Chapter 7

Installing and Supporting I/O Devices

At a Glance

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Overview

This chapter covers the many I/O devices a PC support technician must be familiar with and must know how to install and support. The introductory sections look at the features and characteristics of several input and output devices, including motherboard ports, display devices, and expansion cards. Next, the student learns how to install common peripherals, input devices, expansion cards, dual monitors, and multiple video cards. Troubleshooting is always an important skill for technicians, and so the chapter ends with a discussion of what can go wrong with I/O devices, and how to identify the source of the problem and fix it.

Chapter Objectives

After reading this chapter and completing the exercises, the student will learn:
- About the general approaches you need to take when installing and supporting I/O devices
- About the types of I/O devices and their characteristics
- How to install input devices, including the mouse, keyboard, barcode reader, fingerprint reader, and touch screen
- How to install and configure several I/O devices, including ports on the motherboard, dual monitors, and expansion cards
- How to troubleshoot I/O devices, including keyboards, pointing devices, and video

Teaching Tips

Basic Principles to Support I/O Devices

1. Distinguish between internal and external I/O devices.
   a. Provide examples of each type.

2. Review the fundamental principles and concepts of I/O device support:
   - Every I/O device is controlled by software (device driver).
   - The manufacturer is the best guide for installation and support.
   - Some devices need application software to use the device.
   - Device problems can sometimes be solved by updating device drivers or firmware.
   - Learning about I/O devices is a moving target.
   - Devices and their device drivers are managed using Device Manager.
   - Some devices are expected to follow the Energy Star standards.

Teaching Tip

More information on the EPA Energy Star green program for computers may be found at: [http://www.energystar.gov](http://www.energystar.gov)
Types and Features of I/O Devices

1. Point out that in this section, the student will learn about the I/O ports on a motherboard and display devices, including a monitor, projector, video card, and other expansion cards.

I/O Ports on the Motherboard

1. Note that a device can plug into a port that comes directly off the motherboard or a port provided by an expansion card.

2. Describe some of the motherboard and expansion card ports available.

3. Explain that in this section, the student will learn about the details of the serial, parallel, USB, and FireWire ports that come directly off a motherboard.

4. Use Figure 7-2 to illustrate the rear of computer case showing ports.

5. Use Table 7-1 to illustrate the speeds of various ports, from fastest to slowest.

6. Introduce and describe USB Ports.
   a. Provide examples of devices that can use a USB port.
   b. Describe the advantages USB ports offer over regular serial or parallel ports.
   c. Use Figure 7-3 to illustrate a motherboard with two USB ports and a USB cable.
   d. Use Figure 7-4 to illustrate a computer case with USB ports located on the front of the case.
   e. Define and explain the term hot-swappable.
   f. Use Figure 7-5 and Figure 7-6 to explain how to safely stop and remove a USB device.
   g. Explain the different versions of the USB standard.
   h. Mention the organization responsible for developing USB.
   i. Use Figure 7-7 to illustrate the official USB logos.
   j. Describe how USB devices are daisy-chained together.
   k. Use Figure 7-8 to illustrate a PS2 to USB adapter.
   l. Describe the USB cable.
   m. Use Figure 7-9 to illustrate a mini-B connector used with a digital camera.

   a. Note that IEEE 1394 technology is also referred to as FireWire or i.Link.
   b. Describe the three versions of IEEE 1394: 1394a, 1394b, and 1394c.
   c. Use Figure 7-10 through Figure 7-12 to illustrate FireWire concepts.
   d. Define the term isochronous data transfer.
   e. Relate the IEEE 1394 specification for isochronous data transfer to the transmission of real-time data, such as television signals.
   f. Use Figure 7-13 to illustrate an example of a configuration that leverages isochronous data transfer.
8. Introduce and review serial ports.
   a. Note that serial ports were originally designed for I/O devices, such as the mouse and the external modem.
   b. Use Figure 7-14 to illustrate two serial ports, one parallel port, and one game port for comparison.
   c. Note that serial ports are sometimes called DB9 and DB25 connectors and explain those terms.
   d. Describe how serial ports are provided.
   e. Describe how serial ports may be enabled or disabled.
   f. Describe the serial port specifications appearing in RS-232c (Reference Standard 232 revision c).
   g. Note that a serial port might also be called a COM1 (Communications port 1) or COM2 port.
   h. Describe the controller logic on a motherboard that manages serial ports - UART (Universal Asynchronous Receiver-Transmitter) or UART 16550.

9. Introduce and describe parallel ports.
   a. Note that parallel ports simultaneously transmit 8 bits of data.
   b. Emphasize that parallel ports were primarily designed for printers and are being replaced by USB ports.
   c. Describe the three types of parallel ports: Standard parallel port (SPP), EPP (Enhanced Parallel Port), ECP (Extended Capabilities Port).
   d. Use Figure 7-15 to illustrate a parallel cable.
   e. Describe bidirectional signaling and DMA.
   f. Mention that parallel ports can use an I/O expansion card or come off the motherboard.
   g. Point out that for parallel ports on an expansion slot all documentation should be read and followed for configuration.
   h. Point out that for parallel ports on the motherboard, the configuration is performed in CMOS setup, which can have up to four different settings for parallel ports.

10. Introduce and describe infrared transceivers.
    a. Mention that an infrared transceiver is also called an IrDA (Infrared Data Association) transceiver or an IR transceiver
    b. Point out that an infrared port is used for wireless communication.
    c. Describe technologies that may use infrared transmission (e.g., television remote controls, wireless keyboards, mice, cell phones, PDAs, and printers).
    d. Describe communication between a notebook and a PDA.
    e. Describe how infrared transceivers may be used to connect a PC to a network.
    f. Use Figure 7-16 to illustrate a remote control that can be used with multimedia applications installed on a notebook computer.
    g. Use Figure 7-17 to illustrate and explain how a motherboard might support infrared.
    h. Describe how to use the motherboard IR headers.
    i. Explain how to troubleshoot problems with infrared.
    j. Explain why infrared wireless is becoming obsolete.
Teaching Tip

More information on USB 3.0 may be found at:
http://www.usb.org/developers/docs

Quick Quiz 1

1. __________________ systems and peripherals have the U.S. Green Star, indicating that they satisfy certain energy conserving standards of the U.S. Environmental Protection Agency (EPA).
   Answer: Energy Star

2. True or False: USB ports are becoming the most popular ports for slower I/O devices.
   Answer: True

3. __________________ and i.Link are common names for another peripheral bus officially named IEEE 1394.
   Answer: FireWire

4. __________________ refers to the logic on the motherboard that controls the serial ports on the board.
   Answer: UART (universal asynchronous receiver-transmitter)

5. True or False: Infrared wireless is becoming obsolete because of the line-of-sight issue.
   Answer: True

Display Devices

1. Introduce the two main categories of monitors.

2. Using Figure 7-18, explain how a CRT monitor works.

3. Using Figure 7-19, explain how an LCD monitor works.
   a. Use Figure 7-20 to illustrate the back of an LCD monitor.

4. Use Table 7-2 to summarize the features and technologies that apply to LCD and CRT monitors.

5. Explain the concepts of refresh rate and response time.

6. Explain the difference between an interlaced CRT monitor and a noninterlaced CRT monitor.

7. Define and explain the terms resolution and native resolution.

8. Discuss the different resolution standards.
9. Describe the various monitor settings that can be changed.

10. Explain degaussing.

11. Point out how monitor and video card settings can be changed and describe how the utilities and tools are accessed.
   a. Use Figure 7-21 to illustrate how the NVIDIA utility is accessed from the Control Panel.

12. Describe how to use Windows Vista to adjust resolution and refresh rate.
   a. Use Figure 7-22 to illustrate the Display Settings dialog box.
   b. Use Figure 7-23 to illustrate how to change the refresh rate to the highest setting.

13. Explain how to obtain the native resolution if it is not listed in the Display Settings window.
   a. Use Figure 7-24 to illustrate how to add a new resolution to the available resolutions.
   b. Use Figure 7-25 to illustrate how to create a customized resolution.

   a. Use Figure 7-27 to illustrate a projector.
   b. Indicate that projectors, which connect to a second video port, are used to display information for larger groups.
   c. Explain how to use a projector with a desktop and a laptop.

15. Introduce and explain video cards.
   a. Use Figure 7-28 to illustrate a video card.
   b. Describe the ports provided by video cards.
   c. Use Figure 7-29 to illustrate video card ports.
   d. Use Figure 7-30 to illustrate a digital to analog video port converter using a DVD-I connector with extra four pins.
   e. Use Figure 7-31 to illustrate two types of DVI ports.
   f. Use Figure 7-32 to illustrate an S-Video cable used to connect a video card to an S-Video port on a television.
   g. Use Figure 7-33 to illustrate an HDMI to DVI cable.

16. Describe other important features of video cards including a graphics processor unit (GPU) and video RAM.

17. Describe requirements for the Windows Vista Aero user interface:
   • 128 MB video memory
   • Video card supporting DirectX 9 or higher
   • Windows Display Driver Model (WDDM)

18. Explain how to use the dxdiag.exe command to display information about hardware and diagnose problems with DirectX.
   a. Use Figure 7-34 to illustrate how the DirectX Diagnostic tool reports information about DirectX components.
b. Use Figure 7-35 to illustrate how the DirectX Diagnostic tool reports information about the installed video card and drivers.

c. Describe how the 128 MB or more of video memory requirement may be met.

d. Use Figure 7-36 to illustrate memory allocated to video under Windows Vista.

19. Describe the requirements for installing dual video cards.

   a. Use Figure 7-37 to illustrate a video card that supports SLI.
   b. Use Figure 7-38 to illustrate a video card using an SLI bridge.

**Expansion Cards**

1. Discuss common types of expansion slots.

| **Teaching Tip** | More information on how CRT and LCD monitors work may be found at: http://www.bit-tech.net/hardware/2006/03/20/how_crt_and_lcd_monitors_work/1 |

**Quick Quiz 2**

1. For CRT monitors, ______________ is a measure of how many spots on a CRT screen are addressable by software.
   Answer: resolution

2. True or False: A noninterlaced monitor draws the entire screen in one pass.
   Answer: True

3. True or False: The resolution rate is the number of times one screen or frame is built in one second.
   Answer: False

4. ______________ is the latest digital audio and video interface standard.
   Answer: HDMI (High-Definition Multimedia Interface)

5. The ______________ command is used to display information about hardware and diagnose problems with DirectX.
   Answer: dxdiag.exe

**Installing Input Devices**

1. Introduce the topics covered in this section.

**How to Install a Keyboard and Mouse**

1. Explain how to install a keyboard and mouse.
a. Use Figure 7-40 to illustrate two PS/2 and DIN connectors used by keyboards and mice.
b. Use Figure 7-41 to illustrate a wireless mouse and USB receiver.
c. Use Figure 7-42 to illustrate a mouse and keyboard requiring drivers in order to use the extra buttons and zoom bar.
d. Use Figure 7-43 to illustrate the two utilities installed on the Windows desktop to configure the mouse and keyboard buttons after installing the mouse and keyboard in Figure 7-42.

2. Point out that most devices installed in a system appear Device Manager.

3. Emphasize that to uninstall a USB device, the Control Panel is usually involved.
   a. Use Figure 7-44 and Figure 7-45 to illustrate the use of the Control panel to uninstall a USB device.

**Explain how to Install a Touch Screen**

1. Introduce and describe a touch screen.
2. Explain how to install a touch screen.

**How to Install a Barcode Reader**

1. Introduce and describe a barcode reader.
2. Explain how a barcode reader interfaces with a PC.
3. Use Figure 7-46 to illustrate a handheld barcode scanner by Intermec Technologies.
4. Explain how to install a barcode reader.

**How to Install a Fingerprint Reader**

1. Define and explain the term “biometric device”.
2. Describe a fingerprint reader.
   a. Use Figure 7-47 to illustrate a fingerprint reader.
3. Discuss how to use fingerprint readers.
4. Describe how to install the fingerprint reader depicted in Figure 7-47.
   a. Use Figure 7-48 through Figure 7-50 to illustrate the installation process.

**How to Install a KVM Switch**

1. Introduce and describe a Keyboard, Video, and Mouse (KVM) switch.
   a. Use Figure 7-51 to illustrate a KVM switch.
   b. Use Figure 7-52 to illustrate the hardware configuration for the KVM switch in Figure 7-51.
Installing and Configuring I/O Devices and Ports

1. Introduce the topics covered in this section.

Using Device Manager

1. Introduce and describe Device Manager (devmgmt.msc) as the primary Windows tool for managing hardware.

2. Explain how to access Device Manager.
   a. Use Figure 7-53 to illustrate a Windows Vista System window used to access Device Manager.

3. Use Figure 7-54 through Figure 7-59 to illustrate examples of Device Manager.

Using Ports on the Motherboard

1. Describe ports found on a motherboard.

2. Explain how to disable an onboard port.
   a. Use Figure 7-60 to illustrate a BIOS setup screen where you can enable and disable ports.

3. Emphasize that any device that shows up in BIOS setup should also be listed in Device Manager. However, not all devices listed in Device Manager are listed in BIOS setup.

4. Use Figure 7-61 to explain that when having a problem with a port, after knowing the port is enabled in BIOS setup, turn to the Device Manager to make sure it recognizes the port without an error.

5. Explain why a technician must read the documentation before installing USB and FireWire ports.
   a. Explain how to use a USB or FireWire port with Windows.
   b. Use Figure 7-62 to illustrate a connector providing two USB ports and one game port.

6. Explain how parallel ports can be configured in the BIOS.
   a. Use Figure 7-64 to illustrate the BIOS setup on one system to configure the parallel port.
   b. Use Figure 7-65 to illustrate how parallel ports are referenced in Device Manager.

Teaching Tip

More information on how fingerprint scanners work may be found at: http://computer.howstuffworks.com/fingerprint-scanner.htm
7. Introduce and explain serial ports.
   a. Use Figure 7-66 to illustrate how serial ports are referenced in Device Manager.

**Installing and Configuring Adapter Cards**

1. Review the items that should be verified when preparing to install an adapter card.

2. Discuss the general directions to install an adapter card.
   a. Use Figure 7-67 to illustrate how to secure the case.

3. Describe how to install a FireWire controller card.
   a. Use Figure 7-68 and Figure 7-69 to illustrate the process.

4. Describe how to install a video card.
   a. Use Figure 7-70 through Figure 7-76 to illustrate the process.

5. Describe how to install two video cards.
   a. Use Figure 7-77 through Figure 7-80 to illustrate the process.

6. Describe how to install a SATA, eSATA, and RAID storage controller card.
   a. Use Figure 7-81 through Figure 7-85 to illustrate the process.

**Troubleshooting I/O Devices**

1. Introduce the topics covered in this section.

**Troubleshooting Motherboard I/O Ports**

1. Describe how to troubleshoot motherboard I/O ports.
   a. Use Figure 7-86 to illustrate loopback plugs.

**Troubleshooting Keyboards**

1. Describe how to troubleshoot a keyboard.

**Troubleshooting Monitors and Video Cards**

1. Explain how to resolve the following problems.
   a. Power light (LED) does not go on; no picture.
   b. Power LED is on, no picture on power-up.
   c. Power is on, but monitor displays the wrong characters.
   d. Monitor flickers, has wavy lines, or both.
   e. No graphics display or the screen goes blank when loading certain programs.
   f. Screen goes blank 30 seconds or one minute after the keyboard is left untouched.
   g. Poor color display.
   h. Picture out of focus or out of adjustment.
   i. CRT monitor makes a crackling sound.
   j. Display settings make the screen unreadable.
Troubleshooting Other Adapter Cards

1. Describe how to troubleshoot other video cards.
   a. Use Figure 7-89 to illustrate the Setup program on CD to uninstall the adapter card drivers.

   **Teaching Tip**
   More information on troubleshooting device conflicts with Device Manager may be found at: [http://support.microsoft.com/kb/310126](http://support.microsoft.com/kb/310126)

Quick Quiz 3

1. A(n) ________________ device allows a user to move a pointer on the screen and perform tasks such as executing (clicking) a command button.
   Answer: pointing

2. A(n) ________________ device is an input device that inputs biological data about a person, which can be input data to identify a person’s fingerprints, handprints, face, voice, eye, or handwritten signatures.
   Answer: biometric

3. ________________ and i.Link are common names for another peripheral bus officially named IEEE 1394.
   Answer: FireWire

4. Chips sometimes loosen because of thermal changes; this condition is called chip ________________.
   Answer: creep

5. A(n) ________________ motherboard (one that follows energy-saving standards) used with an Energy Saver monitor can be configured to go into standby or doze mode after a period of inactivity.
   Answer: green

Class Discussion Topics

1. Why is it recommended to use biometric devices in combination with another authentication technique?

2. How does the use of a video card with a graphics accelerator affect the performance of video systems? How is the performance of the CPU affected?

3. What are the advantages of USB ports relative to parallel and serial ports?
Additional Projects

1. Perform additional research on the RGB color system used by image capture devices, such as monitors. In relation to the science of color, define the terms additive and subtractive. Determine whether the RGB system is additive or subtractive. How many discrete color combinations of RGB are possible with an 8-bit buffer? With a 24-bit buffer? Provide a response in 2 to 3 paragraphs.

2. Perform additional research on graphics accelerators. Identify 3 to 5 operations that enable graphics accelerators to render 2-D and 3-D images. How does the sophistication of the graphics accelerator drive affect the selection of a monitor for a system? Provide a response in 1 to 2 paragraphs.

3. Perform additional research on FireWire (IEEE 1394). Describe how the FireWire bus uses direct memory access (DMA). What are the advantages to implementing DMA in hardware, without the intervention of the OS? What are the security risks associated with this approach? How can these security risks be addressed? Summarize your findings in 2 to 3 paragraphs.

Additional Resources

1. Types of Keyboards:
   http://en.wikipedia.org/wiki/Keyboard_technology

2. How a Computer Mouse Works:
   http://www.howstuffworks.com/mouse.htm

3. More Information on the CRT Monitor:
   http://www.pcguide.com/ref/crt/

4. More Information on LCD Monitors:
   http://www.avdeals.com/classroom/what_is_tft_lcd.htm

5. USB Technology:
   http://www.computerhope.com/help/usb.htm

Key Terms

- **biometric device**: An input device that inputs biological data about a person, which can be input data to identify a person’s fingerprints, handprints, face, voice, eye, and handwritten signature.
- **chip creep**: A condition in which chips loosen because of thermal changes.
- **COM1 (Communications port 1)**: Another name for a serial port.
- **CRT (cathode-ray tube)**: A primary output device, which takes up a lot of desk space and costs less than a LCD (liquid crystal display) monitor.
- **degauss button**: A button on a CRT monitor that can be pressed to eliminate accumulated or stray magnetic fields around the monitor, which can cause a CRT monitor to flicker or have wavy lines.
- **DVI-I**: A port supporting both analog and digital signals.
- **dxdiag.exe**: A command to display information about hardware and diagnose problems with DirectX.
- **ECP (Extended Capabilities Port)**: A bidirectional parallel port mode that uses a DMA channel to speed up data flow.
- **Energy Star**: Energy Star systems and peripherals have the U.S. Green Star, indicating that they satisfy certain energy conserving standards of the U.S. Environmental Protection Agency (EPA), sometimes called the Green Standards. Devices that can carry the Green Star include computers, monitors, printers, copiers, and fax machines.
- **EPP (Enhanced Parallel Port)**: A parallel port that allows data to flow in both directions (bidirectional port) and is faster than original parallel ports on PCs that allowed communication only in one direction.
- **FireWire**: A common term for IEEE 1394.
- **flat panel monitor**: A desktop monitor that uses an LCD panel.
- **hard drive dock**: A dock that will house and protect a hard drive outside the computer case.
- **HDMI (High-Definition Multimedia Interface)**: The latest digital audio and video interface standard. It is not widely available on video cards or motherboards, but is expected to ultimately replace DVI. HDMI is currently used on televisions and other home theater equipment. To connect a PC to this equipment that uses HDMI, you can purchase an HDMI to DVI cable.
- **hub**: A network device or box that provides a central location to connect cables.
- **i.Link**: Another term for IEEE 1394.
- **I/O controller card**: An older card that can contain serial, parallel, and game ports and floppy drive and IDE connectors.
- **IEEE 1284**: A standard for parallel ports and cables developed by the Institute for Electrical and Electronics Engineers and supported by many hardware manufacturers.
- **IEEE 1394**: Standards for an expansion bus that can also be configured to work as a local bus. It is expected to replace the SCSI bus, providing an easy method to install and configure fast I/O devices. Also called FireWire and i.Link.
- **IEEE 1394.3**: A standard, developed by the 1394 Trade Association, that is designed for peer-to-peer data transmission and allows imaging devices to send images and photos directly to printers without involving a computer.
- **infrared (IR) transceiver**: A wireless transceiver that uses infrared technology to support some wireless devices such as keyboards, mice, and printers. A motherboard might have an embedded infrared transceiver, or the transceiver might plug into a USB or serial port. The technology is defined by the Infrared Data Association (IrDA). Also called an IrDA transceiver or infrared port.
- **interlaced**: A type of display in which the electronic beam of a monitor draws every other line with each pass, which lessens the overall effect of a lower refresh rate.
- **IR transceiver**: Provides an infrared port for wireless communication.
- **IrDA (Infrared Data Association) transceiver**: Another term for an infrared transceiver.
- **isochronous data transfer**: A method used by IEEE 1394 to transfer data continuously without breaks.
- **IRQ (Interrupt ReQuest) line**: A line on a parallel port. BIOS manages these request lines that are used by a device to hail the CPU asking for data to be processed, and you do not need to change this value.
- **Isochronous data transfer**: A data transfer method used by IEEE 1394 where data is transferred continuously without breaks.
- **KVM (Keyboard, Video, and Mouse) switch**: A switch used to connect a single keyboard, mouse, and monitor to multiple computers.
- **LCD monitor**: A thin, flat monitor based on a technology that manipulates liquid crystals.
- **Motherboard mouse**: Another term for a PS/2 mouse.
- **LPT (Line Printer Terminal)**: A parallel port in device Manager.
- **Native resolution**: The one resolution for an LCD monitor, which is the actual (and fixed) number of pixels built into the monitor.
- **Noninterlaced**: A type of display in which the electronic beam of a monitor draws every line on the screen with each pass.
- **Refresh rate**: The process of periodically rewriting data, such as on dynamic RAM.
- **Resolution**: The number of pixels on a monitor screen that are addressable by software (example: 1024 x 768 pixels).
- **RGB (red, green, and blue)**: Used by older video cards and CRT monitors.
- **RS-232c (Reference Standard 232 revision c or Recommended Standard 232 revision c)**: A serial port interface standard.
- **Standard parallel port (SPP)**: A standard port allows data to flow in only one direction and is the slowest of the three types of parallel ports. The standard parallel port is sometimes called a normal parallel port or a Centronics port, named after the 36-pin Centronics connection used by printers.
- **Super VGA (SVGA)**: A monitor using a minimum refresh rate standard of 70 Hz, or 70 complete vertical refreshes per second.
- **S-Video port**: A 15-pin video port used on a desktop or notebook computer to connect a projector.
- **Touch screen**: An input device that uses a monitor or LCD panel as a backdrop for user options. Touch screens can be embedded in a monitor or LCD panel or installed as an add-on device.
- **UART (universal asynchronous receiver-transmitter)**: A chip that controls serial ports. It sets protocol and converts parallel data bits received from the system bus into serial bits.
- **VGA (Video Graphics Adapter)**: The standard analog video method of passing three separate signals for red, green, and blue (RGB), which older video cards and CRT monitors use.