE 1.3** Floppy Disk Capacities

| Floppy Drive Size | Number of Tracks | Capacity |
|---|---|---|
| 5¼" | 40 | 360KB |
| 5¼" | 80 | 1.2MB |
| 3½" | 80 | 720KB |
| 3½" | 80 | 1.44MB |
| 3½" | 80 | 2.88MB |

## CD-ROM Drives

Most computers today have a CD-ROM (Compact Disc Read-Only Memory) drive. The compact disks are virtually the same as those used in CD players. The CD-ROM is used to store data for long-term storage. CD-ROMs are read-only, meaning that once information is written to a CD, it can't be erased or changed. Also, it takes much longer to access the information than it does to access data residing on a hard drive. Why, then, are CD-ROMS so popular? Mainly because they make a great software distribution medium. Programs are always getting larger and requiring more disks to install. Instead of installing a program using 100 floppy disks (a real possibility, believe me), you can use a single CD, which can hold approximately 650MB. (A second reason they are so popular is that CD-ROMs have been standardized across platforms, with the ISO 9660 standard.). Figure 1.41 shows an example of a typical CD-ROM drive.

**FIGURE 1.41** A typical CD-ROM drive

CD-ROM drives are rated in terms of their data transfer speed. The first CD-ROM drives transferred data at the same speed as home audio CD players, 150KBps. Soon after, CD drives rated as "2x" drives that would transfer data at 300KBps appeared (they just increased the spin speed in order to increase the data transfer rate). This system of ratings continued up until the 8x speed was reached. At that point, the CDs were spinning so fast that there was a danger of the CDs flying apart inside the drive. So, although future CD drives used the same rating (as in 16x, 32x, etc.), their rating was expressed in terms of theoretical maximum transfer rate. The drive isn't necessarily spinning faster or transferring data at 40 or 50 times 150KBps, it is just theoretically possible using the drive's increased buffers and so on.

## CD-R and CD-RW Drives

*CD-Recordable (CD-R) and CD-Rewriteable (CD-RW) drives* (also known as CD *burners*) are essentially CD-ROM drives that allow a user to create (or *burn*) their own CD-ROMs. They look very similar to CD-ROM drives, except the front panel of the drive includes a reference to either CD-R or CD-RW.

The difference between these two types of drives is that CD-R drives can write to a CD only once. A CD-RW can erase information from a disk and rewrite to it multiple times. Also, CR-RW drives are rated according to their read, write, and rewrite times. So, instead of a single rating like 40x, they have a rating of 32x-16x-4x, which means it reads at 32x, writes at 16x, and rewrites at 4x.

## DVD-ROM Drives

A new type of drive is finding its way into computers: the DVD-ROM drive. You have probably heard of DVD (Digital Versatile Disc) technology in use in many home theater systems. A DVD-ROM drive is basically the same as the DVD player's drive in a home theater system. As a result, a computer equipped with a DVD-ROM drive and the proper video card can play back DVD movies on the monitor.

However, in a computer, a DVD-ROM drive is much more useful. Because DVD-ROMs use slightly different technology than CD-ROMs, they can store up to 4.3GB of data. This makes them a better choice for distributing large software bundles. Many software packages today are so huge they take multiple CD-ROMs to hold all the installation and reference files. A single DVD-ROM, in a double-sided, double-layered configuration, can hold as much as 17GB (as much as 26 regular CD-ROMs).

A DVD-ROM drive looks very similar to a CD-ROM drive. The only difference is the DVD logo on the front of most drives.

## DVD Burners

A DVD burner operates it a similar manner to a CD-R or CD-RW drive: It can store large amounts of data onto a DVD. However, there are many different standards for DVD burners; as they mature, we hope a clear leader will emerge.

## Other Storage Media

Many additional types of storage are available for PCs today. However, most of them are not covered on the A+ exam, so we'll just discuss them briefly here. Among the other types of storage are Zip drives, tape backup devices, and optical drives. There are also external hard drives like the Kangaru drives, and new storage media like the USB memory sticks that can store 128 to 256MB on a single small plastic device that can be carried on a keychain.

### Zip Drives and Jaz Drives

Iomega's Zip and Jaz drives are detachable, external hard disks that are used to store a large volume (around 100MB for the Zip, 1 and 2GB for the Jaz) of data on a single, floppy-sized disk. New Zip drives hold up to 250MB of data. The drives connect to either a parallel port or a special interface card. Internal Zip drives are IDE. Zip and Jaz drives are used primarily to transport large amounts of data from place to place, a task that used to be accomplished with numerous floppies.

### Tape Backup Devices

Another form of storage device is the tape backup. Tape backup devices can be installed internally or externally and use a magnetic tape medium instead of disks for storage. They hold much more data than any other medium, but are also much slower. They are primarily used for archival storage.

With hard disks, it's not a matter of "if they fail"; it's "when they fail." So, you must back up the information onto some other storage medium. Tape backup devices are the most common choice in larger enterprises and networks, because they can hold the most data and are the most reliable over the long term.

### Optical Drives

Optical drives work by using a laser rather than magnetism to change the characteristics of the storage medium (typically an aluminum-coated plastic disk). Optical drives look similar to and are used for the same applications as Zip drives (archival storage and large file transport). However, optical drives can store more information and have slower access times than Zip drives.

# Adapter Cards

An *adapter card* (also known as an *expansion card*) is simply a circuit board you install into a computer to increase the capabilities of that computer. Adapter cards come in many different kinds, but the important thing to note is that no matter what function a card has, the card being installed must match the bus type of the motherboard you are installing it into (for example, you can only install a PCI network card into a PCI expansion slot).

Four of the most common expansion cards that are installed today are as follows:

- Video card
- Network interface card (NIC)
- Modem
- Sound card

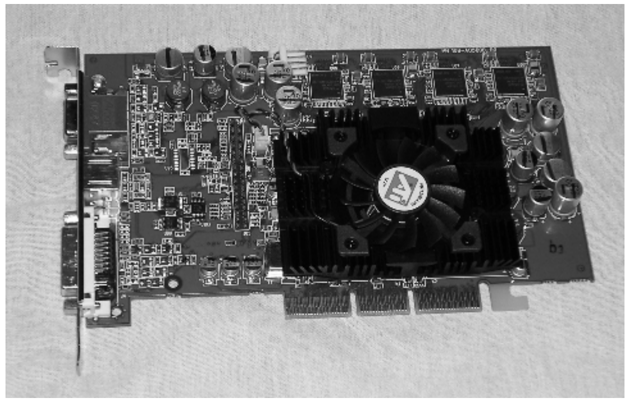
Let's take a quick look at each of these cards, their functions, and what they look like.

## Video Card

A *video adapter* (more commonly called a *video card*) is the expansion card you put into a computer in order to allow the computer to display information on some kind of monitor or LCD display. A video card also is responsible for converting the data sent to it by the CPU into the pixels, addresses, and other items required for display. Sometimes, video cards can include dedicated chips to perform certain of these functions, thus accelerating the speed of display.

With today's motherboards, most video cards are AGP expansion cards that fit in the AGP slot on a motherboard. Figure 1.42 shows an example of a video card.

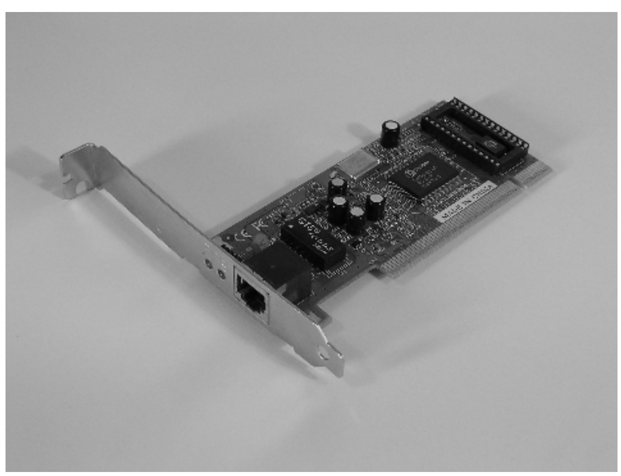
**FIGURE 1.42** A video expansion card



## Network Interface Card (NIC)

A *network interface card (NIC)* is an expansion card that connects a computer to a network so that it can communicate with other computers on that network. It translates the data from the parallel data stream used inside the computer into the serial data stream of packets used on the network. It has a connector for the type of expansion bus on the motherboard (PCI or ISA) as well as a connector for the type of network (such as RJ-45 for UTP or BNC for coax). In addition to the NIC, you need to install software or drivers on the computer in order for the computer to use the network. Figure 1.43 shows an example of a NIC.

**FIGURE 1.43** A network interface card (NIC)

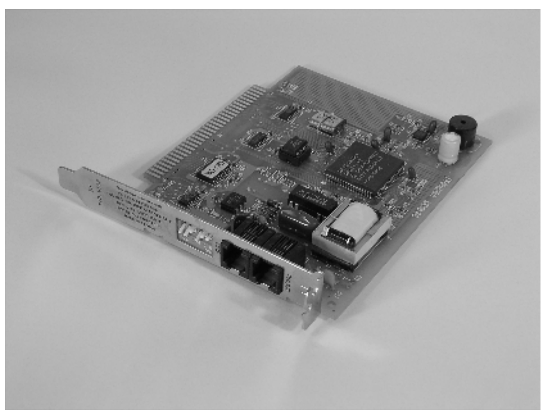


**NOTE** Some computers have NIC circuitry integrated into their motherboards. Therefore, a computer with an integrated NIC wouldn't need to have a NIC expansion card installed, unless you were using the second NIC for load balancing or fault tolerant applications.

## Modem

Any computer that connects to the Internet via a dial-up connection needs a modem. A *modem* is a device that converts digital signals from a computer into analog signals that can be transmitted over phone lines and back again. These expansion card devices have one connector for the expansion bus being used (PCI or ISA) and another for connection to the telephone line. Actually, as you can see in Figure 1.44, there are two RJ-11 ports: one for connection to the telephone line and the other for connection to a telephone. This is the case primarily so that putting a computer online still lets someone hook a phone to that wall jack (although they won't be able to use the phone while the computer is connected to the Internet).

**FIGURE 1.44** A modem

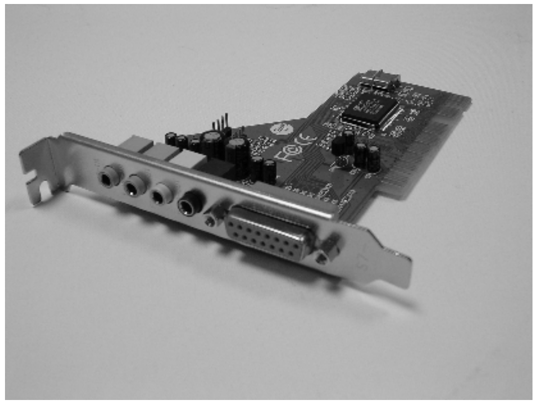


## Sound Card

Just as there are devices to convert computer signals into printouts and video information, there are devices to convert those signals into sound. These devices are known as *sound cards*. Many different manufacturers make sound cards, but the standard has been set by Creative Labs with its SoundBlaster series of cards.

A sound card typically has small, round, 1/8-inch jacks on the back of it for connecting to microphones, headphones, and speakers as well as other sound equipment. Many sound cards also have a DB-15 game port which can be used for either joysticks or Musical Instrument Digital Interface (MIDI) connections (allows a computer to talk to a digital musical instrument, like a digital keyboard or similar). Figure 1.45 shows an example of a sound card.

**FIGURE 1.45** A typical sound card



# Display Devices

The second way of getting information out of a computer is to use a computer display. Display systems convert computer signals into text and pictures and display them on a TV-like screen. As a matter of fact, the first personal computers used television screens because it was simple to use an existing display technology rather than to develop a new one. Several types of computer displays are in use today, including the TV. All of them use either the same *cathode ray tube (CRT)* technology found in television sets (almost every desktop monitor uses this technology) or the *liquid crystal display (LCD)* technology found on all laptop, notebook, and palmtop computers.

## Display Concepts

Several aspects of display systems make each type of display different. However, most display systems work the same way. First, the computer sends a signal to a device called the *video adapter*—an expansion board installed in an expansion bus slot—telling it to display a particular graphic or character. The adapter then *renders* the character for the display—that is, it converts the single instruction into several instructions that tell the display device how to draw the graphic—and sends the instructions to the display device. The primary differences after that are in the type of video adapter you are using (monochrome, EGA/CGA, VGA, or SuperVGA) and the type of display (CRT or LCD).

### Video Technologies

Let's first talk about the different types of video technologies. There are four major types: monochrome, EGA/CGA, VGA, and SuperVGA. Each type of video technology differs in two major areas: the highest resolution it supports and the maximum number of colors in its palette.

Resolution depends on how many picture units (called *pixels*) are used to draw the screen. The more pixels, the sharper the image. The resolution is described in terms of the screen's dimensions, indicating how many pixels across and down are used to draw the screen. For example, a resolution of 1,024 × 768 means 1,024 pixels across and 768 pixels down were used to draw the pixel grid. The video technology in this example would use 786,432 (1,024 × 768 = 786,432) pixels to draw the screen.

### Monochrome

The first video technology for PCs was *monochrome* (from the Latin *mono*, meaning one, and *chroma*, meaning color). This black-and-white video (actually, it was green and white or amber and black) was fine for the main operating system of the day, DOS. DOS didn't have any need for color. Thus, the video adapter was very basic. The first adapter, developed by IBM, was known as the Monochrome Display Adapter (MDA). It could display text but not graphics, and used a resolution of 720 × 350 pixels.

The Hercules Graphics Card (HGC), introduced by Hercules Computer Technology, had a resolution of 720 × 350 and could display graphics as well as text. It did this by using two separate modes: a *text mode* that allowed the adapter to optimize its resources for displaying predrawn characters from its onboard library, and a *graphics mode* that optimized the adapter for drawing individual pixels for on-screen graphics. It could switch between these modes on-the-fly. These modes of operation have been included in all graphics adapters since the introduction of the HGC.

### EGA and CGA

The next logical step for displays was to add a splash of color. IBM was the first with color, with the introduction of the Color Graphics Adapter (CGA). CGA could display text, but it displayed graphics with a resolution of only 320 × 200 pixels with four colors. It displayed a better resolution (640 × 200) with two colors—black and one other color. After a time, people wanted more colors and higher resolution, so IBM responded with the Enhanced Graphics Adapter (EGA). EGA could display 16 colors out of a palette of 64 with a resolution of 320 × 200 or 640 × 350 pixels.

These two technologies were the standard for color until the IBM AT was introduced. This PC was to be the standard for performance, so IBM wanted better video technology for it.

### VGA

With the PS/2 line of computers, IBM wanted to answer the cry for "more resolution, more colors" by introducing its best video adapter to date: the Video Graphics Array (VGA). This video technology had a whopping 256KB of video memory on board and could display 16 colors at 640 × 480 pixels or 256 colors at 320 × 200 pixels. It became widely used and has since become the standard for color PC video; it's the starting point for today's computers, as far as video is concerned. Your computer should use this video technology at minimum.

One unique feature of VGA is that it's an analog board. Thus the 256 colors it uses can be chosen from various shades and hues of a palette of 262,114 colors. VGA sold well mainly because users could choose from almost any color they wanted (or at least one that was close).

### SuperVGA

Up to this point, most video standards were set by IBM. IBM made the adapters, everyone bought them, and they became a standard. Some manufacturers didn't like this monopoly and set up the Video Electronics Standards Association (VESA) to try to enhance IBM's video technology and make the enhanced technology a public standard. The result of this work was SuperVGA (SVGA). This new standard was indeed an enhancement, because it could support 256 colors at a resolution of 800 × 600 (the VESA standard), or 1,024 × 768 pixels with 16 colors, or 640 × 480 with 65,536 colors.

### XGA

In the final development in this tale of "keeping up with the Joneses," IBM introduced a new technology in 1991 known as the Extended Graphics Array (XGA). This technology was only available as an Micro Channel Architecture (MCA) expansion board and not as an ISA or EISA board (MCA, ISA, and EISA are expansion bus technologies discussed in more detail in Chapter 2). (It was rather like IBM saying, "So there. You won't let me be the leader, so I'll lead my own team.") XGA could support 256 colors at 1,024 × 768 pixels or 65,536 colors at 640 × 480 pixels. It was a different design, optimized for GUIs like Windows or OS/2. It was also an *interlaced* technology, meaning that rather than scan every line one at a time to create the image, it scanned every other line on each pass, using the phenomenon known as *persistence of vision* to produce what appears to our eyes as a continuous image.

Table 1.4 details the various video technologies, their resolutions, and the color palettes they support.

**TABLE 1.4** Video Display Adapter Comparison

| Name | Resolutions | Colors |
|---|---|---|
| Monochrome Display Adapter (MDA) | 720 × 350 | Mono (text only) |
| Hercules Graphics Card (HGC) | 720 × 350 | Mono (text and graphics) |
| Color Graphics Adapter (CGA) | 320 × 200 | 4 |
| | 640 × 200 | 2 |
| Enhanced Graphics Adapter (EGA) | 320 × 200 | 16 |
| | 640 × 350 | |
| Video Graphics Array (VGA) | 640 × 480 | 16 |
| | 320 × 200 | 256 |

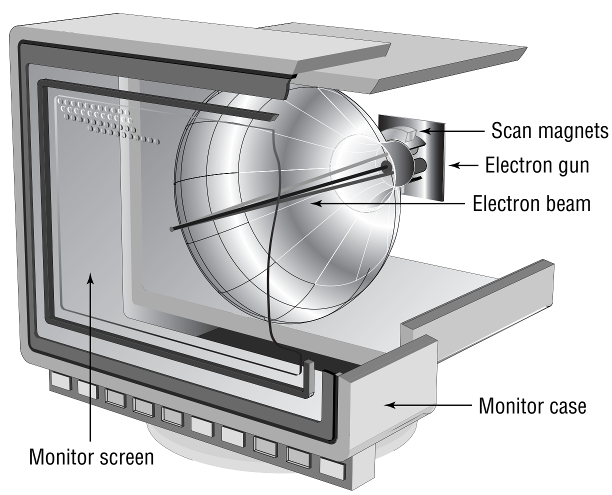
**TABLE 1.4** Video Display Adapter Comparison *(continued)*

| Name | Resolutions | Colors |
|---|---|---|
| SuperVGA (SVGA) | 640 × 480 | 65,536 |
| | 800 × 600 | 256 |
| | 1,024 × 768 | 16 |
| Extended Graphics Array (XGA) | 800 × 600 | 65,536 |
| | 1,024 × 768 | 256 |

## Monitors

As we have already mentioned, a monitor contains a CRT. But how does it work? Basically, a device called an *electron gun* shoots electrons toward the back side of the monitor screen (see Figure 1.46). The back of the screen is coated with special chemicals (called *phosphors*) that glow when electrons strike them. This beam of electrons scans across the monitor from left to right and top to bottom to create the image.

**FIGURE 1.46** How a monitor works




There are two ways to measure a monitor's image quality:

***Dot pitch*** The shortest distance between two dots of the same color on the monitor. Usually given in fractions of a millimeter (mm), the dot pitch tells how "sharp" the picture is. The lower the number, the closer together the pixels are, and, thus, the sharper the image. An average dot pitch is 0.28mm. Anything smaller than 0.28mm is considered great.

***Refresh rate*** (Technically called the *vertical scan frequency*.) Specifies how many times in one second the scanning beam of electrons redraws the screen. The phosphors stay bright for only a fraction of a second, so they must constantly be hit with electrons to stay lit. Given in draws per second, or Hertz, the refresh rate specifies how much energy is being put into keeping the screen lit. The standard refresh rate is 60Hz for VGA. However, some monitors have a refresh rate of 72Hz, which is much easier on the eyes (less flicker is perceived).

One note about monitors that may seem rather obvious: You must use a video card that supports the type of monitor you are using. For example, you can't use a CGA monitor on a VGA adapter.

NOTE

To use a 72Hz monitor, your video card must also support the 72Hz refresh rate. Most video cards sold today support this faster 72Hz refresh rate but are configured as 60Hz out of the box. If you intend to use the 72Hz rate, you must configure the card to do so. Check the documentation that came with the card for details on how to configure it.

### Liquid Crystal Displays (LCDs)

Portable computers were originally designed to be compact versions of their bigger brothers. They crammed all the components of the big desktop computers into a small, suitcase-like box called (laughably) a *portable computer*. No matter what the designers did to reduce the size of the computer, the display remained as large as the desktop version's. That is, until an inventor found that when he passed an electric current through a semicrystalline liquid, the crystals aligned themselves with the current. It was found that by combining transistors with these liquid crystals, patterns could be formed. These patterns could represent numbers or letters. The first application of these *liquid crystal displays* (LCDs) was the LCD watch. It was rather bulky, but it was cool.

As LCD elements got smaller, the detail of the patterns became greater, until one day someone thought to make a computer screen out of several of these elements. This screen was very light compared to computer monitors of the day, and it consumed little power. It could easily be added to a portable computer to reduce the weight by as much as 30 pounds. As the components got smaller, so did the computer, and the laptop computer was born.

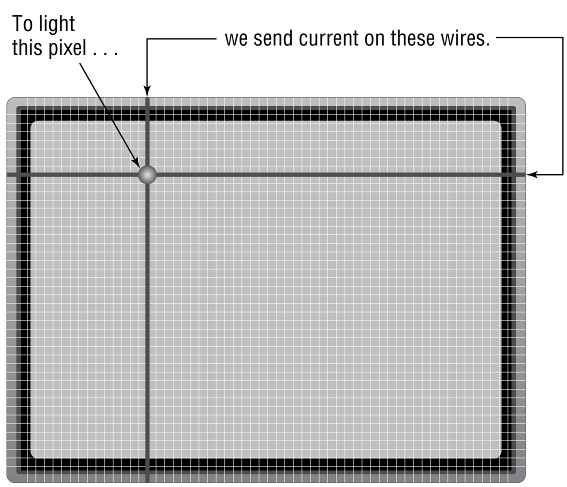
LCDs are not just limited to laptops; desktop versions of LCD displays are available as well. They use the same technologies as their laptop counterparts but on a much larger scale. Plus, these LCDs are available in either analog or digital interfaces for the desktop computer. The analog interface is exactly the same as the interface used for most monitors. All digital signals from the computer are converted into analog signals by the video card, which are then sent along the same 15-pin connector as a monitor. Digital LCDs, on the other hand, are directly driven by the video card's internal circuitry. They require the video card to be able to support digital output (through the use of a Digital Visual Interface, or DVI, connector). The advantage is that since the video signal never goes from digital to analog, there is no conversion-related quality loss. Digital displays are generally sharper than their analog counterparts.

Two major types of LCD displays are used today: active matrix screen and passive matrix screen. The main differences lie in the quality of the image. However, both types use lighting behind the LCD panel to make the screen easier to view:

**Active matrix** An active matrix screen works in a similar manner to the LCD watch. The screen is made up of several individual LCD pixels. A transistor behind each pixel, when switched on, activates two electrodes that align the crystals and turn the pixel dark. This type of display is very crisp and easy to look at. The major disadvantage of an active matrix screen is that it requires large amounts of power to operate all the transistors. Even with the backlight turned off, the screen can still consume battery power at an alarming rate. Most laptops with active matrix screens can't operate on a battery for more than two hours.

**Passive matrix** Within the passive matrix screen are two rows of transistors: one at the top, another at the side. When the computer's video circuit wants to turn on a particular pixel (turn it black), it sends a signal to the x- and y-coordinate transistors for that pixel, thus turning them on. This then causes voltage lines from each axis to intersect at the desired coordinates, turning the desired pixel black. Figure 1.47 illustrates this concept.

**FIGURE 1.47** A passive matrix display




The main difference between active matrix and passive matrix is image quality. Because the computer takes a millisecond or two to light the coordinates for a pixel in passive matrix displays, the response of the screen to rapid changes is poor, causing, for example, an effect known as *submarining*: On a computer with a passive matrix display, if you move the mouse pointer rapidly from one location to another, it will disappear from the first location and reappear in the new location without appearing anywhere in between.

To keep the quality of the image on an LCD the best, the screen must be cleaned often. Liquid crystal displays are typically coated with a clear plastic covering. This covering commonly gets dirtied by fingerprints as well as a generous coating of dust. The best way to clean the LCD lens coating is to wipe it off occasionally with a damp cloth. Doing so will ensure that the images stay crisp and clear.

# Ports and Cables

Now that you've learned the various types of items found in a computer, let's discuss the various types of ports and cables used with computers. A *port* is a generic name for any connector on a computer into which a cable can be plugged. A *cable* is simply a way of connecting a peripheral or other device to a computer using multiple copper or fiber optic conductors inside a common wrapping or sheath. Typically, cables connect two ports, one on the computer and one on some other device.

Let's take a quick look at some of the different styles of port connector types as well as peripheral port and cable types. We'll begin by looking at peripheral port connector types.

## Peripheral Port Connector Types

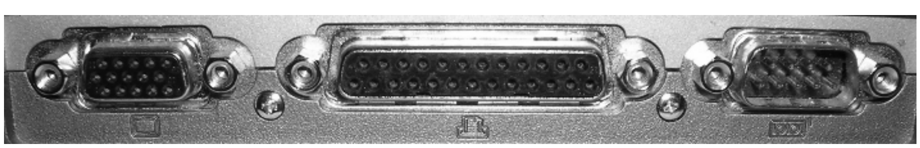
Computer ports are interfaces that allow other devices to be connected to a computer. Their appearance varies widely, depending on their function. In this section we'll examine the following types of peripheral ports:

- DB-series
- RJ-series
- Other types

### DB-Series

*DB connectors*, the most common style of connector found on computers today, are typically designated with DB-*n*, where the letter *n* is replaced by the number of connectors. DB connectors are usually shaped like a trapezoid, as you can see in Figure 1.48. The nice part about these connectors is that only one orientation is possible. If you try to connect them upside down or try to connect a male connector to another male connector, they just won't go together, and the connection can't be made. Table 1.5 lists common DB-series ports and connectors as well as their most common uses.

**FIGURE 1.48** DB series ports and connectors



On the left is a 15-pin video port, in the center is a 25-pin female printer port, and on the right is a 9-pin male serial port.

**TABLE 1.5** Common DB-Series Connectors

| Connector | Gender | Use |
|---|---|---|
| DB-9 | Male | Serial port |
| DB-9 | Female | Connector on a serial cable |
| DB-25 | Male | Serial port |
| DB-25 | Female | Parallel port, or connector on a serial cable |
| DB-15 | Female | Game port |
| DB-15 | Male | Connector on a game peripheral cable |
| DB-15HD | Female | Video port (HD has three rows of 5 pins as opposed to two rows) |
| DB-15HD | Male | Connector on a monitor cable |

## RJ-Series

*Registered jack (RJ)* connectors are most often used in telecommunications. Figure 1.49 shows the two most common examples of RJ ports and connectors: RJ-11 and RJ-45. RJ-11 connectors are used most often in telephone hookups; your home phone jack is probably an RJ-11 jack or port. RJ-45 connectors, on the other hand, are most commonly found on Ethernet networks that use twisted pair cabling.

**FIGURE 1.49** RJ ports and connectors

On the left in this picture is an RJ-11 connector and on the right is an RJ-45 connector. Notice the size difference.

As you can see, RJ connectors are typically square with multiple gold contacts on the top (flat) side. A small locking tab on the bottom prevents the connector and cable from falling or being pulled out of the jack accidentally.

## Other

A few other ports are used with computers today. These ports include:

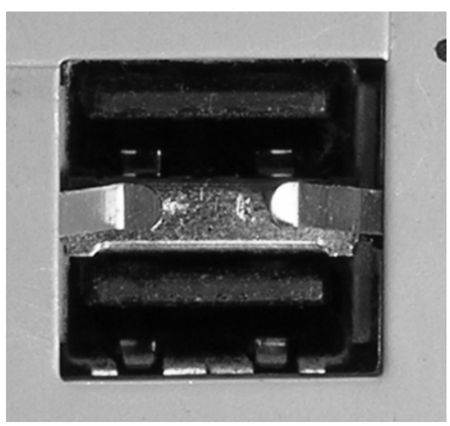
- Universal Serial Bus (USB)
- IEEE 1394 (FireWire)
- Infrared
- RCA
- PS/2 (mini DIN)
- Centronics

Let's look at each one and how it is used.

### Universal Serial Bus (USB)

Most computers built after 1997 have one or two flat ports in place of one DB-9 serial port. These ports are Universal Serial Bus (USB) ports, and they are used for connecting multiple (up to 127) peripherals to one computer through a single port (and use of multiport peripheral *hubs*). USB version 1.1 supported data rates as high as 12Mbps (1.5MBps). The newest version, USB 2.0, supports data rates as high as 480Mbps (60MBps). Figure 1.50 shows an example of a USB port.

**FIGURE 1.50** A USB port



NOTE

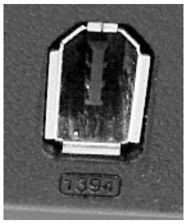
The newest version of USB, USB 2.0, uses the same physical connection as the original USB, but it is much higher in transfer rates. You can tell if a computer supports USB 2.0 by looking for the red and blue "High Speed USB" graphic somewhere on the computer (or on the box).

Because of USB's higher transfer rate, flexibility, and ease of use, most devices that in the past used serial interfaces now come with USB interfaces. It's rare to see a newly introduced PC accessory with a standard serial interface cable. For example, PC cameras (like the Logitech QuickCam) used to come as standard serial-only interfaces. Now you can only buy them with USB interfaces.

### IEEE 1394 (FireWire)

Recently, one port has been slowly creeping into the mainstream and is seen more and more often on desktop PCs. That port is the IEEE 1394 port (shown in Figure 1.51), more commonly known as a *FireWire* port. Its popularity is due to its ease of use and very high (400Mbps) transmission rates. Originally developed by Apple, it was standardized by IEEE in 1995 as IEEE 1394. It is most often used as a way to get digital video into a PC so it can be edited with digital video editing tools. At the time of this writing, many Apple iMac models include a FireWire port. You can see FireWire on many PCs and laptops.

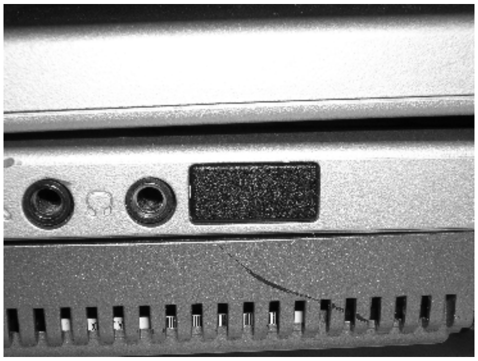
**FIGURE 1.51** A FireWire port on a PC




### Infrared

Increasing numbers of people are getting fed up with being tethered to their computers by cords. As a result, many computers (especially portable computing devices like laptops and PDAs) are now using infrared ports to send and receive data. An *infrared port* is a small port on the computer that allows data to be sent and received using electromagnetic radiation in the infrared band. The infrared port itself is a small, dark square of plastic (usually a very dark maroon) and can typically be found on the front of a PC or on the side of a laptop or portable. Figure 1.52 shows an example of an infrared port.

**FIGURE 1.52** An infrared port



Infrared ports send and receive data at a very slow rate (maximum speed on PC infrared ports is less than 4Mbps). Most infrared ports on PCs that have them support the *Infrared Data Association (IrDA) standard*, which outlines a standard way of transmitting and receiving information via infrared so that devices can communicate with each other.

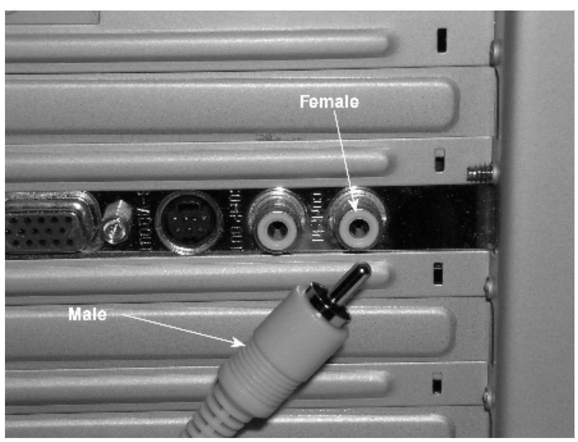
NOTE More information on the IrDA standard can be found at the organization's website: `www.irda.org`.

Noted that although infrared is a wireless technology, most infrared communications (especially those that conform to the IrDA standards) are line-of-sight only and take place within a short distance (typically less than 4 meters). Infrared is typically used for point-to-point communications like controlling the volume on a device with a handheld remote control.

### RCA

The RCA jack (shown in Figure 1.53) was developed by the RCA Victor company in the late 1940s for use with its phonographs. You bought a phonograph, connected the RCA jack on the back of your phonograph to the RCA jack on the back of your radio or television, and used the speaker and amplifier in the radio or television to listen to records. It made phonographs cheaper to produce and had the added bonus of making sure everyone had an RCA Victor radio or television (or at the very least, one with the RCA jack on the back). Either way, RCA made money.

**FIGURE 1.53** An RCA jack (female) and RCA connector (male)

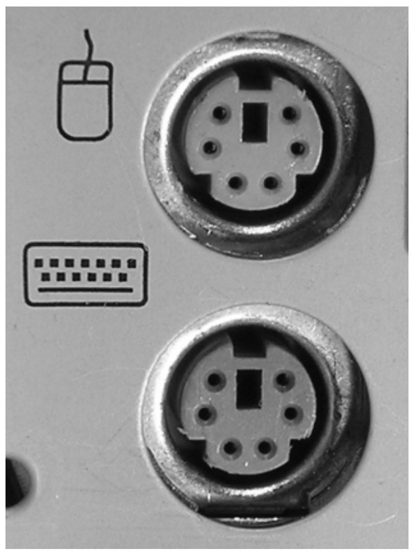



Today, RCA jacks and connectors are used to transmit both audio and video information. Typically, when you see an RCA connector on a PC video card (next to a DB-15HD connector), it's for composite video output (output to a television or VCR).

### PS/2 (Keyboard and Mouse)

Another common port, as mentioned earlier, is the PS/2 port. A *PS/2 port* (also known as a *mini-DIN 6* connector) is a mouse and keyboard interface port first found on the IBM PS/2 (hence the name). It is smaller than previous interfaces (the DIN-5 keyboard port and serial mouse connector), and thus its popularity increased quickly. Figure 1.54 shows examples of both PS/2 keyboard and mouse ports. You can tell the difference because usually the keyboard port is purple and the mouse port is green. Also, typically there are small graphics of a keyboard and mouse, respectively, imprinted next to the ports.

**FIGURE 1.54** PS/2 keyboard and mouse ports



### Centronics

The last type of port connector is the Centronics connector. It has a unique shape, as shown in Figure 1.55. It consists of a central connection bar surrounding by an outer shielding ring. The Centronics connector is primarily used in parallel printer connections and SCSI interfaces. It is most often found on peripherals, not on computers themselves (except in the case of some older SCSI interface cards).

**FIGURE 1.55** A Centronics connector

## Common Peripheral Interfaces and Cables

An *interface* is a method of connecting two dissimilar items together. A *peripheral interface* is a method of connecting a peripheral or accessory to a computer, including the specification of cabling, connector type, speed, and method of communication used.

The most common interfaces used in PCs today include:

- Parallel
- Serial
- USB
- IEEE 1394 (FireWire)
- Infrared
- RCA
- PS/2

For each type, let's look at the cabling and connector used as well as the type(s) of peripherals that are connected.

### Parallel

The most popular type of interface available on computers today is the parallel interface. Parallel communications take the interstate approach to data communications. Normally, interstate travel is faster than driving on city roads. This is the case mainly because you can fit multiple cars going the same direction on the same highway by using multiple lanes. On the return trip, you take a similar path, but on a completely separate road. The *parallel interface* transfers data eight bits at a time over eight separate transmit wires inside a parallel cable (one bit per wire). Normal parallel interfaces use a DB-25 female connector on the computer to transfer data to peripherals.

The most common use of the parallel interface is printer communication. There are three major types: standard, bidirectional, and enhanced parallel ports. Let's look at the differences between the three.

#### Standard Parallel Ports

The standard parallel port only transmits data *out* of the computer. It cannot receive data (except for a single wire carrying a Ready signal). This parallel port came with the original IBM PC, XT, and AT. It can transmit data at 150KBps and is commonly used to transmit data to printers. This technology also has a maximum transmission distance of 10 feet.

#### Bidirectional Parallel Ports

As its name suggests, the bidirectional parallel port has one important advantage over a standard parallel port: It can both transmit and receive data. These parallel ports are capable of interfacing with devices like external CD-ROM drives and external parallel port backup drives (Zip, Jaz, and tape drives). Most computers made since 1994 have a bidirectional parallel port.

TIP

In order for bidirectional communication to occur properly, the cable must support bidirectional communication as well.

### Enhanced Parallel Ports

As more people began using parallel ports to interface with devices other than printers, they started to notice that the available speed wasn't good enough. Double-speed CD-ROM drives had a transfer rate of 300KBps, but the parallel port could transfer data at only 150KBps, thus limiting the speed at which a computer could retrieve data from an external device. To solve that problem, the Institute of Electrical and Electronics Engineers (IEEE) came up with a standard for enhanced parallel ports called IEEE 1284. The IEEE 1284 standard provides for greater data transfer speeds and the ability to send memory addresses as well as data through a parallel port. This standard allows the parallel port to theoretically act as an extension to the main bus. In addition, these ports are backward compatible with the standard and bidirectional ports.

There are two implementations of IEEE 1284: ECP parallel ports and EPP parallel ports. An *Enhanced Capabilities Port* (ECP port) is designed to transfer data at high speeds to printers. It uses a DMA channel and a buffer to increase printing performance. An *Enhanced Parallel Port* (EPP port) increases bidirectional throughput from 150KBps to anywhere from 600KBps to 1.5MBps.

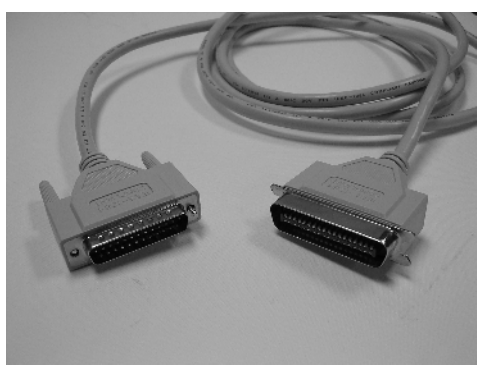
TIP

The cable must also have full support for IEEE 1284 in order for proper communications to occur in both directions and at rated speeds.

### Parallel Interfaces and Cables

Most parallel interfaces use a DB-25 female connector as shown earlier in this chapter. Most parallel cables use a DB-25 male connector on one end and either a DB-25 male connector or Centronics-36 connector on the other. Printer cables typically used the DB-25M to Centronics-36 configuration. Inside a parallel cable, eight wires are used for transmitting data, so one byte can be transmitted at a time. Figure 1.56 shows an example of a typical parallel cable (in this case, a printer cable).

**FIGURE 1.56** A typical parallel cable



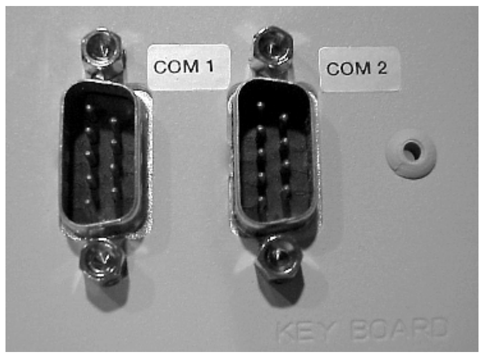
## Serial

If parallel communications are similar to taking the interstate, then serial communications are similar to taking a country road. In serial communications, bits of data are sent one after another (single file, if you will) down one wire, and they return on a different wire in the same cable. Three main types of serial interfaces are available today: standard serial, Universal Serial Bus (USB), and FireWire.

### Standard Serial

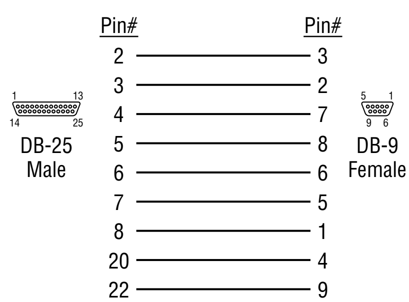
Almost every computer made since the original IBM PC has at least one serial port. They are easily identified because they have either a DB-9 male (shown in Figure 1.57) or DB-25 male port. Standard serial ports have a maximum data transmission speed of 57Kbps and a maximum cable length of 50 feet.

**FIGURE 1.57** Standard DB-9 male serial ports




Serial cables come in two common wiring configurations, *standard serial cable* and *null modem serial cable*. A standard serial cable is used to hook various peripherals like modems and printers to a computer. A null modem serial cable is used to hook two computers together without a modem. The transmit wires on one end are wired to the receive pins on the other side, so it's as if a modem connection existed between the two computers, but without the need for a modem. Figures 1.58 and 1.59 show the wiring differences (the *pinouts*) between a standard serial cable and a null modem cable. In the null modem diagram, notice how the transmit (tx) pins on one end are wired to the receive (rx) pins on the other.

**FIGURE 1.58** A standard serial cable wiring diagram




Finally, because of the two different device connectors (DB-9 male and DB-25 male), serial cables have a few different configurations. Table 1.6 shows the most common serial cable configurations.

**FIGURE 1.59** A null modem serial cable wiring diagram

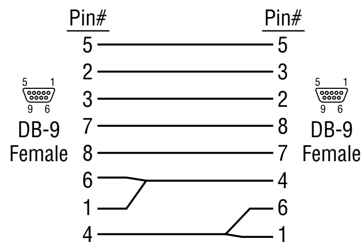


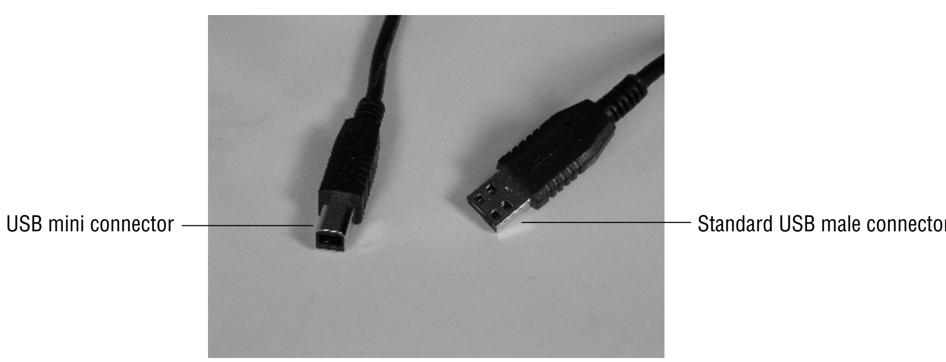

**TABLE 1.6** Common Serial Cable Configurations

| 1st Connector | 2nd Connector | Description |
|---|---|---|
| DB-9 female | DB-25 male | Standard modem cable |
| DB-9 female | DB-9 male | Standard serial extension cable |
| DB-9 female | DB-9 female | Null modem cable |
| DB-25 female | DB-25 female | Null modem cable |
| DB-25 female | DB-25 male | Standard serial cable or standard serial extension cable |

## Universal Serial Bus (USB)

The USB interface is very straightforward. Essentially, it was designed to be plug and play—just plug in the peripheral, and it should work (providing the software is installed to support it). The USB cable is simple: a USB male connector on each end (as shown in Figure 1.60). Sometimes manufacturers put a mini connector on one end to make it fit the form factor of the device that needs a USB connection. These connectors vary widely, and we won't cover them here.

**FIGURE 1.60** A USB cable



TIP

A USB cable will go into a USB port only one way. If the cable is not going into the port properly, try flipping it over.

One part of the USB interface specification that makes it so appealing is the fact that if your computer runs out of USB ports, you can simply plug a device known as a *USB hub* in to one of your computer's USB ports, which will give you several more USB ports from one USB port. Figure 1.61 shows an example of a USB hub.

**FIGURE 1.61** A USB hub

USB cables are used to connect a wide variety of peripherals to computers, including mice, digital cameras, printers, and scanners. USB's simplicity of use and ease of expansion make it an excellent interface for just about any kind of peripheral.

NOTE

For more information on USB, check out `www.usb.org`.

## IEEE 1394 (FireWire)

The IEEE 1394 interface is about one thing: speed. Its first iteration, now known as FireWire 400, has a maximum data throughput of 400Mbps. The latest iteration, FireWire 800, has a maximum data throughput of 800Mbps. It caries data at that speed over a maximum cable length of 4.5 meters (FireWire 400) and 100 meters (FireWire 800 over fiber optic cables).

FireWire (also known as i.Link in Sony's parlance) uses a very special type of cable, as shown in Figure 1.62. It is difficult to mistake this cable for anything but a FireWire cable.

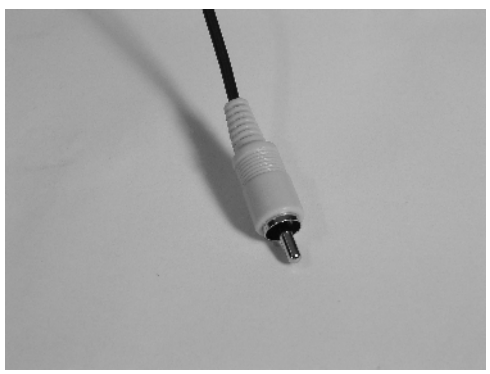
Although most people think of FireWire as a tool for connecting their digital camcorders to their computers, it's much more than that. Because of its high data transfer rate, it is being used more and more as a universal, high-speed data interface for things like hard drives, CD-ROM drives, and digital video editing equipment.

**FIGURE 1.62** A FireWire (IEEE 1394) cable

## RCA

The RCA cable is simple. There are two connectors, usually male, one on each end of the cable. The male connector connects to the female connector on the equipment. Figure 1.63 shows an example of an RCA cable. An RCA male to RCA female connector is also available; it's used to extend the reach of audio or video signals.

**FIGURE 1.63** An RCA cable

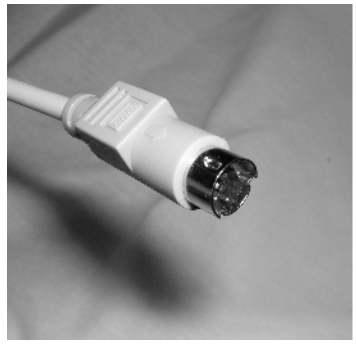


The RCA male connectors on a connection cable are sometimes plated in gold to increase their corrosion resistance and to improve longevity.

## PS/2 (Keyboard and Mouse)

The final interface we'll discuss is the PS/2 interface for mice and keyboards. Essentially, it is the same connector for the cables from both items: a male mini-Din 6 connector. Most keyboards today still use the PS/2 interface, whereas most mice are gravitating toward the USB interface (especially optical mice). However, mice that have USB cables still may include a special USB-to-PS/2 adapter so they can be used with the PS/2 interface. Figure 1.64 shows an example of a PS/2 keyboard cable.

**FIGURE 1.64** A PS/2 keyboard cable



> **NOTE** Most often, PS/2 cables have only one connector, because the other end is connected directly to the device being plugged in. The only exception is PS/2 extension cables used to extend the length of a PS/2 device's cable.

# Summary

In this chapter, we took a brief tour of the components of a PC. You learned about the different components that make up a PC, including the case, motherboard, drives and storage, expansion cards, and display devices. In addition, we discussed common peripheral ports and cables and their appearance. You learned what each of these items looks like and how they function. In the next chapter, we'll go into more depth about the inner workings of a PC.

# Key Terms

Before you take the exam, be certain you are familiar with the following terms:

Accelerated Graphics Port (AGP)

adapter card

AT system connector

ATX motherboard

ATX system connector

baby AT

Berg connector

cable

CD-Recordable (CD-R) and CD-Rewriteable (CD-RW) drives

Central Processing Unit (CPU)

CMOS battery

computer case

DB connector

desktop case

device bay

direct-solder method

diskette

dongle

dongle connection

dot pitch

drive interface

Dual Inline Memory Modules (DIMMs)

electron gun

Enhanced Capabilities Port

Enhanced Parallel Port

Ethernet port

expansion card

expansion slot

FireWire

Firmware

floppy disk

floppy drive

floppy drive interface

floppy drive power connector

full AT

full tower case

game port

graphics mode

hard disk interface

Industry Standard Architecture (ISA) expansion slot

Infrared Data Association (IrDA) standard

infrared port

integrated system board

interface

interlaced

joystick port

mid tower case

midi tower case

mini tower case

modem

Molex connector

monochrome

motherboard

network interface card (NIC)

nonintegrated system board

null modem serial cable

parallel interface

parallel port

peripheral interface

personal computer (PC)

pin

pixel

planar board

port

power supply
proprietary case
proprietary design
PS/2 port
refresh rate
registered jack (RJ)
riser card
serial port
Single Inline Memory Module (SIMM)
standard peripheral power connector
standard serial cable
system board
text mode
Universal Serial Bus (USB)
Video (SVGA) port
watt

# Review Questions

1. Which computer component contains all the circuitry necessary for *all* components or devices to communicate with each other?

   A. Motherboard

   B. Adapter card

   C. Hard drive

   D. Expansion bus

2. Which case type is typically used for servers?

   A. Mini tower

   B. Mid tower

   C. Full tower

   D. Desktop

3. What was the original name for a monitor?

   A. Video Display Unit

   B. CRT

   C. LCD

   D. Optical Display Unit

4. Which motherboard design style is the most popular?

   A. ATX

   B. AT

   C. Baby AT

   D. NLX

5. Which motherboard socket type is used on the Pentium IV chip?

   A. Slot 1

   B. Socket A

   C. Socket 370

   D. Socket 478

6. What is the maximum amount of data that can be stored on a 5¼-inch floppy disk?

   A. 360KB

   B. 1.2MB

   C. 320KB

   D. 720KB

**7.** Which is another term for the motherboard?

**A.** A fiberglass board

**B.** A planar board

**C.** A bus system

**D.** An IBM system board XR125

**8.** Which of the following is used to store data and programs for repeated use? Information can be added and deleted at will, and it does *not* lose its data when power is removed.

**A.** Hard drive

**B.** RAM

**C.** Internal cache memory

**D.** ROM

**9.** Which motherboard socket type is used with the AMD Athlon XP?

**A.** Slot 1

**B.** Socket A

**C.** Socket 370

**D.** Socket 478

**10.** You want to plug a keyboard in to the back of a computer. You know that you need to plug the keyboard cable into a PS/2 port. Which style of port is the PS/2?

**A.** RJ-11

**B.** DB-9

**C.** Din 5

**D.** Mini-DIN 6

**11.** What are the five voltages produced by a common PCs power supply? (Select all that apply.)

**A.** +3.3VDC

**B.** –3.3VDC

**C.** +5VDC

**D.** –5VDC

**E.** +12VDC

**F.** –12VDC

**G.** +110VAC

**H.** –110VAC

12. What is the maximum speed of USB 2.0 in Mbps?
    - A. 1.5
    - B. 12
    - C. 60
    - D. 480

13. If you wanted to connect a LapLink cable (a parallel data transfer cable) so that you could upload and download files from a computer, which type of parallel port(s) does your computer need to have? (Select all that apply.)
    - A. Standard
    - B. Bidirectional
    - C. EPP
    - D. ECP

14. What peripheral port type was originally developed by Apple and is currently primarily used for digital video transfers?
    - A. DVD
    - B. USB
    - C. IEEE 1394
    - D. IEEE 1284

15. What peripheral port type is expandable using a hub, operates at 1.5MBps, and is used to connect various devices (from printers to cameras) to PCs?
    - A. DVD 1.0
    - B. USB 1.0
    - C. IEEE 1394
    - D. IEEE 1284

16. Which peripheral port type was designed to transfer data at high speeds to printers only?
    - A. DVD
    - B. USB
    - C. IEEE 1394
    - D. IEEE 1284

17. Which motherboard form factor places expansion slots on a special riser card and is used in low-profile PCs?
    - A. AT
    - B. Baby AT
    - C. ATX
    - D. NLX

**18.** Which Intel processor type(s) use the SEC when installed into a motherboard? (Select all that apply.)

**A.** AMD Athlon

**B.** 486

**C.** Pentium

**D.** Pentium II

**19.** Which of the following can a DVD-ROM store in addition to movies? (Select all that apply.)

**A.** Audio files

**B.** Word documents

**C.** Digital photos

**D.** All of the above

**20.** What type of expansion slot is almost always used for high-speed, 3D graphics video cards?

**A.** USB

**B.** AGP

**C.** PCI

**D.** ISA

# Answers to Review Questions

1. A. The spine of the computer is the system board, otherwise known as the motherboard. On the motherboard you will find the CPU, underlying circuitry, expansion slots, video components, RAM slots, and various other chips.
2. C. Because they have the most expansion room and room for disk drives, full tower cases are used for most servers. In some cases (such as small offices) the other case styles can be used, but they are less common.
3. B. The first display systems were nothing more than fancy black-and-white TV monitors called CRTs.
4. A. Although all the motherboard design styles listed are in use today, the ATX motherboard style (and its derivatives) is the most popular design style.
5. D. Most Pentium IV chips use the Socket 478 motherboard CPU socket.
6. B. Today, drives that offer anything less than 1.2MB are increasingly rare, because most computers do not carry the 5 1/4-inch size.
7. B. The spine of the computer is the system board, otherwise known as the motherboard and less commonly referred to as the planar board.
8. A. A hard drive stores data on a magnetic medium, which does not lose its information after the power is removed, and which can be repeatedly written to and erased.
9. B. The Socket A motherboard socket is used primarily with AMD processors, including the Athlon XP.
10. D. A PS/2 port is also known as a Mini-DIN 6 connector.
11. A, C, D, E, F. A PC's power supply produces +3.3VDC, +5VDC, –5VDC, +12VDC, and –12VDC from 110VAC.
12. D. The USB 2.0 spec provides for a maximum speed of 480 megabits per second (Mbps—not megabytes per second, or MBps).
13. B, C, D. Bidirectional parallel port can both transmit and receive data. An ECP was designed to transfer data at high speeds. EPP parallel ports provide for greater transfer speeds and the ability to send memory addresses as well as data through a parallel port.
14. C. The 1394 standard provides for greater data transfer speeds and the ability to send memory addresses as well as data through a serial port.
15. B. USBs are used to connect multiple peripherals to one computer through a single port. They support data transfer rates as high as 1.5MBps (for USB 1.0, which is the option listed here).
16. D. IEEE 1284 standard defines the ECP parallel port to use a DMA channel and the buffer to be able to transfer data at high speeds to printers.

**17.** D. The NLX form factor places expansion slots on a special riser card and is used in low-profile PCs.

**18.** D. The unique thing about the Pentium II is that it uses a Single Edge Connector (SEC) to attach to the motherboard instead of the standard PGA package.

**19.** D. The DVD-ROM can store many types of data as well as movies. In the computer world, data can be audio files, Word documents, digital photos, and many other things.

**20.** B. Although technically PCI and ISA could be used for video adapters, AGP was specifically designed for the use of high-speed, 3D graphic video cards.