Ports and Connectors

ITINERARY

- **Objective 2.01** Legacy Multifunction Ports
- **Objective 2.02** Standard Single-Function Ports
- **Objective 2.03** Modern Multifunction Ports

NEWBIE	SOME EXPERIENCE	EXPERT
2.5 hours	1.5 hours	1 hour

Mastering the craft of the PC technician requires that you learn a lot of details about what sometimes seems to be thousands of individual parts, connections, and settings. Even the most basic PC contains many hardware components, each with its own set of characteristics, shapes, sizes, and colors. Fortunately, it's much simpler than it seems! Computer makers use only a few types of connectors for most devices, so once you learn one type of connector, you'll know how to use it on any type of PC.

This chapter describes *integrated I/O devices*—the major connectors, plugs, and sockets that you'll find on a typical PC—and spells out many of the amazing array of acronyms and abbreviations used by techs. The CompTIA A+ certification exams expect you to recognize a particular part simply by seeing what type of connector attaches to that part, so pay attention, folks!

Legacy Multifunction Ports

Good techs don't go around saying, "Just plug that *doohickey* into the *whatchamacallit* on the back of the PC," and you shouldn't either. These things have names, after all, so you should get into the habit of using them. Every cable has a *connector* at the end that plugs into a corresponding *port* on a PC. Connectors carry data and sometimes power between devices attached to the PC. Ports are the *interfaces*, the "doorways" used to connect devices to the PC. Connectors and ports can be either male or female, defined as having pins or sockets, respectively.

Let's start with the two ancient multifunction ports that linger on most modern PCs: serial ports and parallel ports. Serial and parallel ports have a slight *D* shape, which allows only one proper way to insert a plug into the socket and makes it easier to remember what they're called. Technically, they're known as *D-sub* or *D-subminiature* connectors, but most techs call them *DB*.

Serial Ports

Serial ports come in 9-pin and 25-pin varieties (Figure 2-1). Of the two, the 9-pin (five pins on the top row, four on the bottom) variety is much more common, although even those are rapidly disappearing from modern PCs.

Serial ports transfer data 1 *bit* (the smallest unit of data in the PC world) at a time, with a maximum throughput speed of 115 *kilobits per second* (Kbps).

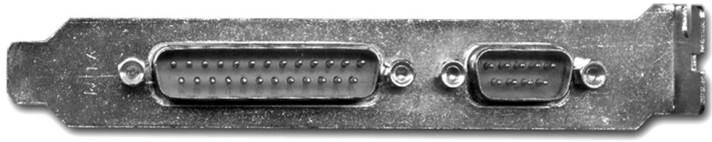
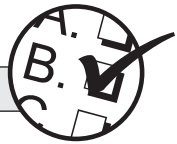


FIGURE 2.1 A 25-pin serial port and a 9-pin serial port

Devices that connected to the PC via the serial port included mice, external modems, label printers, personal digital assistants (PDAs), and digital cameras.

Exam Tip

Make sure you know that serial ports transfer data 1 bit at a time.



All devices in a PC get assigned certain *system resources,* and serial ports are no exception. The CPU uses input/output (I/O) addresses to give commands to devices; some devices use an interrupt request (IRQ) to contact the CPU.

Most motherboards have at least one serial port—appropriately called Serial Port 1. By default, this port gets assigned the I/O address 3F8 and IRQ 4 (COM1). The rare Serial Port 2 on a PC gets I/O address 2F8 and IRQ 3 (COM2) by default.

You can use the CMOS setup utility to change the resources assigned to devices built into the motherboard—such as serial ports. Further, you can enable or disable the serial port(s) in the CMOS setup utility to free up resources, although you'd need to do this only on old computers. Chapter 7 covers the CMOS setup utility in great detail.

Local Lingo

System setup utility Many techs refer to the CMOS program as the *system setup utility.* The latter term happens to be more accurate as no modern PC uses a *complementary metal-oxide semiconductor* chip to store CMOS information, but the older term has stuck. As one old tech said, looking me straight in the eye, "CMOS is CMOS, son."

Parallel Ports

Parallel ports are the 25-pin (13 on the top row, 12 on the bottom) female ports on the back of older PCs, as shown in Figure 2-2. Folks often incorrectly refer to

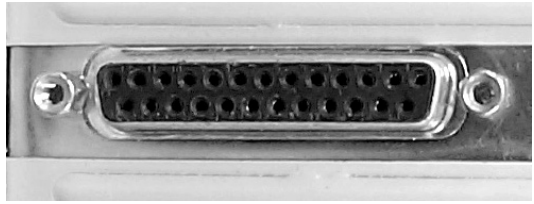
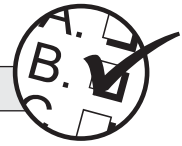


FIGURE 2.2 A 25-pin parallel port

parallel ports simply as "printer ports," but many other devices have used parallel ports, such as external CD-ROM drives, Zip drives, and scanners.

Exam Tip

Parallel communications transfer data 8 bits, or 1 byte, at a time.



Printers that connect to parallel ports on the PC have a *centronics* port rather than a parallel port. Centronics connectors have a central tongue with contacts rather than pins (Figure 2-3), and come in two varieties. The more common is the 36-pin IEEE 1284B connector; the rarely used variety is the mini centronics IEEE 1284C connector (Figure 2-4).

FIGURE 2.3 IEEE 1284B centronics connector and port

FIGURE 2.4 IEEE 1284C mini centronics connector

Local Lingo

IEEE IEEE stands for the Institute of Electrical and Electronics Engineers, the international organization that creates standards for electrical things, such as ports, cables, and connectors. You'll see them again later in this chapter.

Parallel ports traditionally get I/O address 378 and IRQ 7 (LPT1), but as with the serial port assignments, modern motherboards give you the option of changing this setting. Technological advances, such as the Extended Capability Port (ECP) and the Enhanced Parallel Port (EPP), offer improved throughput, to about 10 times faster than a standard parallel port.

Standard Single-Function Ports

Every PC sports several single-function ports for connecting peripherals such as keyboards, monitors, and the like. With only a couple of exceptions, these standard ports support only a single type of device.

The Keyboard Port

Keyboards come in a variety of styles, from the plain-Jane, rectangular typewriter substitute to the exotically curved, multifunction gadget that's bristling

with special function *hotkeys* and equipped with ports of its own. Regardless of their appearance, however, all keyboards enable you to do one thing—enter commands into your PC.

Modern PCs have a purple 6-pin mini-DIN (commonly called a *PS/2 connector*) port (Figure 2-5). The mini-DIN port is keyed so you can insert the keyboard connector only one way.

The Mouse Port

Like keyboards, mice come in an array of sizes and shapes, and they use a variety of connectors to attach to the PC (see Figure 2-6). All mice enable you to manipulate the operating system (OS) and applications.

Traditionally, mice plugged into one of the serial ports on the back of the PC, but most motherboards today have a dedicated mini-DIN mouse port. Aside from color, the green mouse port appears identical to the purple PS/2 keyboard port, but they're not interchangeable.

FIGURE 2.5 A 6-pin mini-DIN connector

FIGURE 2.6 A serial mouse connector (left) and a PS/2 mouse connector

You can plug a PS/2 mouse connector into a PS/2 keyboard port, and vice versa, but they won't work. Mice go into mouse ports—keyboards go into keyboard ports. Some portable computers have a single black or gray mini-DIN port that can handle both a mouse and a keyboard (though obviously not at the same time!).

Video Ports

Standard cathode ray tube (CRT) monitors and many projectors connect to your PC using a 15-pin D-subminiature connector arranged in three rows of five pins each. The corresponding video port on the PC, as shown in Figure 2-7, accommodates only that connector. No other port on your PC looks like this one.

Many flat-panel liquid crystal display (LCD) monitors and some projectors use a specially keyed, 24-pin Digital Visual Interface (DVI) connector that plugs into a DVI port on the back of your video adapter card, as shown in Figure 2-8. DVI comes in several varieties, such as analog, *DVI-A,* and digital, *DVI-D*. Chapter 10 covers monitors and projectors in more detail.

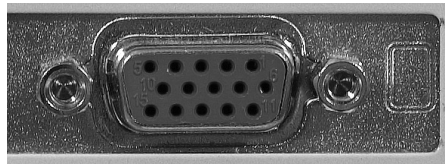


FIGURE 2.7 A female 15-pin DB connector

FIGURE 2.8 DVI connector for a flat-panel monitor

Local Lingo

Thin-film transistor The most common LCD monitors use a technology called *thin-film transistor (TFT).* Many techs erroneously refer to all LCD monitors as TFTs.

Some video cards connect to display devices using three RCA connectors or five BNC connectors, called *component* and *RGB video,* respectively. Figure 2-9 shows both types of ports on monitors.

FIGURE 2.9 RGB and component connectors

Audio Ports

At one time, audio was considered an extra add-on, but sound is standard issue on modern PCs. Most audio ports take the form of the popular 1/8" mini-audio connectors commonly seen on the Sony Walkman or other similar gadgets. A PC typically has at least three color-coded sound ports: a green speaker output port, a pink microphone input port, and a blue auxiliary input port, as shown in Figure 2-10. Better audio systems offer more jacks for rear speakers, center speaker, and subwoofer.

Travel Advisory

Some sound cards have audio ports that are all one color. If you run into one of those, you can try to figure out what the obscure symbols mean or get the information from a user manual or the manufacturer's Web site.

FIGURE 2.10 Sound card 1/8" mini-audio connectors

You will occasionally see variations, particularly on systems with high-performance sound cards. Some have separate outputs for each audio channel, or they may incorporate one or two special connectors called *Sony/Philips Digital Interface (S/PDIF)* ports, as shown in Figure 2-11. S/PDIF ports come in two flavors, electrical and optical. The electrical port uses an RCA connector on a coaxial cable; the optical uses a fiber connector. Some sound cards from Creative Labs use a 1/8" mini-audio jack for electrical S/PDIF.

Multimedia Ports

The convergence of television, music, and the computer has many newer PCs sporting various multimedia connectors. Some of these connectors, such as the *RG-6 coaxial* connector, have been around for a long time. The RG-6 connector sits on the video card or a dedicated TV tuner card and enables your PC to receive video and audio signals from a cable company or video cassette player. Other older connectors include *S-Video*—for sending video content from the PC to the TV—and *composite* connectors—for connecting left- and right-channel audio and a single video source into or out from the PC. Figure 2-12 shows an ATI All-in-Wonder card with the many multimedia connectors it offers.

The latest media center PCs designed to fit into your living room décor rather than on your desk come with *High Definition Multimedia Interface*

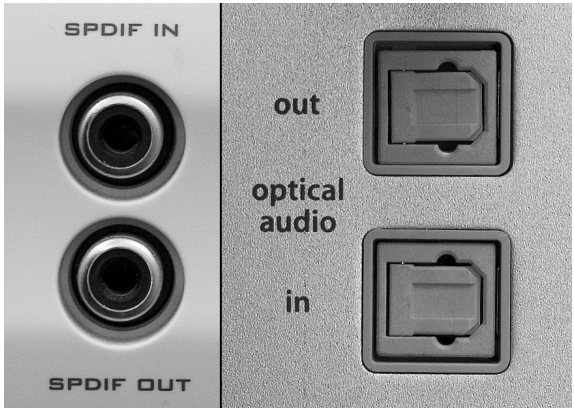


FIGURE 2.11 S/PDIF connectors, electrical (left) and optical (right)

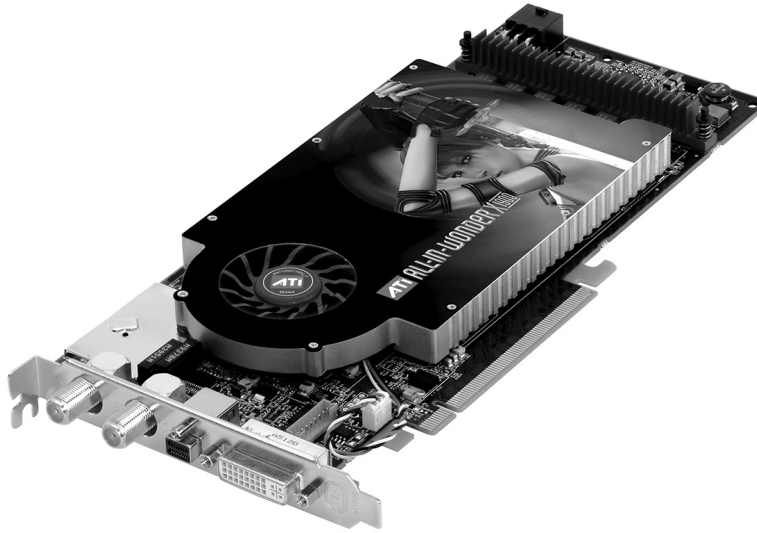


FIGURE 2.12 Multimedia card

(HDMI) ports (Figure 2-13) for connecting the PC to a high-definition television (HDTV). The HDMI interface handles both the high-definition video signal and multichannel digital audio streams.

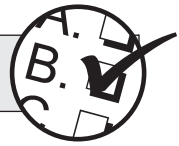
FIGURE 2.13 HDMI connector

MIDI/Joystick Ports

Older PCs have an integrated female DB-15 port for connecting joysticks or other game controllers. These ports also support MIDI devices, such as a music synthesizer keyboard, although you need a special breakout box to make the MIDI connection. Unlike DB-15 video connectors, MIDI/Joystick connectors have pins arrayed in two rows, with eight on the top and seven on the bottom, as shown in Figure 2-14.

Exam Tip

Make sure you know that the two-row, 15-pin DB connector can be used for both MIDI devices and joysticks.



Modem Ports

PC modem ports look identical to female telephone jacks and use standard, two-wire RJ-11 telephone cables and connectors (Figure 2-15). The locking clips on the male RJ-11 connectors secure the cable into the port. Most modems also have an output port for a telephone.

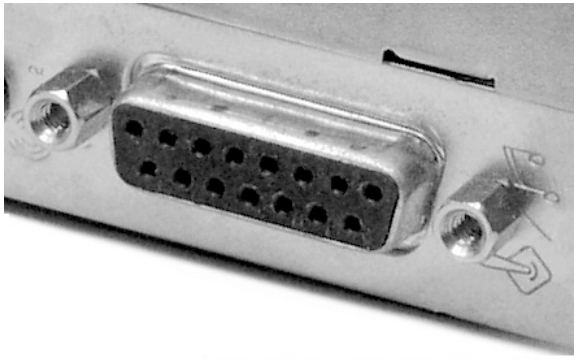


FIGURE 2.14 MIDI/Joystick port

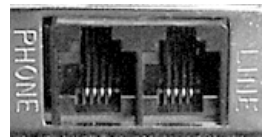


FIGURE 2.15 RJ-11 ports on a modem

Network Interface Ports

Network interfaces come in two main varieties. Most network interface cards (NICs) and motherboards have an eight-wire RJ-45 port (Figure 2-16). RJ-45 connectors look like wider-than-normal RJ-11 telephone connectors and plug into the female RJ-45 ports in the same manner that RJ-11 telephone cables plug into a modem. High-end NICs have two fiber connections (in/out) of one variety or another. The most common fiber connectors are the SC-ST and the LC-LC (Figure 2-17).

Local Lingo

NIC Network interface cards (NICs) enable PCs to connect to a network. Techs call them NICs even when the network adapter is built into a motherboard and thus distinctly lacking in "card-ness."

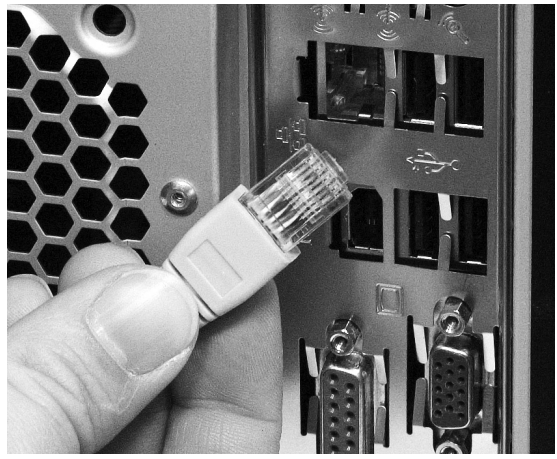


FIGURE 2.16 An RJ-45 connector and port

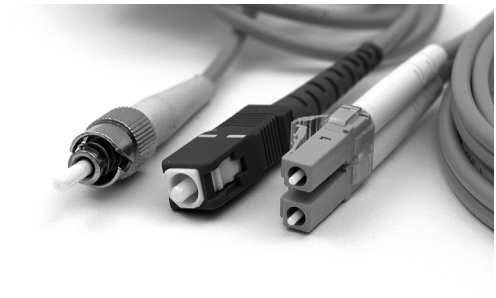
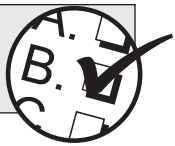


FIGURE 2.17 SC-ST and LC-LC fiber connectors

Exam Tip

Make sure you know the difference between RJ-11 connectors and RJ-45 connectors, and that you can easily tell the difference between the two at a glance.



Modern Multifunction Ports

Modern PCs use one or more multifunction ports to supplement or replace the aged serial and parallel ports. All newer machines have *universal serial bus (USB)* ports; many have *IEEE 1394 (FireWire)* ports; and a few have a *small computer systems interface (SCSI)* port. All three come in at least two varieties and can be used to connect everything from printers to digital cameras.

USB

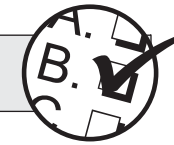
USB comes in two flavors, USB and Hi-Speed USB. Regular USB—often mistakenly called USB 1.1—devices transfer data at speeds of 1.5 or 12 megabits per second (Mbps), making them much faster than parallel or serial communications. Hi-Speed USB is faster still, capable of bursts up to 480 Mbps. Note that despite the huge difference in speeds, Hi-Speed USB technology is fully backward-compatible with regular USB devices. You can plug a regular USB device into a Hi-Speed port, in other words, and it will work.

Local Lingo

USB 1.1 All current USB devices fall into the USB 2.0 specification. The initial specification that came to market was called *USB 1.1* and matched the data throughput and connections of the current USB 2.0 (not Hi-Speed) devices. Many techs and consumers continue to use the term USB 1.1 to describe the lower speed USB 2.0 devices. Some marketing materials distinguish between 1.5 and 12 Mbps USB devices as USB and Full-Speed USB, although the latter term is not used in the specification at all.

Exam Tip

The CompTIA A+ certification exams use the term USB 1.1 to describe the low-speed USB 2.0 devices.



USB ports come in three varieties, A, B, and mini. All are female and rectangular-shaped. The four contact pins are mounted on a plastic protrusion that keeps you from inserting the USB cable improperly. You plug the flat USB A connector into the corresponding port on a PC or USB hub—a generic term for a device with multiple USB ports (Figure 2-18). Most bigger peripherals, such as printers and scanners, have a B port into which you'd plug a B connector (Figure 2-19). Small USB devices, such as digital cameras and music players, use the mini port. Figure 2-20 shows a mini USB port and connector.

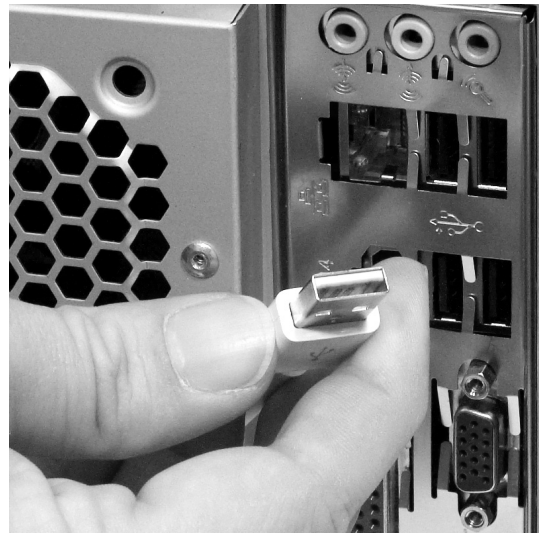


FIGURE 2.18 USB A-type port and connector

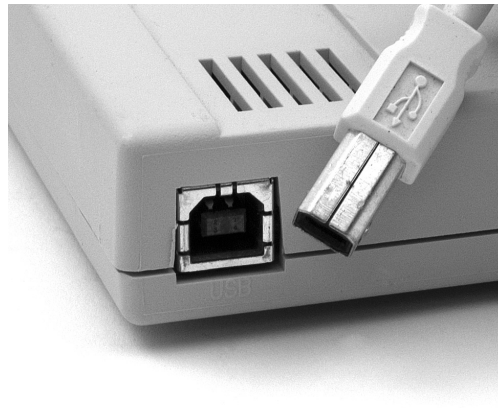


FIGURE 2.19 USB B-type port and connector

You can also find USB extenders. These have a USB A port on one end and a USB A connector on the other. You can use these for extending a mouse or keyboard cable and for connecting wide USB devices—such as thumb drives—to portable computers.

Many current devices, such as keyboards, mice, joysticks, microphones, scanners, printers, modems, PDAs, digital cameras, lap warmers, cup heaters, personal fans, lamps, and more, connect to the PC via USB.

FIGURE 2.20 Mini USB port and connector

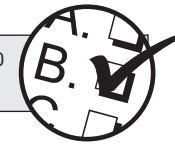
Travel Assistance

For more information about USB, visit http://www.usb.org/.

USB devices are *hot-swappable*, which means that you can connect or disconnect them at any time without powering down your PC. USB technology enables you to connect up to 127 devices together in a series called a *daisy chain*!

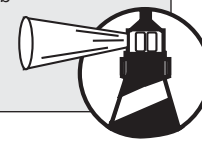
Exam Tip

Remember that you can hot-swap USB devices and daisy-chain up to 127 USB devices together.



Travel Advisory

For the purposes of the CompTIA A+ Certification exams, you need to know that you can connect 127 devices together—but for real-life, on-the-job situations, it's a bad idea to hit this maximum. Some applications reserve bandwidth, and you could wind up with quite a mess. Too much of a good thing isn't good!



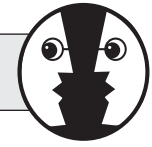
IEEE 1394

IEEE 1394 is an exciting communications technology created in a joint effort by Apple Computers, Texas Instruments, and the IEEE organization. The IEEE 1394 standard has been widely adopted not only by computer and peripheral makers, but also by manufacturers of home electronics such as digital video recorders.

Different manufacturers market IEEE 1394 technology under different trade names, such as *FireWire* (Apple), *iLink* (Sony), or *Lynx* (Texas Instruments), but they all refer to the same thing. Of these terms, FireWire is the most popular term among techs.

Local Lingo

FireWire, iLink, and Lynx The terms FireWire, iLink, and Lynx all refer to the IEEE 1394 interface.



The original specification for FireWire—*1394a*—calls for data transfers of up to 400 Mbps. The current generation of FireWire—*1394b*—is capable of speeds up to a blinding 800 Mbps. What's even more impressive is that the design spec for FireWire states that speeds of up to 1600 Mbps are possible. FireWire technology is a very good match for video, external hard drives, backup storage devices, and other hardware that needs real-time data access.

Connecting FireWire devices together enables them to communicate. Running a FireWire cable between two PCs, for example, creates an instant point-to-point network for sharing files. You can connect up to 63 FireWire devices together in a daisy chain, although you would need devices that came with their own power supply to use that many. One cool feature of FireWire chains is that you can use a device somewhere down the chain even if one or more devices in between the port and device is powered down.

The 6-pin standard FireWire 400 ports are slightly taller than USB ports and rounded on one end. The connector plugs are of course shaped to fit, as shown in Figure 2-21. Some devices, such as digital camcorders, use a 4-pin mini-FireWire connector, similar to the mini-USB connector, although they are certainly not interchangeable (Figure 2-22). FireWire 800 devices use a square 9-pin connector (Figure 2-23). You can get adapters and two-headed cables to connect a FireWire 400 device into a FireWire 800 port.

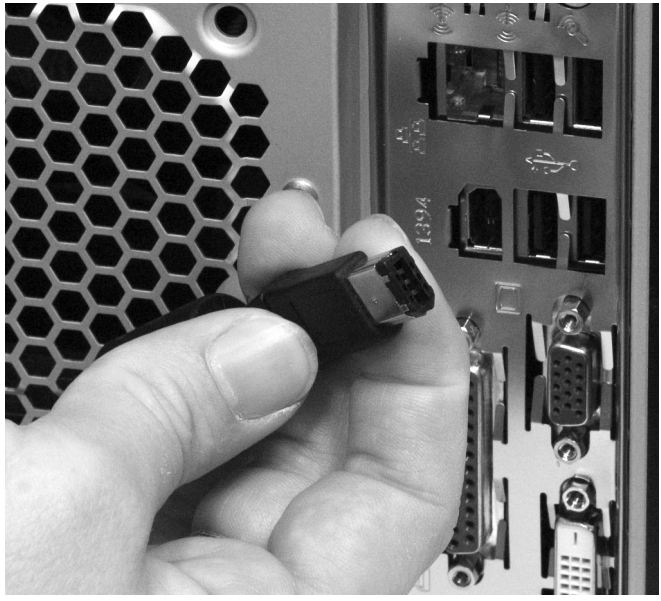


FIGURE 2.21 FireWire 400 (IEEE 1394a) connector and port

FIGURE 2.22 Mini-FireWire port and connector

Travel Assistance

For more information regarding FireWire and the IEEE 1394 standard, visit http://www.ieee.org/.

FIGURE 2.23 FireWire 800 (IEEE 1394b) port and connector

SCSI

SCSI—amusingly pronounced "skuzzy"—has been around for a long time. Innovations in SCSI technology have kept SCSI competitive with other enhanced technologies such as USB and FireWire. Many high-end PCs have built-in SCSI connectors, and SCSI controller cards are widely available to add SCSI ports to your system.

SCSI devices have a variety of interfaces—*SCSI-1, SCSI-2, Ultra SCSI, Wide Ultra SCSI,* just to name a few—but the 68-pin female Ultra-320 port shown in Figure 2-24 is the most common today. You may also see 50-pin or 25-pin ports on some older devices or PCs. Note that the very fine port sockets shown in the picture are matched to fine contact pins on the male Ultra-320 connector. Take it from me, these tiny pins bend and break easily, so handle with care!

Data throughput on SCSI varies from around 5 to 80 megabytes per second (MBps) for early incarnations to 320 MBps for many current versions. Chapter 8 covers the amazing variety of SCSI devices and standards.

Travel Assistance

For more information on SCSI, check out the SCSI Trade Organization at http://www.scsita.org/.

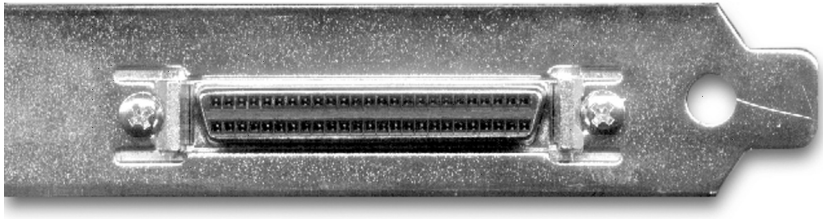


FIGURE 2.24 Ultra-320 port

✔ **Objective 2.01: Legacy Multifunction Ports** The 9-pin and 25-pin serial ports and the 25-pin parallel ports are used for connecting serial and parallel devices, respectively, to the PC. Serial devices transfer data 1 bit a time, whereas parallel devices transfer data 8 bits at a time.

✔ **Objective 2.02: Standard Single-Function Ports** Keyboards connect to the motherboard with 6-pin mini-DIN (PS/2) or USB connectors. Mice connect to the 9-pin serial bus in older systems, and PS/2 or USB in newer systems. Make sure you remember the 15-pin, three-row D-sub port is for video, whereas the 15-pin, two-row D-sub port is for MIDI devices or joysticks. Finally, know the difference between the RJ-11 connectors for modems and the RJ-45 connectors for NICs.

✔ **Objective 2.03: Modern Multifunction Ports** USB enables you to hot-swap devices and daisy-chain up to 127 devices in one PC. The Type A connector goes into the USB port; the Type B or mini connector goes into the USB device. USB (a.k.a. normal USB 1.1) is capable of throughput speeds up to 12 Mbps, while Hi-Speed USB is good for up to 480 Mbps. IEEE 1394 is also known as FireWire, iLink, and Lynx. The 1394a version is capable of speeds up to 400 Mbps, and 1394b runs at up to 800 Mbps. Either version of IEEE 1394 enables you to connect up to 63 devices to a single IEEE 1394 port. Finally, the 68-pin ports used by Ultra-320 devices are the most common ones seen on the many SCSI technologies available today, but you might also see 50-pin, 25-pin, or other varieties.

REVIEW QUESTIONS

1. Which of these connectors can you use to connect a keyboard to a PC? (Select two.)
   - **A.** Mini-DIN
   - **B.** 9-pin serial
   - **C.** 25-pin parallel
   - **D.** USB

2. Which of these connectors can you use to connect a CRT monitor to a PC?
   - **A.** 25-pin serial
   - **B.** 9-pin serial
   - **C.** 15-pin D-sub in two rows
   - **D.** 15-pin D-sub in three rows
3. Which of the following ports can be found on network cards?
   - **A.** HDMI
   - **B.** Parallel
   - **C.** RJ-45
   - **D.** USB
4. How many pins does a parallel port have?
   - **A.** 10
   - **B.** 25
   - **C.** 34
   - **D.** 36
5. How is data transferred in serial communications?
   - **A.** 10 bits at a time
   - **B.** 1 bit at a time
   - **C.** 1 byte at a time
   - **D.** 16 bits at a time
6. How is data transferred in parallel communications? (Select two.)
   - **A.** 8 bits at a time
   - **B.** 1 byte at a time
   - **C.** 1 bit at a time
   - **D.** 8 bytes at a time
7. In theory, how many USB devices can you daisy-chain together?
   - **A.** 1
   - **B.** 2
   - **C.** 63
   - **D.** 127

8. Which connector provides high-quality video *and* audio?
   - **A.** HDMI
   - **B.** S/PDIF
   - **C.** S-Video
   - **D.** VGA
9. To what does a Type A USB connector connect?
   - **A.** To a USB port on the PC
   - **B.** To a USB device
   - **C.** To a serial port on the back of your PC
   - **D.** To a USB modem
10. What is the top data transfer speed possible under the IEEE 1394a standard?
   - **A.** 50 megabits per second
   - **B.** 400 megabits per second
   - **C.** 400 megabytes per second
   - **D.** 800 megabits per second
11. How many devices can you daisy-chain on a single FireWire connection?
   - **A.** 63
   - **B.** 65
   - **C.** 127
   - **D.** 1023

REVIEW ANSWERS

1. **A D** Keyboards can use a mini-DIN or USB connector.
2. **D** An CRT monitor cable has a 15-pin D-sub connector in three rows.
3. **C** Most network cards have RJ-45 ports.
4. **B** Parallel ports have 25 pins or contacts.
5. **B** Serial communications transfer data 1 bit at a time.
6. **A B** Parallel communications transfer data 8 bits (1 byte) at a time.
7. **D** You can, in theory, daisy-chain 127 USB devices together.

8. **A** The HDMI connector can handle high-definition video and multiple digital audio signals.
9. **A** The Type A connector on a USB cable connects to the USB ports on the back of your PC. USB devices have a Type B port.
10. **B** The IEEE 1394a FireWire standard enables data transfers of up to 400 megabits per second.
11. **C** You can daisy-chain up to 63 devices on a single FireWire port.